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SECOND REPORT
OF THE
ROYAL COMMISSIONERS
ON
TECHNICAL INSTRUCTION.

Vol. III.

T9(A).3.M811-

Presented to both Houses of Parliament by Command of Her Majesty.



LONDON:
PRINTED BY EYRE AND SPOTTISWOODE.

To be purchased, either directly or through any Bookseller, from any of the following Agents, viz.,
Messrs. HANSARD & SON, 13, Great Queen Street, W.C., and 82, Abingdon Street, Westminster;
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1884.

[C.—3981.—II.] Price 5s.

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NOTES
ON
TECHNICAL EDUCATION IN RUSSIA

BY
WILLIAM MATHER.

To Sir BERNHARD SAMUELSON, Bart., M.P., Chairman of the
Royal Commission on Technical Instruction.

SIR,

In accordance with your request that I should collect some notes on education in Russia, with special regard to technical instruction, I availed myself of a three months' visit to that country, in the early part of this year, for the purpose.

I have now the honour of submitting the following notes as the results of my inquiries, and I have appended some observations, bearing upon this subject, made during repeated visits and extended travels in Russia, through a period of 20 years.

Russia differs from all other European countries in not possessing some national system of elementary education. This may be accounted for by the institution of serfdom, which up to 1860 excluded what we should call the "working classes" from all rights beyond those accorded to them at the pleasure of their owners. Education in the most elementary form may, here and there, have been given in the villages by the priests if the proprietors permitted or encouraged it. In the towns no provision whatever was made by the authorities for the education of the labouring classes previous to the emancipation.

On the other hand, the Government has for many years paid considerable attention to the formation of educational institutions for the families of military and civil officials, the professional classes, and all grades of the nobility. To such institutions the sons of merchants have also been admitted, but the latter have had to depend chiefly on private tutors, and largely upon the advantages offered in other countries, or in Finland, the Baltic provinces, and Poland, which are politically parts of Russia, but retain to some extent their own social institutions, and have long possessed greater facilities for general education, in proportion to the population, than those existing in Russia proper.

In such towns as St. Petersburg, Moscow, Tver, Tula, Kharkof, Kief, Kazan, Saratof, and Odessa, Colleges (Real-schulen) and

Gymnasias have long existed, and in some of them also Universities. There are not more than 20 towns in Russia proper having over 50,000 inhabitants, and not more than 150 having over 10,000. The urban population is extremely small compared with the whole number of inhabitants. Exact statistics are not easily obtained, but it is within the mark to state that not more than 10,000,000 out of a total population of about 80,000,000 dwell in what we should designate "towns," using this term in its narrowest sense.

The rest of the population is spread over a vast territory, in small communities, pursuing rural occupations under conditions of agriculture and the holding of land, since the emancipation, which will yield enough, with something to spare in the most fertile districts, to those peasants who are frugal and thrifty. Notwithstanding that all the serfs received a grant of land with their freedom about 22 years ago, the inferior quality, or the want of means to improve it, has made it impossible, in a great number of cases, for the peasants to wholly maintain their families in their own communes or villages. Hence there is a great deal of migration, the heads of families move in search of employment to long distances, leaving children to the care, or neglect, of their relations. The parents will even separate one from the other, and live hundreds of miles apart from Easter to Easter, when all work ceases for one week to a month, among handicraftsmen and in all kinds of manufactories, and family reunions take place amid the religious festivals of the Russian Church.

These migratory habits are on the increase since the extension of the railway system.

The only education at present available in the villages is a certain amount of instruction which it is the duty of the village priest to impart, but over which there is no control. There is no village where a priest is not stationed or a church does not exist. Sometimes a group of little hamlets a mile or two apart will have a church and one school in common. The priests are generally men of very meagre education, with large families, and a small quantity of land which they have to till, often with their own hands, to secure a livelihood.

It will readily be seen that such conditions are not favourable to education, even in the narrowest sense of the word. Some children acquire reading and writing imperfectly if they are naturally bright, but as there is no systematic superintendence of public instruction on the part of any authorities, the masses of the people are still growing up in ignorance, and the vice of intemperance is one of the most painful results of it.

There are, however, some indications of improvement, which I must mention.

The reforms following upon the emancipation of the serfs included a system of communal government in the villages, the establishing of county boards of jurisdiction in the rural districts, and the extension of municipal institutions in the towns.

These several authorities ought to form and represent public opinion, and doubtless the late Emperor intended they should do so.

Too much praise cannot be accorded to the Emperor Alexander II. for the great reforms he accomplished. His aspirations and individual efforts to raise the whole people met with scant sympathy among the privileged classes surrounding the throne; and even amongst the people there has not been that co-operation which is necessary to conduct the new institutions efficiently. For instance, trial by jury has been worked with so little appreciation and interest that misdemeanours and crimes against society (apart altogether from political offences) have not been punished or condemned by public opinion, as represented in the open courts of justice, in the manner to inculcate a due regard for morality and order.

Had the educated classes of Russia, outside the court circle, taken advantage of the large measure of freedom granted by Alexander II., and by their personal influence and pecuniary aid adopted means to improve the lower classes, there would have been more rapid progress in all directions.

Whenever in a certain locality the people themselves have taken an interest in these new institutions, and worked them well, a marked change has been made in the educational facilities of the place. I have been the guest of the mayor of a small town in the interior of Russia, who, at the time of my visit, was deeply engaged in the building of what promised to be a remarkably good school. It was the work of the municipality, with some assistance from the county board, and was intended to be a high school with a small manual training department attached. There is no reason why all towns should not have done likewise, and some may have done so. I have personal experience of the influence which a few enlightened men can now exercise when they take the trouble to avail themselves of the representative institutions which give the power to administer local affairs. The apathy, however, manifested by the public generally in making the utmost use of the powers granted by Government is not encouraging. The sense of personal responsibility is doubtless of slow growth in a country subject to autocratic rule for centuries, even when local self-government is permitted. Hence the question of public instruction has not yet become a matter of sufficient interest to move the municipal bodies to establish common schools in any considerable number in the towns. The mother city of Russia, Moscow, is lamentably short of such schools, though there is great wealth in the community, and an enormous trade is carried on in this central market of the empire.

Of what we should call "school age," say from 5 to 13, there must be about 100,000 children in Moscow requiring a common school education. I could only obtain a record of 55 such schools altogether, provided by the municipality, giving accommodation for about 7,000 scholars.* Two-thirds of these are from the very

* About 24 new schools are to be erected shortly by the municipality.

poor classes. These schools are small and all overcrowded. The course of instruction comprises religion (as taught by the Orthodox Church), reading, writing, arithmetic, grammar, history, and geography. These schools are for both sexes. The girls preponderate, but they leave earlier than the boys, generally when they have some knowledge of reading and writing; the boys remain longer as a rule, with the hope of obtaining some reduction in the time of compulsory military service if they can pass certain examinations.

Apart from these schools, the only opportunity for the poorest classes is in a few charity schools, or, when they go to work, in some of the manufactories in and around Moscow, in connection with which there are (with few exceptions) good elementary schools.* This provision is entirely voluntary, and the time allowed for the children to attend school during working hours will vary according to the benevolence of the millowners and manufacturers. It is the custom to work all textile manufactories throughout Russia, excepting in the district of St. Petersburg, night and day, with two sets of workpeople in relays, working six hours each. During the day leisure (from 6 o'clock a.m. to 12 o'clock) the children attend school and get such recreation as they may care to take. In the evening leisure (from 6 p.m. to midnight), they sleep. It is a hard life, and not conducive to their studying even the simple lessons put before them.

There has been hitherto no law in operation in Russia to prevent the employment of children of tender years. I have seen, not unfrequently, children of not more than seven or eight years of age working equal hours with adults. Happily a law has at length been passed to alter this state of things, and during the course of this year it will come into operation. It enacts that no children shall be employed under 10 years of age, and when 10, only for a limited number of hours per day, until they reach the age of 14. It is to be hoped that this enactment will be followed immediately by further provision for the education of children of the poorest classes, otherwise an enormous number of them will be entirely without occupation while their parents are at work, and liable to a worse fate than has hitherto befallen them. In connection with this point, I may mention that the Government is stated to have a scheme in preparation for the primary education of the people on the parochial principle, through the priests of the Church, under the control of the ecclesiastical authorities. It is not probable that Russia will succeed on these lines where other nations have failed, though the remarkable unity of religious faith throughout Russia proper may, for a time, obviate difficulties common to all western countries.

In the manufactories having schools the law to restrict the employment of children will be immediately beneficial, and will afford the time necessary for the children to obtain a moderately

* In some manufactories there are workshops, or manual training schools, and schools of design. The names of Mensicura T. S. Morozoff, A. Baranoff, Msiutan, and Prohoroff are worthy of special notice in connection with this useful work.

good elementary education. It is the universal practice in all mills to engage the workpeople at Easter for the whole year, and to provide large barracks in which the people live, and so many of their children as they may have brought with them from their villages. The schools provided by the employers are open to all the children of those who work in the mill, whether the children are employed in the mill or not.

The number of workpeople engaged in the textile industries is a very small proportion of the entire population. There are probably about 400 establishments, comprising cotton, linen, and woollen mills, and bleaching, dyeing, and print works, &c. The number of people employed will vary from 50 to 10,000. There are many manufactories giving employment to over 5,000 people, and one or two employ upwards of 10,000 people. The aggregate number of workpeople engaged in such industries must be under 400,000, of whom a considerable proportion are children. It may fairly be said that such children at present are in the way to receive a better education than any others of their class in the country. The extension of the railway system during the last 20 years has created a new kind of employment for a considerable number of the lower classes. Extensive repairing shops are required on the chief lines, and schools are generally provided by the railway companies where a number of their workpeople are congregated. In 1860 there were about 500 miles of railway in regular operation, there are now upwards of 20,000 miles. The iron industry of Russia has necessarily developed with the railway system and the extension of the textile manufactures, but there are no important establishments where the locomotive or stationary engines, or general machinery are constructed. The large works of Struve at Kolomna are an exception, also the extensive establishment of the Nicholas Railway at St. Petersburg, founded by the Americans who first worked the line. Foundries for casting pipes, beams, and pillars, rolling mills for plates, rails, and bar iron, mechanics' shops for repairs, jobbing workshops and railway waggon works, form the chief features of the production in the iron industry. Shipbuilding is confined chiefly to the Government establishments, and the building of river steamers by a few private firms. Papermaking is a considerable industry, and the production of sugar from beetroot in the neighbourhood of Kief is on a very extensive scale. Handicrafts are very numerous, and the making of articles for domestic purposes.

Taking the country as a whole, the mechanical arts and industrial pursuits, as distinct from agricultural occupations, are comparatively insignificant, and the resources of the country hitherto developed do not offer great facilities for such occupations. There has, however, been a good deal of ambition shown on the part of the Government to encourage by artificial means mechanical and manufacturing skill. The two great Imperial Technical Schools of Moscow and St. Petersburg have long been classed among the finest in Europe in point of equipment, and in possessing ample means. The museums and mining school of St. Petersburg have

for many years afforded the opportunity for a high class theoretical training in mining engineering, and contain a rich record of the mineral resources of the empire.

A large civil engineering school has existed for many years at St. Petersburg ; also a school for surveyors and hydraulic engineering. These schools were originally managed by foreigners,—German or French,—but for many years past the staff of teachers has been entirely composed of highly trained Russians.

The preparation necessary for students entering these institutions has been in the Real-schools, Progymnasias, and Gymnasias, also established by the Government. In recent years some efforts have been put forth by private individuals to establish handicraft schools and manual training schools. Several of the large railway companies have also established small technical schools for the sons of their employés.

Moscow.

Possesses altogether 127 educational establishments. They comprise the Moscow Imperial University, the Imperial Technical School, the School for Land Surveyors, the Lyceum, the University for the study of Eastern Languages (generally styled the Armenian University), eight Gymnasias ; two schools for girls, and six for boys, two Progymnasias, the Moscow Real School, the five High Schools for girls, the Practical Academy of Commercial Knowledge, the Moscow Commercial School, the Teachers' Institute, the Kommissaroff Technical School, the Strogonoff School of Art and Technical Drawing, the Mechanics' Handicraft School, Moscow Society for the Spread of Technical Knowledge, and a few charitable industrial schools.

The Moscow Imperial University.

This University gives training to 2,500 students. It has a staff of one rector and pro-rector, 83 professors and teachers, 8 instructors, and 10 librarians.

The total fees amount to 20*l.* per annum, but for the most part the students are free. They are generally the sons of Government officials and professional men whose incomes are very small, but whose rank entitles them to certain privileges which the Government of Russia accords to those in the Imperial service. The physical and chemical laboratories are very extensive and well equipped.

The botanical, anatomical, and natural history museums are well stored with specimens. The library is very extensive and well selected. There is in connection with this university a medical school with dissecting rooms attached. The course of instruction follows the lines of the German universities. The English, French, and German languages are taught in addition to the classics. The students are prepared for the university in the gymnasium, and enter at about 20 years of age.

The Imperial Technical School of Moscow.

The object of this school is to train civil engineers, mechanical engineers, draughtsmen and foremen, and chemists. The complete course of studies is a combination of theory and practice. The theoretical studies are carried on in large class-rooms amply supplied with all necessary apparatus for illustration. The practical lessons are given by means of manual work in workshop classes, specially arranged for exercise in the use of hand-tools, followed by the construction of simple machines, or parts of machines, in the workshop proper, comprising foundry, smithy, machine-tool and fitting department, and joiners' shop. The products of the workshop are sold or put into the museum. There is a loss of some hundreds of pounds a year on the sales.

The foundry is probably the only department which pays its expenses, and here 25 regular workmen are employed to instruct students and make castings. About eight tons of metal a week can be turned out in castings. In all departments a few regular workmen are constantly employed.

The students enter at 18 to 20 years of age, having first to pass an examination or furnish certificates of qualification from other schools. The complete course of studies occupies six years; it extends to seven years for those who have not been duly qualified before applying for admission, and who avail themselves of a preparatory course of one year. For the first three years all regular students pass through the same studies, after which a separation is made between the students of engineering and of chemistry, forming two divisions of the school.

The full course of studies includes:—

Religion.

Algebra, trigonometry, descriptive geometry, integral and differential calculus, geodesy, physical science, applied physics; chemistry inorganic, organic, and analytical; botany and zoology, working with microscope, mineralogy and geology; mechanics, statics, dynamics, applied mechanics, hydraulics, thermodynamics, steam and steam engine, construction of machines; drawing, free-hand and linear; designing, and making working drawings for the shops; theory of the resistance and strengths of materials; studies of pumps, presses, hydraulic motors, steam generators, steam engines, steam hammers, &c.

The properties of textile materials. The properties of woods and metals; spinning of cotton, flax, and wool, and weaving.

The properties of materials used in bleaching, dyeing, and printing textile fabrics. Metallurgy. Metallurgical chemistry.

The arts of construction in buildings, bridges, machines, and the designing of mills and manufactories; estimating costs, and the keeping of books.

Political economy, statistics; languages, French and German.

The practical work in the shops includes the use of hand-tools, working in wood, making patterns, turning of metals in foot lathes, in which exercises students must pass an examination before they can enter the workshop proper, and take part in the construction of machines. It is generally the fourth year before students reach this stage.

For the chemical division laboratories are provided, each devoted to a special branch of the science.

The museum is very extensive, and supplied with illustrations of the latest useful inventions, and specimens of materials gathered chiefly from international exhibitions. A very complete department of model machine tools, with description of the construction and utility of each tool. A series of diagrams are used in connection with this, showing the intricate parts enlarged beyond the natural size, for clear explanation. The professors are sent to all exhibitions to report upon and collect the best inventions.

The students work in the shops and laboratories not less than 12 hours a week. The smithy and foundry are not entered by students until the last year of the course, during which 100 hours are devoted to these departments. There is a special course for students who, for want of the natural ability to pursue theoretical studies, cannot get beyond the examinations of the third or fourth year, but who may nevertheless possess the practical and constructive faculty. The work given to the special class is all of the most practical character; such as the making of working drawings and full-sized drawings of parts of machines, making experiments on materials, working longer hours in the shops, and generally devoting their time to the application to practical construction of the knowledge they have gained in the more elementary branches of science.

The civil engineering students are much occupied in making what they term "graphic mathematical calculations":—a written description of some engineering work is given to the student of which he must first make a freehand general design, and then freehand sketches of each detail, with full dimensions, and with the necessary calculations worked out on each sheet for the correct construction of the whole work.

In the workshops about 280 students are at work for some portion of each day. The time is divided between machine-tools and hand-tools. The manufactured articles consist of simple pumps, water and steam valves, boiler fittings, screw presses, &c.

The school cannot compete with ordinary manufacturers of such articles on a commercial basis.

There are now about 70 free students who live on the premises, having clothing, board, and lodging given to them. This privilege is granted on passing certain examinations, together with giving requisite proofs of inability to pay.

The school accommodates about 600 students, one half are boarders, of whom about 200 pay the full fee of 45*l.* a year (present exchange), the remainder are day students paying 15*l.* a year.

The endowment of the school, chiefly from the Imperial family, is large, amounting to about 400,000*l.*

The income is about 34,000*l.* a year and exceeds the expenditure. A large staff of professors, teachers, and instructors,—all Russian subjects,—conduct the studies. The premises occupy several acres of land, and the position renders the school easily accessible from all parts of the city.

This institution has deservedly attracted a great deal of attention throughout Europe and in America, owing to the importance of its aims and purposes, the ample means it has always enjoyed to carry them out, and the length of time it has existed. The results, however, cannot be considered satisfactory from a practical point of view. The school has had no strongly marked effect upon the development of civil or mechanical engineering or of manufacturing industry in the last 25 years, during which Russia has extended her railway system enormously and has established what manufacturing industries she possesses. The presence of foreigners in almost all the important positions on railways, in workshops, in mills and print works, &c., some of whom have had but little theoretical scientific training, proves that even with the laudable patriotic desire to employ native talent in responsible positions it has not been found profitable to do so.

Doubtless the Government has found employment for a considerable number of the graduates from the Imperial Technical School in the Department of Roads and Communications. Some have become teachers and professors in the institutions for which their training has so well qualified them. As mechanical draughtsmen and surveyors a certain amount of employment has always been open to the graduates. In this branch the training in the school is exceptionally good, but the remuneration in such employment is low and unprogressive. Probably the most successful men in after-life are those who have had to join the "special class," owing to their want of capacity to pursue abstract science in the higher classes, but who showed the practical faculty of dexterity with the hand and originality of thought in applying what theory they could master. Such persons have taken humble positions in workshops without any pretensions to the rank of a full graduate of the school, and in hard work have gained the necessary experience to become foremen and managers.

There appear to be two fundamental mistakes in the management of this institution.

First, the full course extends over too long a period, and the studies are of too theoretical a character.

Second, the students enter at too advanced an age and leave only when they are fully developed men of 25 years old, under the urgent necessity of making a living anyhow, and by

age and circumstances unable to take employment as improvers in industrial establishments before recommending themselves as competent engineers for any class of work. The result of this is that they often bring discredit on their training.

There is no possibility of teaching in a school that sort of knowledge which practical work, carried out on commercial principles within restrictions as to time of execution, &c., can alone make any one familiar with. Without this experience, the highly trained, and even really clever graduate is placed at a great disadvantage with the less educated foreign workman in Russia, who takes a position of great responsibility as foreman and manager, owing to his practical knowledge acquired through a long apprenticeship, and who also receives a salary twice or three times as high as that for which the technologically trained Russian engineer offers his services in vain.*

The professors of the school complain that their students come up ill prepared. In view of the present necessities of Russia, the better plan would be to take in boys at this school at 15 years old, to pass them through a preparatory stage, and turn them out at 18 or 20 years, making the most of the time on the same lines as the present, with less of the higher theoretical studies (excepting for professors and teachers), so as to leave the graduates the chance of going into practical manufactories, or to obtain employment on the railways, in some humble capacity as volunteers or apprentices or improvers, for two or three years, before they seek to fill responsible positions.

The Government has done its utmost to encourage the young men from this institution, by showing greater preference for them than for foreigners, when it is at all possible to use their services. This year an instruction has gone round to all the Government workshops, on railways and elsewhere, that not a single manager or foreman must be employed who is not, or will not become, a Russian subject.

The Institute of Land Surveyors.

This is a Government establishment and is free. There are 260 students, many of them sons of poor Government officials.

The staff consists of one director, one inspector, and 30 professors and teachers. The general education is good, followed by special instruction in land surveying, forestry, &c.

The Lyceum.

This school was founded by the Grand Duke Nicholas (brother of the late Emperor) with the intention of making it a sort of

* During the last 20 years I have taken great interest in the development of Russian industry, having been intimately connected with several branches of it, and being obliged to visit the country for some months almost annually throughout that period, I have had exceptional opportunities of testing the results of the technical school.

"Eton" for the higher classes of society. Provision was made for 600 boys, who were to pay 120*l.* each for instruction, board, and residence. There are now only 120 scholars.

The boys are admitted, at 12 years old, to preparatory classes, followed by 8 higher classes comprising the full course of instruction, which is classical in character, and forms a preparation for the universities. Modern languages are also taught, including English.

This school does not appear to be appreciated.

Armenian University.

This is an institution chiefly for the purpose of studying Eastern languages—Persian, Turkish, Tartar, Armenian, Arabic, and Russian, and also Eastern history, religion, the Russian Orthodox and the Armenian Greek faiths. There are 10 professors, 19 teachers, and 10 assistant teachers; about 180 scholars, who are with few exceptions Armenians, also a few Persians. The institution is entirely free.

Gymnasia.

These schools follow the lines of instruction given in the German Gymnasia. Scholars are admitted at 11 years of age. There is a preparatory class, which includes the rudiments of the German language. The accommodation in these schools is from 250 to 450 scholars each. Six hours per week are devoted to the classics. This is compulsory for all scholars. Three hours a week to theology. Modern languages are taught with only moderate success; simple mathematics, rudimentary science. These schools are regarded as preparative for the university. The complete course terminates when the scholars are about 20 years of age. The fees are 10*l.* a year.

The girls' High Schools follow the same course as the boys' Gymnasia. They accommodate from 60 to 80 students each.

The Moscow Real School has a course of seven classes. No dead languages are taught. The special tuition consists of higher arithmetic, drawing, mathematics, the elements of science, and German language, to prepare for the Imperial Technical School. Boys are admitted at 11 and remain to their 18th or 19th year. The fees are 10*l.* per annum. Some of the scholars are admitted free. About 280 scholars in attendance.

The Practical Academy of Commercial Knowledge is a school intended for mercantile training. All the modern languages, including English, are taught. Much time is given to commercial correspondence and book-keeping, also the history of the manufacturing industry. The rest of the subjects follow the ordinary course of secondary education. About 60 boys attend this school. The fees are 10*l.* a year.

Kommissarof Technical School.

This institution was started in 1866 by the efforts of two railway contractors, M.M. Meinen and Gubonin. It is under the patronage of the Government, and obtains some support from it. The institution provides board and lodging. A recent enlargement has taken place to accommodate boys who are willing to pay 10*l.* a year towards their maintenance, which sum includes clothing. There are 58 free scholars, 222 paying 25*l.* a year, and 120 day scholars paying 6*l.* a year. Some of them board at the school, paying 12*l.* a year. There is accommodation for 400 scholars. The free scholars and the boarders have clothing provided. All the boys wear a semi-military uniform. Boys enter at 11 years of age, with an examination in reading, writing, arithmetic, and the German language, and remain five years. Some of the brightest boys are sent to Germany at the end of their fifth year at the expense of the school, and placed in some workshop or manufactory as apprentices. In 10 years about 26 boys have had the advantage of this arrangement.

The school occupies a large building, erected for the purpose, in which there is a well-appointed smithy and joiners' shop, and other work-rooms; foot lathes, vices, and benches for teaching the use of hand-tools. Some simple articles are made by the boys for sale. About 300*l.* a year is the value of what they produce. The promoters are said to have spent between 50,000*l.* and 60,000*l.* The total expenditure is between 7,000*l.* and 8,000*l.* a year. The Government contributes 1,600*l.* The school fees amount to 4,000*l.*; the endowment fund and voluntary contributions provide the remainder. The management is under a board of governors, with a resident director and a staff of teachers. The course of instruction is divided into five classes.

1st Class enter at 11 years old. Reading, writing, arithmetic up to vulgar fractions, grammar, German language, geography, drawing, simple geometrical figures.

2nd Class.—Same subjects in a higher grade, Latin, Russian history, mathematical and mechanical drawing and map drawing. At this stage the boys are sent into the workshop for the use of tools three hours daily.

3rd Class.—Some of the former subjects, algebra, physical geography, free-hand drawing, mechanical drawing, geometry, conic sections.

4th Class.—Mechanics, dynamics, history, elementary physics, mineralogy, metallurgy.

5th Class.—Trigonometry, magnetism and electricity, physics, properties of metals and wood, composition of stones, lime, mortar, machine construction, hydraulics, book-keeping.

Botany and zoology are taught throughout all the classes. Science instruction is not carried beyond the elementary stage, but appears to be thorough as far as it goes. Joinery is the chief feature of the workshop practice, for the 2nd and 3rd classes. After that, all the boys work in metals. There is no attempt to

teach a handicraft. The object appears to be to prepare boys to enter workshops later as apprentices and to acquire a trade. Eight men are employed in the workshops to teach the boys. There are about 44 bench vices, smithy with four fires, about 30 foot lathes, and about 60 joiners' benches. There is a drill hall, the boys receiving military drill with gymnastic exercises. The school possesses a small museum, some excellent specimens of botany, natural history, and a considerable variety of models and mechanical contrivances, and diagrams of mechanical powers, steam engines, boilers, pumps, &c.

Mechanical Handicraft School.

This is an institution similar to the Komissaroff Technical School, but much smaller. It has been founded by the Society for the Promotion of Technical Education. The course of education follows that described in the Komissaroff school. There are 82 scholars, from 12 to 17 years of age. The system of instruction is divided into five classes. The income amounts to 1,656*l.* a year, made up of subscriptions from the society, public subscriptions, profits on work done, school fees, which amount however, only to 140*l.* a year, as most of the scholars are free; a small endowment fund, and 200*l.* from the Government. The scholars are from the peasant class, sons of soldiers, working men, and a few sons of merchants and government officials who desire to have some workshop practice.

Railway Schools.

Similar schools to those above described, are provided by the Nijni Novgorod, the Smolensk, and the Razan Railway Companies. These schools are established for the sons of railway officials, all of them are free, and boys are instructed in them from their 13th to their 17th year.

The Moscow Society for the Spread of Technical Knowledge.

The object of the society is to spread technical knowledge, and to develop it in connection with manufacturing processes, as well as in connection with handicrafts in general. It has full power to establish technical schools, to build libraries and museums, and to publish books in the different branches of technical education. It is composed of honorary members, full members, and associates.

Members, including foreigners, may be of either sex. Honorary members are those who have done important service in the spread of technical knowledge, and full members are those upon whom the society mainly depends. The subscription is five roubles a year, or 100 roubles for life membership.

Associates are those who undertake to carry out the instructions of the committee and obtain valuable information. Members are elected by a majority of votes. The institution is managed by

a President and Vice-Presidents over special divisions of the Council. There is a secretary and treasurer and a committee of management. The officers are elected for three years. Meetings take place four times a year, and oftener if necessary.

A general meeting takes place once a year, when the accounts are presented and duly audited. The capital of the society consists of the yearly subscriptions, money collected from the different exhibitions, and by public lectures, and special donations. Certificates of merit are given under the seal of the society to those boys who distinguish themselves in the handicraft school. This society promises to perform important work in the future. It has only been established in recent years. Its first important work is the Handicraft School above described. Many of the leading manufacturers and merchants of Moscow are members of it, among whom may be specially mentioned Mr. Asaph Baranoff.

Strogonoff Central School of Technical Design and Museum of Art and Industry.

This school was established by Count Strogonoff, with the assistance of the late Emperor, who gave a property in Moscow of the value of 40,000*l.* as an endowment. It occupies a large and handsome house of Count Strogonoff's, and affords accommodation for about 400 art students of both sexes. The teaching staff consists of a president, M^{rs}. Alexis d'Iline, 10 professors, and 3 instructors. The fees are merely nominal. The institution is open to all classes from the peasant to the noble, the materials being found for the poorest students. The instruction is confined almost exclusively to drawing, from the earliest stages to its highest branches—geometrical, freehand, mechanical; drawing from objects, projection, perspective, Russian ornamentation, drawing from flowers and plants, the study of design as applied to the industrial arts, figure subjects, modelling the human figure, painting on china, water colour and oil painting. There is a large collection of models and casts. A considerable number of the scholars are engaged in designs, chiefly for woven fabrics, and several Jacquard looms are employed for experimental effects. Modelling in clay is also taught, with all the necessary appliances. The chief result of the drawing school has been the training of teachers for schools, but many of the students have found employment in church decoration and the painting of icons, used so largely in the churches and in every household in Russia. Art exhibitions are promoted by this institution from time to time. It is capable of greater usefulness than it appears to accomplish at present. It lacks the interest of the wealthier portion of the public, necessary to make it all that its name implies. The school of design might afford an excellent training for designers in connection with the textile industries in and around the city, but hitherto little interest has been taken in it by the manufacturers, to develop native talent in this direction for their own industries.

Probably the most important work performed by this institution, since its foundation in 1860, is the commencement of a Museum of Art and Industry, a sort of South Kensington in embryo. The most interesting and useful feature is the section devoted to the historical collection of Slavo-Russian art, and Byzantine art.

The specimens largely consist of fac-simile copies of old manuscripts, the fruits of pains-taking investigations by the Stroganoff school; also reproductions in plaster and by oil paintings of ancient works of art, executed in metal, wood, stone, ivory, and woven fabrics, found in public and private collections, and in the churches throughout the Empire.

In connection with this museum a remarkable work has been published, entitled "History of Russian ornamental art." It is illustrated with 100 large plates, exquisitely coloured, representing many hundreds of the finest examples. "Russian ornamentation" is a branch of art peculiar to the country. It is a blending of the Byzantine, Slavonic, and Asiatic elements, forming a distinct style, and admitting of an infinite variety of designs of quaint beauty, which the gorgeous yet harmonious colouring, renders extremely effective. The style dates from the tenth century, and its development follows the growth of the Russian Church. This truly national art of decoration, has touched the whole people. It may be traced in the carvings and adornments of the peasants' huts, on articles of rudest furniture, in the embroidery of linen, silk, &c., and in the ornate national costumes of both sexes. It has produced a taste for rich colours in public buildings, dwelling-houses, upholstery, and wearing-apparel, which is peculiar to the Russians to this day. In fact, in recent years a powerful revival has taken place in the study and application of the national art, which makes itself apparent in the newest productions of all manufactured articles and fabrics. The tendency of this movement is undoubtedly elevating and refining. It is evidently the ambition of the Stroganoff school to promote the study and practice of the art in connection with the industries of the country.

ST. PETERSBURG.

This city is better provided with educational institutions of all kinds than the city of Moscow. They may be classed as follows:—

156 Elementary Schools supported by the town authorities.

25 High Schools partaking of the character of Gymnasias and Real schools, supported by private individuals.

Schools and institutions (including handicraft schools) established by the Government, or under Government patronage, and partly supported by the State and members of the Imperial family, consisting of:—

35 Middle and Lower Class Schools.

6 Real Schools.

- 3 Progymnasia.
- 18 Gymnasia.
- 11 Technical Schools.
- The Technological Institute.
- The Civil Engineers' Institute.
- The Institution of Engineers for Roads and Canals, &c.
- The Institution and Museum of Mining Engineers.
- The Institution for Forestry.
- The Historical Philological Institution and the Archæological Institution.
- The Imperial Alexander Lyceum.
- The Imperial University.
- The Imperial Academy of Arts.
- 26 Military and Naval Schools and Institutions.

For female education alone :—

- 4 Normal Schools.
- 18 Gymnasia.
- 54 institutions for female instruction of various grades, supported by societies and private individuals.

In addition to the above are the seminaries and institutions for theological training.

It will not be necessary for me to describe the schools and institutions for general education, as the course of instruction follows the same lines as in those schools and institutions of a similar character in Moscow. I shall confine my observations to the Technological Institute, the Civil Engineers' Institute, the Institute for training Mining Engineers, the Handicraft and Industrial School, and the Girls' Handiwork School.

The Technological Institute.

This institution occupies a central position in the city. The buildings cover an area of about 10,000 square yards, and are three storeys high. In addition there are large open spaces and detached workshops. 700 students are in daily attendance. The class-rooms are large, each giving accommodation for 100 students, the workshops are very extensive, and the museum, model room, chemical and physical laboratories, are most complete. There are technical laboratories for the bleaching, dyeing, and printing of textile fabrics, for paper making, and sugar making. They are all supplied with small working plant for the use of the students.

The schools were established in 1828, under the care of the then Minister of Finance. In the early days boys were entered at 13, and could not enter after 15 years of age. The whole course was for six years, and those who passed successfully were exempt from military service. In 1832 the present extensive buildings were erected. In 1866 a society was formed for the purpose of finding situations for successful students. In 1870 another society was formed for the pecuniary assistance of the students. In 1875 a change was made in the rules of the insti-

tution, requiring boys to pass an examination before entrance, which altered the character of the institution, and raised the age at which students could enter up to 18 years. In 1875 there were 900 students in attendance, of whom 300 were free. During the 56 years of its existence the school has undergone many changes, and the results have varied as the management was more or less efficient. At the present time, under the direction of Professor Iline, it enjoys a high reputation in Russia, and every place is occupied. Besides the president, there are 16 professors, and 32 teachers, exclusive of the instructors in the workshops.

One half the students only pay 5*l.* a year. About 150 are free. The total income in fees from the students is only 2,500*l.* a year. The total expenditure is 25,000*l.* The students are admitted without regard to nationality or religion, but are required to pass an entrance examination, or to bring certificates from a Real school or Gymnasium. The whole course extends over five years, and is divided into four classes, the fifth year being devoted entirely to workshop practice. All students pass through the same subjects for the first three years, when a selection is made between the mechanical course, and the course for technical chemistry; the latter course forming two parts, the so-called "Mechanical and chemical divisions." If, after the second year, students are found to be mentally unfitted to advance into the higher classes, they are dismissed the school, or they may enter the workshops as apprentices for a four years' training as workmen. There are at present 30 apprentices in the institution.

There is accommodation in the workshops for about 100 students. Only a few articles are manufactured in the shops for sale, the value of which is not more than 100*l.* a year.

The subjects taught in the *First Course* are as follows:—

Mathematics, geometry, differential calculus, integral calculus, algebra, plane and solid geometry, physics, the expansion of solid bodies possessed of specific gravity, pneumatics, theoretical mechanics, statics, mechanical motions, freehand and mechanical drawing, theory of shadows and perspective, inorganic chemistry.

Second Course.—Physics, laws of gases, steam, theory of heat, theory of resistance in bodies, elasticity and tenacity, tensile and breaking strains, tempering test, ductility of plates, determination of strength of various substances, deflection under given strains, Inorganic chemistry. Minerals and their tests; details of machines, bolts, screws, keys, cones, drums, pulleys, fly-wheels; applied mechanics, friction, and adhesion. Mechanical powers, pulleys, levers, endless screws, wedges. Mechanical appliances, parallel motion, reciprocating and rotary motions. Laws of hydrostatic pressure, turbines, water-mills, wind-mills, steam engines, locomotive and gas engines, injectors, pumps, presses, valves, governors. The art of building, and materials for building. Earthworks, stone work

(natural and concrete), wood work, plaster, cement, paint and glass. Architecture, as a science and as an art; its history and styles. Parts of buildings, foundations, roofs, fire-proofing, arches, staircases, and domes. Land surveying, technical and architectural drawing. Calculations, theoretical mechanics, geology, mineralogy.

During the first and second course about 10 hours a week are devoted by all students to drawing.

Third Course.—Mechanical theory of heat, construction of steam engines, details and working of all the parts of land and marine engines. Technology of metals, cast and wrought iron and steel. Theory and construction of boilers, fuel, heating surface and fire-grate areas. Construction of chimneys, generation of steam, explosions, Hydrostatics. Hydraulic motors and hydraulic lifts. Theory and construction of cranes. Measurement of heat and steam, saturated steam, superheated steam, and condensation. Mechanical projection. Analytical chemistry, organic chemistry, chemical technology of mineral bodies. Acids and alkalies. Anatomy and physiology of plants. Technical chemistry. Laboratory work. Technology of organic bodies.

Fourth Course.—Technology of fibrous substances. Manufacture of cotton and cotton fabrics. Grinding corn. Construction of wind-mills (mechanical and chemical divisions). Theory and instruction in heating and ventilating buildings (mechanical and chemical divisions). Theory and construction of locomotives (mechanical division only). Theory and construction of machines used in the manufacture of iron. Blowing engines, steam hammers. Rolling mills, shearing, punching, and riveting machines. Machine tools; Qualities of cast iron. Different modes of melting cast iron. Moulding. Machine construction. Designs of steam boilers with chimney, steam engines, water wheels and turbines. Technology of organic bodies (chemical division only). Oils, tallow, tar, soap, bones and their use. Technology of nutritious substances, starch, sugar, potatoes. Preparation of sugar from beetroot. Technology of colouring matters, preparation of colours. Machines used for bleaching, dyeing, and printing. Technical plans of manufactories.

The object of making technical plans in the fourth course of the chemical division is to acquaint the students with the buildings and appliances necessary to carry out processes in which chemistry is largely required. Each student has to work out the plans in detail of one of the following manufactures. Manufacture of sulphuric acid, glass, soda-ash, porcelain, &c.

Fifth Course.—This is devoted to the preparation of plans, full-sized working drawings, and practical work in the machine shops, foundry, smithy, joiners' shop, and in the practical

laboratories for dyeing, bleaching, and printing, &c. The students of the mechanical division give six hours a week to constructional drawing and eight hours a week to the designing and drawing of manufactories. In the former they have to design bridges, trusses, and study the computation of strains, arches, roofs, columns, &c. In the latter they are required to prepare plans for machine shops, forges, foundries, saw mills, and water works. In the workshops they have to learn the use of tools, filing, turning, planing, screw-cutting, moulding, smith work, and joinery. At the end of the fifth course each student is expected to construct some piece of mechanism. Sample machine tools by the best makers in Europe are placed in the mechanics' shop for the instruction of the students. Special instruction in the tending of steam engines and boilers is given in the last year. In the chemical division students are engaged in the purification of petroleum, of vegetable, animal, and mineral oils; gas manufacture from coal, wood, and naphtha, making drawings of the buildings required and the different kinds of furnaces and appliances. They have to make researches in the statistics of raw material, imports, and exports. A special course of electricity and its practical application has been recently established, but it is optional with the students to undertake it.

Looking over the statistics of this school, it would appear that from 70 to 100 students graduate after the full five years' course each year. There has been steady improvement in the preparation of the students in the Real-schools and the Gymnasia. The number of those who have left of their own accord, or who were sent away in consequence of being unfit to pursue the studies beyond the second class, is from 10 to 15 per cent. each year. About two-thirds of the students appear to be capable of being transferred to the higher classes from year to year.

It is claimed for this institution that a large proportion of the graduates succeed in finding good positions in the Government service, the railways, and in some of the large manufactories of the country. Mr. Asaph Baranoff, of Moscow, who has had special opportunities of judging of the results produced by the two institutions of Moscow and St. Petersburg, considers that the training of the St. Petersburg school, so far as chemistry is concerned, is highly efficient for experimental purposes. I met a considerable number of young men, who were formerly students of the St. Petersburg Technical School, in several of the large Turkey red dyeworks around Moscow, yet very rarely have I met with a graduate of either of these schools holding a responsible position in a calico-printworks, of which there are upwards of 50 in the country. I attribute this want of practical success on the part of the young men in both the mechanical and chemical industries to the fact that the pursuit of theoretical science is over-strained, and beyond the requirements of the country at the present time. The singular dependency of Russia upon the practical knowledge

and aptitude of foreigners proves that there is but a very limited field for the use of these theoretically trained men who leave the technical schools at 25 years of age. I believe the training in both institutions in theoretical science to be sound and thorough, but it is more suited to a country highly developed in all its resources than to one like Russia, almost wholly agricultural, and with manufacturing industry confined to the simpler applications of the mechanical arts.

Civil Engineers' Institute.

This institution was established in the reign of Alexander the First. It has accommodation for over 400 students. There are at present 250 students in attendance, of whom 190 pay 5*l.* a year. It occupies very extensive and handsome premises, which cost about 100,000*l.* It possesses an excellent library, a very fine collection of instruments and apparatus for physical science, a well-equipped chemical laboratory; a very fine museum and model-room, in which are models of the most important engineering works carried out in the empire, including canals, waterworks, buildings, railway bridges, docks, lighthouses, &c. One important feature in the institution is a very fine experimenting room, to illustrate constructive engineering, the testing of beams, girders, columns, the strength of materials in torsion, tension, and shearing strains; the qualities of stone, bricks, and cement, the strength of timber and of appliances used in railway construction, hydraulic apparatus, and specimens of rails used in the construction of the Russian railways. The institution is under the control of a director, Professor Gherevonof, an inspector, his assistant, 12 professors, 8 demonstrators, and 10 masters. The expenditure of the school is about 11,000*l.* a year, supplied by the Government.

This establishment gives a highly theoretical training in civil engineering by means of a course extending over six years. The students generally enter at 19 or 20 years of age. The instruction is confined entirely to lectures, and demonstrations in the lecture rooms. Free-hand, architectural, and mechanical drawing are taught with great thoroughness, also higher mathematics, land surveying, chemistry, and the principles of engineering science as applied to railways, roads, canals, docks, waterworks, public buildings. The only practical work undertaken in the school is in connection with the mechanical laboratory, in experimenting upon materials used in engineering construction, and in the experimental construction of bridges by the use of models. In the summer months the students go out for surveying purposes along the canals and rivers, and in the country around the city. The works of railway companies are also visited, and the laying of the permanent way, and railway appliances generally, are inspected and reported upon. Nearly all the graduates of this institution pass into the Government service, and some are sent to remote distances in the empire to superintend the making of roads, bridges, &c. About 2,000 young men have been passed through the full course during the last 20 years of its existence.

This institution bears the character of being rigidly theoretical in its training, pursuing abstract science in connection with engineering, rather than developing the mind of the student on the lines of the practical application of scientific principles. It was admitted to me by a responsible person that, to make the school more suited to the requirements of the age, it would be necessary to shorten the course to four years and to let men enter upon it at an earlier age by two years. It cannot be doubted that for people like the Russians, who do not possess naturally the mechanical faculty in a high degree, all this highly theoretical training of their young men is not conducive to a speedy development of that faculty. There is a tendency induced to become conceited with mere book knowledge and with information acquired only through the memory, or it produces a lack of energy on the part of the young men, who after leaving this institution feel that they are wanting in the facility to apply the knowledge they may have acquired, and who from their age, unless possessed of singular force of character, are not prepared to take very subordinate positions. Complaints have frequently been made to me by many professors who are engaged in the higher education of Russian youths that what they do is not appreciated by the large manufacturers, the merchants and the industrial companies of the country. On the other hand, I have frequently heard complaints from the latter sources that the education of these institutions, of the Gymnasias, and of the Universities unfits young men, without capital, for the practical work of getting their own living. There can be no doubt that most of the students receiving education in the highest grades are extremely poor, and for the greater number of them it would be better were they to sacrifice the diplomas of the higher schools and Universities for the substantial benefit of learning practically, at an early age, a trade or profession by which they could support themselves and become of real use to their country.

Institute for training Mining Engineers.

This is an institution more especially known for its very fine collection of the mineral deposits of the Russian Empire, and for its important geological collection. The School of Mines connected with it is for the instruction of young men in mining engineering on similar lines to those which I have described in the School of Civil Engineers. It cannot be said that Russia affords as yet a large field for the use of such knowledge, applied specifically to mining. The coal fields of Russia are practically undeveloped. The Donetz coal field is too remote for the manufacturing districts and the railway communication too uncertain to admit of its large use. The lignite or brown coal which is found within a radius of 200 or 300 miles of Moscow does not offer fuel of a sufficiently good quality to require a large number of people for its extraction. The ruthless destruction of forests in Russia, for fuel, during the last 20 years, without systematic replacement

under Government supervision, has produced loss to the nation. The training of a large corps of foresters would have paid better than the training of theoretical engineers who find it difficult to procure employment. In the woods and forests there is a continual source of wealth if the requisite skill and care were employed in planting and cutting down. Constant occupation for a very large number of intelligent and well-trained young men might have been found in this conservation of the country's rich timber growth. It is a remarkable fact that, during this year and the last, English coal has been found to be the most profitable fuel which manufacturers could use, immediately around Moscow, at a price laid down of about 2*l.* per ton. Twenty years ago the price of wood fuel was so low as to be equivalent to coal at 10*s.* a ton, and *now* coal at 40*s.* is the cheaper fuel. Siberia is the chief country of Russia's mineral wealth, but not until the railway communications are established in connection with the valuable properties in that region will it be possible to utilise the facilities offered in the mining school at St. Petersburg for the training of a large number of mining engineers. The Government is making extreme efforts to cause capital to flow into the remote districts where mineral deposits exist.

All the railways in the country are obliged to use rails made in the country, and this year an increased duty has been put upon pig-iron, which will seriously increase the cost of importation from other countries.

The Handicraft and Industrial School.

This is an institution possessing a very fine building, recently erected at a cost of about 45,000*l.* The school was promoted by some of the members of the Imperial family, together with the town authorities and private individuals. Its object is to educate and train boys of poor parents who are deserving of assistance (and for orphans) in the mechanic arts. It also receives a number of boys who are paid for either by their parents or friends. The boys enter at 12 years of age and remain until they are 17. They receive a sound elementary education in the following subjects:—Reading, writing, arithmetic, the Russian language, history, geography, natural history, elementary chemistry, mechanics, and physics, technology of metals and wood, free-hand drawing, mechanical projection, singing, and gymnastics. The practical work consists of joinery, boot-making, engraving, paper-hanging, smiths' work, turning, planing and shaping of metals; and various articles in ironmongery are manufactured. They sell about 600*l.* worth in value of such articles per year. There are 300 boys who are lodged, boarded, and clothed in the institution. About 20 youths leave each year who have no difficulty in finding immediately occupation in workshops where they receive about 12*s.* per week. The course of instruction extends over five years. In the first two years they spend two hours in the workshops and five hours in the classes; in the

third and fourth years four-and-a-half hours in the workshops and five in the classes. In the fifth year the whole day is spent in the workshops.

The boys who pay for the privilege of attending the school are charged 25*l.* a year, which includes board, lodging, and clothes. This school appears to be doing a very important work. In connection with it there is a society for the promotion of the future welfare of the boys, and the officers of the society make great efforts to provide suitable situations before the boys leave the schools. The society seeks subscriptions to extend and improve the institution, by which means it is hoped the accommodation may be so far enlarged as to admit a number of day scholars to take advantage of the manual training which is given. I saw a collection of very creditable work in the museum of the institution, produced by the boys. There is no uniform worn here, as in most schools in Russia, but simply a white blouse with a belt which is suitable for either workshop or school. The staff necessary to conduct this school consists of 24 persons. The director, sub-director, one scripture teacher, six teachers, ten instructors, two teachers in drawing, and three in handicrafts. Certain certificates obtained at this school will entitle boys to enter a Gymnasium or Real-school free of cost.

The Girls' department of the same institution is conducted by a head-mistress, two scripture teachers, four teachers, two instructors, one science teacher, and nine teachers of handicrafts. In the girls' department a similar elementary education is given. Girls are admitted from 10 to 12 years of age and remain until they are 17. A considerable number of girls pay for their education, or their friends pay for them, to admit them into this institution; the amount of the fee charged is 15*l.* a year for full residence. Semi-boarders pay 6*l.* a year and daily scholars 3*l.* a year. Besides receiving an ordinary elementary education, the girls are taught the cutting out of clothing, all kinds of needlework, dressmaking and millinery, lace-making, housekeeping, and cooking. The girls of the highest class take in turn the management of the household. The united expenditure of this institution last year was 16,000*l.*, including some new apparatus and tools. The total assets of the institution amount to 78,000*l.*

The Imperial Academy of Fine Arts.

This Academy offers great facilities, to all classes equally, for the study of drawing, painting, and sculpture, in connection with the National Picture Gallery and Museum. A considerable field for the employment of artists and art students exists in Russia, owing to the decoration of churches with paintings of sacred subjects, and the demand for sacred pictures among all classes of the population. These are regarded as indispensable objects in every room, both of cottage and of mansion, and consist largely of paintings in oil. There is no doubt that the splendid galleries

and rich collection of works of art at St. Petersburg have a great influence, though limited at present to the higher classes.

The educational institutions of Russia, even including those of Poland, Finland, and the Baltic provinces, are not sufficient to account for the intelligence and enterprise displayed by a large number of merchants and manufacturers and professional men. The facilities for education offered in Germany have for many years been appreciated and utilised by the middle classes of Russia, also the aptitude to acquire languages natural to the Russians has enabled those who had means to travel over Europe to collect information readily. The presence of a large number of foreigners of exceptional ability,—German, English, and French,—has promoted the rapid growth of manufacturing industries (within the limited field which the natural conditions of the country offer), and much is due to the spread of western ideas on all subjects.

It must, however, be admitted that Russia has produced some distinguished men in science, art, and literature. In the science of engineering the most eminent have been connected with the military and naval services, or some other branch of Government employment. Originality and boldness of conception have not been wanting in the public works executed during the last half century, though it is difficult to draw the distinction between foreign and native talent. Probably very few eminent men have been educated exclusively in Russia. It is almost essential for an educated Russian to live sometime abroad to acquire several European languages. The scientific man, especially until recently, must have depended largely upon foreign books for his information, and, doubtless, with few exceptions, the most distinguished men outside the Government service have received part of their education or experience out of their own country.

The Principal of the Civil Engineering School at St. Petersburg has built some of the important bridges in the country. He derived his education from Russian sources. Naval construction has been the object of bold experiment by Russian engineers, adding to knowledge though not resulting in practical success.

Electricity has long been a favourite branch of science with Russian physicists, some of whom have experimented usefully in the direction more particularly of the application of electricity as a motive power. In quite recent times the name of Jabloschkoff entitles Russia to a very honourable position in the development of electrical science. The work of Jabloschkoff will always be recognised as having contributed to the rapid growth of electric lighting throughout the world.

In travellers, explorers, and geographers, Russia has furnished daring and cultured men whose labours have brought under notice vast regions on her borders ready for the spread of commerce and civilisation. In the fine arts, Russia has commenced a school which is already recognised as possessing distinct qualities of imagination as well as high technical skill. In the field of general literature the names of Russian authors are becoming widely known and deservedly honoured.

Of the masses of the people I can truly say that they show the aptitude to learn quickly when well directed. They possess some excellent natural qualities, docility, endurance, obedience, veneration, and the faculty of imitation. They are rising in self-respect, and the spirit of emulation is growing fast. All these qualities only require quickening by systematic elementary instruction to create a new life in the people, leading to greater prosperity and morality. There is a strong desire apparent to be less dependant on foreigners, and if this could only be accompanied by a determination on the part of the authorities, and the higher classes to extend educational and other institutions, on the principles upon which other great European nations have been built up, there is reason to believe that the great resources of this vast empire will be rapidly developed by an intelligent people for their own advantage and the welfare of mankind.

I have to thank Sir Edward Thornton, the British Ambassador at St. Petersburg, for his extreme courtesy and kindness in obtaining introductions which facilitated my inquiries; and to Mr. N. W. Hornstedt, the British Vice-consul at Moscow, my cordial acknowledgments are especially due for the valuable assistance he rendered me in the pursuit of my object. To the Principals of the institutions I visited I have to tender my hearty thanks for their polite attentions, and for their cordial responses to my inquiries.

WILLIAM MATHER.

Manchester,
August 28, 1884.

REPORT
ON THE
ENGLISH SILK INDUSTRY

BY
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THE Royal Commission on Technical Instruction having preferred that my evidence shall take the form of a written statement, instead of being given orally in the form of question and answer, I propose to treat my subject under the following heads:—

Introductory remarks.

Notes on the early history of the silk trade in England.

Tabular statement respecting the condition, past and present, of the English silk centres.

Some further particulars of the principal silk centres, supplementary to the tabular statement.

On the reeling, throwing, dyeing, and manufacturing history and operations of silk.

The Worshipful Company of Dyers.

On the weighting of silks.

Extent to which the weighting of silk is practised in the main silk centres on the continent of Europe.

On weighted silks.

The "spun silk" or "schappe" industry.

Tussur and other wild silks.

Silk printing.

Silk finishing.

The French Treaty of 1860.

Strikes.

Decorative or pattern embellishment.

Museums.

Technical instruction at Crefeld.

On the statistics of the silk industry at home and abroad.

Appendices:—

- I. Board of Trade Returns of the quantities and values of the English Silk Imports and Exports, 1854 to 1883.
- II. Crefeld statistics from the "Jahres-Bericht der Handels-Kammer zu Crefeld."

III. French statistics.

IV. Extract from the Journal of the Society of Arts of
April 26th, 1884, on the Swiss silk industry.

V. Silk Supply Association of England.

INTRODUCTORY REMARKS.

The inquiry into the influence of technical instruction on the silk trade, both as a useful industry and an art manufacture, is no doubt of importance to those with whom the idea of technical instruction originated, as well as to those who continue the manufacture so long after it has practically ceased to be an industry worthy of the application of capital, and capable of furnishing employment to those of our intelligent artizan population, who have been gradually shorn of their fair and reasonable hope that it would repay their offspring the time and trouble of being taught its details.

These having been also my own feelings and objects for some time past, during which, by frequent opportunities of witnessing the steady growth of the silk industry abroad, and its unhappy decadence in England, I have studied the subject, I have ventured upon a fuller survey of the question than perhaps the limits of the Commission's inquiry really requires, hoping by so doing to show what matters besides technical education require attention in the various branches of the silk industry. If in so writing I can in any way aid in stimulating the general interest towards the re-establishment of the trade, I shall be well satisfied, for I am earnestly convinced that England cannot afford to lose *any* of her artistic industries, especially one which, if properly practised, would give reasonable and happy work to both men and women, and interesting training and occupation to a large proportion of the youth of our silk-manufacturing districts.

NOTES ON THE EARLY HISTORY OF THE SILK TRADE IN ENGLAND.

The refuge which England afforded, and always affords, to persecuted people of other nations, caused her in times past to have a start in perhaps what may be justly considered the most beautiful and artistic industry in the world. We are indebted to two of these persecutions, both of them consequent upon the Reformation, for our silk industry. The first occurred in the latter half of the sixteenth century. This was the religious persecution of the Protestants of Flanders and France, which ceased for a time, towards the end of the sixteenth century, in consequence of the Edict of Nantes, decreed by Henry of Navarre, giving liberty of conscience and freedom of worship to all; privileges up to this time denied. This, unhappily for France

and for freedom, was abrogated in after times by Louis XIV. in the Revocation of the Edict of Nantes in 1685, which was the "death knell of the Huguenots." This caused the second and much greater persecution in France, which drove a million people into their graves or to foreign shores, principally to England.

From this religious and persecuted people we learned the arts, trades, and perfectionments of thread and lace, woollen weaving and dyeing, cambric-making, ship-building, button-making, pottery manufacture, the construction and use of windmills, gardening, hop-growing ;—

"Hops, Reformation, bays, and beer
Came into England all in a year."

Joinery, felt-hat making, tanning, silk-dyeing, clock and watch-making, Arras tapestry, paper-hanging, cutlery, jewellery, mathematical instrument and glass making, engraving, the smith's trade, hemp-dressing, fish-curing, salt making, glass-painting, iron and steel working, sea-fishing, paper-making, and last, though not least, the manufacture of silk.

Many refugees established trades in Norwich, amongst these was the silk manufacture in several branches. Three hundred Dutch and Walloon families, settled here, and introduced the flowering and striping of silks and damasks, which shortly became one of the principal branches of trade in Norwich. This was done under licence granted by Queen Elizabeth in 1564, through the influence of the Duke of Norfolk, and at his charge, until the settlers, shortly afterwards by their industry, made themselves self-supporting. The silk trade of Norwich is now mainly represented by the manufacture of silk crêpe for mourning, in which it has almost a monopoly, and by the manufacture of dyed spun silk into a great variety of decorative furniture cloths.

A portion of the refugees, who settled at Spitalfields, afterwards migrated to Dublin, and established the manufacture of poplins, formerly called tabinets, fabrics for dress purposes, for which the French have been for long celebrated, made of silken warp and woollen weft.

On the introduction of the power loom and steam engine, others migrated to Manchester and its neighbourhood, as well as to Macclesfield, Coventry, and "other northern manufacturing towns then rising into importance."^{*}

TABULAR STATEMENT OF PARTICULARS OF THE ENGLISH SILK CENTRES.

I have prepared the following statement of particulars of the English silk centres in a tabular form, for the purpose of readier reference, and to give a comparative view of the subject :—

^{*} Smiles "Huguenots in England and Ireland," p. 338, to which work I am indebted for most of the facts in this chapter.

TABULAR STATEMENT OF THE CONDITION, I

SUBJECTS.	CONGLETON.	COVENTRY.	DERBY.	LEEK.
1. Commencement and origin of silk industry.	1752. Introduced by John Clayton of Stockport.	Beginning of eighteenth century. Introduced by a Mr. Bird.	1717. Introduced by John Lombe.	Came originally from Macclesfield, where there are twist "wheel heads," but seen, from 10 (?) 150 years old.
2. Population notes.	In 1811, 4,816	In 1748-9, 17,817	In 1801, 10,832	In 1801, 8,700 Now, over 12,500.
3. Number of looms at the best period of the silk trade.	-	In 1800. "A la bas" looms in weavers' houses, 8,412 Hand looms in weavers' houses - 1,025 Single hand looms in weavers' houses - 2,610 Steam power looms in factories - 1,800	In 1845. Power looms - 225 Hand looms (Derby and county) - 150 Elastic web looms - 80	800 or 400 hand looms for broad silks power looms.
4. Present number of looms.	-	-	-	About 50 hand looms for broad silks about 300 power looms.
5. Description of goods made.	Broad silks, handkerchiefs, velvets and ribbons.	1824-5. Gauze and satin ribbons. 1859-60. Chiefly bonnet ribbons; about one-fourth figured ribbons and waistbands. 1881-2. Plain and fancy ribbons.	Formerly hosiery, broad silks, velvets, galloons and ribbons. Now elastic webs and surgical stockings and bandages.	Sewing silks and twists, fringes and embroidery silks all kinds, button galloons, fern bindings, web bands, serges, handkerchiefs, muffs, brocades and damasks.
6. Most prosperous period.	1830 to 1860	-	1844 to 1864	1874
7. Operatives employed, best period.	1860, 5,186	1861. 40,600 people dependent on ribbon trade.	6,850	-
8. Operatives employed now.	In 1888, 1,275 In 1894, 1,230.	Not more than a quarter of the number thus engaged in 1861 are now engaged in the ribbon trade, but some have taken up other branches of weaving.	2,400	-

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PRESENT, OF THE ENGLISH SILK CENTRES.

LONDON (including Spitalfields).	MACCLESFIELD.	MANCHESTER.	MIDDLETON.	NOTTINGHAM.
1029 the silk rowsters of London formed an association.	About the middle of the seventeenth century.	About seventy years ago.	About seventy years ago.	Very small at the beginning of the present century.
- - -	The Parliamentary Borough— 1851 - 39,045 1881 - 37,020		Seventy years ago, about 3,000. " "	Commencement of present century, 28,000.
825. and looms - 24,000	Hand looms, 5,000 to 6,000.	Probably 20,000	In 1850, 3,000 to 4,000 hand looms.	—
at 1,200	Hand looms 2,000 to 2,200. Power looms, 800 to 900. 200 looms are em- ployed in Scotland and 120 in Falls- worth in weaving Macclesfield goods.	Not 1,000	200 to 300.	—
merly plain and rured garment ods, vestings, mbrellas, silk ockings, parasols, ilvets, damaska to now with imitance; garment ods excepted.	Ladies ties for the neck, saracnets, Persians, bandan- nos, swivel shawls, president swivels, scarves plain and figured, handker- chiefs plain and figured, piece goods. Swivel trade now gone to Scotland.	30 years ago, plain and black gros graines; now figured goods.	In 1850, plain and figured broad silks and black gros graines.	Lace, hosiery, and taffeted silk pieces for gloves.
	A temporary pros- perity accrued to Macclesfield during the period of the Franco-German war (1870-2) in conse- quence of the stoppage of impor- tation of manufac- tured goods from the Continent. The best normal develop- ment of the trade occurred from 1841 to 1851.		1850	The last few years.
100	About 5,000 silk weavers and about 10,000 others engaged in silk in 1841-51.		Probably 5,000, 3,000 to 4,000 of these were silk weavers.	—
arly 4,000			About 400	—

SUBJECTS.	CONGLETON.	COVENTRY.	DEBBY.	LEEK.
9. Number of throwing mills, best period, and now.	1839, 40 silk throwsters in Congleton district. Now 12; about three-fourths of their machinery employed.	1840. Four large silk throwing mills besides several small establishments using hand machinery. Now two partly employed.	At best period, 23; all good firms. Now nine, three of them small firms.	One now, and one best period.
10. Number of dyers employed at the best period.	- - - - -	In 1840, there were four large firms, but the quantity of silk dyed in 1860-4, and during the late French and German war, must have been the greatest.	120 workpeople	Not known
11. Numbers of dyers employed now.	None	- - - - -	120 workpeople, chiefly employed on silk sent to be dyed from other towns.	300 to 400
12. Relative number of cottage hand-looms as compared with factory hand-looms now.	No cottage weaving	- - - - -	- - - - -	There are about factory hand-looms now, and very few cottage looms.
13. Cause of factory hand-loom weaving superseding cottage hand-loom weaving.	- - - - -	Altered construction of looms.	Centralization of weaving.	The decay of the serice and velvet trade; commencement power-loom and ware trade.
14. Number of silk power-looms at work now.	About 170	Not more than one-third of the number at work in 1860.	None for silk only. 315 elastic web-looms, making one-fourth silk webs and three-fourths cotton and worsted.	About 300
15. Description of goods made by silk power-looms now.	Trimnings, mercenets, smallwares.	Plain and figured ribbons, bookmarks, waistbands, neckties, bracewebs, sashes, &c.	Elastic webs, and in one factory surgical stockings and bandages.	Galloons, ferris, blisings and webs.
16. Strikes in the cottage loom days.	Strikes began in 1863 and have broken out periodically three or four times since.	- - - - -	None	- - - - -
17. Strikes under factory system.	- - - - -	- - - - -	Five	- - - - -

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LONDON (including Spitalfields)	MACCLESFIELD.	MANCHESTER.	MIDDLETON.	NOTTINGHAM.
- - -	35 throwing mills in 1851 and 33 at present. The throwing mills of 1841-51 were much larger than the present, many of which compared with the former are mere rooms, and can scarcely be called throwing mills proper because many of the proprietors are both throwsters and manufacturers.	At best perked six or eight, now only one.	Never any silk throwing in Middleton.	Five at the present time, which is the most prosperous.
at 3,000 work- people.	About 700 workpeople. Employers, 16.	About 600 workpeople	250 workpeople. Most of the silk was thrown dyed in Macclesfield and Coventry.	—
workpeople	About 200 workpeople. Employers, 13.	None	Not more than 80 in silk.	150 workpeople.
- - -	1,500 to 1,800 cottage hand-loom and 400 to 500 factory hand-loom.	- - -	The silk weaving of Middleton has always been by hand-loom. No serious attempt was ever made to introduce power-loom or factory hand-loom weaving.	—
since the depression no apprentices have been taken by the weavers, and so there has been less reason for their working in cottages. A large number of looms suitable to the trade have been piled down. Manufacturers have built factories for those looms requiring great height ceiling and length building.	I. Want of convenience in cottages. II. Desire of manufacturers to have the weaving under their own supervision. III. The large loom rent of 4s. per week would also have some influence in inducing them to make the change.	- - -	No factory hand-loom or power-loom weaving.	No factory hand-loom weaving. The lace machines are all in large factories and are driven by steam power.
at 40; all in one story.	700 to 800	Probably 1,000	None	—
brella silks	Many of the goods formerly made here by the hand-loom.	- - -	No power looms	Lace, stockings, and tufted pieces for gloves.
text, page lii	Very few and of short duration. Home occupations less influenced by agitations from without.	- - -	One strike amongst weavers about 50 years ago. None of any moment since.	No strikes which have had any permanent effect on the trade.
text, page lii	Frequent and often prolonged. Board of Arbitration established in 1846 was in operation three years. No strike during that time. It became inoperative eventually through lack of legal power to enforce decisions.	- - -	No factory system	

SUBJECTS.	COGLETON.	COVENTRY.	DERBY.	LEEK.
18. Effects of strikes -	Trade driven to other place, notably to Middleton.	Ruinous, especially the great strike of 1860.	Bad. See text, page xiv.	- - -
19. Effects of the French Treaty of 1860 on the silk trade.	Ribbon trade left the town. Throwing trade gradually declined, particularly in Italian silks.	Bain to the trade -	Silk throwing much reduced in consequence of general decline of ribbon trade.	Injury to the act trade.
20. Duty before the French Treaty of 1860.	Ribbons, 12½ per cent.	Ribbons, 15 to 30 per cent.	About 15 per cent. -	- - -
21. Branches of the silk trade in which each centre is now chiefly engaged.	Silk spinning and throwing. One factory of broad silk weaving. The remainder chiefly trimmings and small wares.	Elastic webs, "mock gros grains," "faïles," "plush shades," "ottomans," "plaids," "brocade neckties," "dress fringes," "chenille" and other trimmings, "watered saabes," "birthday ribbons," &c., besides spun silk, mixed and fancy goods.	Silk throwing, elastic webs, surgical bandages, trimmings, hosiery, ribbons, galloons.	Sewing silks as twists, fringes as embroidery silks all kinds, button galloons, ferre bindings, web braids, serges, hair kerchiefs, mullie brocades, as damasks.
22. Branches of the silk trade in which each centre was chiefly engaged as its best period.	In 1860, mostly silk ribbons.	The manufactures mentioned in subject 21, except elastic webs, extend from 1870 to the present time.	Hosiery, broad silks, velvets, galloons, ribbons, sewing silks, twists, fringes, braids, braid and round laces, gimps, trimmings, cords, &c.	Same as 21 -
23. Firms now employed in the spinning of bourre or silk waste, that is, making schappe or spun silk.	Three - - -	None - - -	None - - -	One -
24. Time when schappe or spun silk spinning was introduced, if any.	Early part of this century.	None - - -	None - - -	In 1882 -
25. Competition in price.	Keen competition with Middleton prices.	Great competition -	Very much competition.	Extreme competition.
26. Silk centres competing most heavily with each English silk centre.	Middleton, Bedford, Leigh, Blackley, and Manchester. Also Continental towns.	Baile and St. Etienne	Those of the West of England and the Continent.	Leek has little or no competition in its staple trade, sewing silks, but in broad Germany and 8 Chamond, and 1 bindings German and Manchester compete with Leek strongly. In worst goods there is home and foreign competition.

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LONDON (including Spitalfields).	MACCLESFIELD.	MANCHESTER.	MIDDLETON.	NOTTINGHAM.
text, page lii	Considerable impetus given to the withdrawal of trade to the cheaper producing Continental centres and to Scotland. Always disastrous.	- - - -	- - - -	No strikes which have had any permanent effect on the trade.
in to many	Gradual reduction of Macclesfield production.	Silk trade practically died out.	Simply ruined the trade.	Beneficial, see text, page lii.
out 15 per cent.	15 per cent.	15 per cent.	15 per cent.	15 per cent. ad valorem on lace, and 1,440 francs per 100 kilogrammes on silk hosiery.
in and figured silk and velvet for furniture; scarves and ties, umbrellas, sunshades, chenille, and trimmings.	Handkerchiefs, handkerchiefs, bandannos, scarves, piece goods, a few awicels, neck collars for ladies, sarconets, gentlemen's mufflers and umbrells silks.	- - - -	- - - -	Lace, stockings, and tufted pieces for gloves.
me as now, including garment goods.	See reply to No. 5	Men's neckerchiefs, sarconets, dress stuffs, boys' and ladies' handkerchiefs.	Chiefly in mixed fabrics of silk and cotton, and a few looms on broad and narrow silk goods.	See 21. The most prosperous period has been the last few years.
me	One	None	None	One.
me	About 1840	None	None	About 12 years ago.
ry much competition, both with foreigners, and also among the manufacturers themselves.	Keen home competition and still keener foreign competition.	- - - -	Keen competition in galloons with the Germans, who are underselling this district.	Great competition in times of depressed trade.
utuals, Lyons, Cre- fold, and Milan.	Germany, Switzer- land, Italy, France, and Scotland.	Lyons and Crefeld	- - - -	Calais.

SUBJECTS.	CONGLETON.	COVENTRY.	DERBY.	LEEK.
27. Goods exported by each English silk centre to America and the Continent of Europe.	Not very much directly to either.	None now. The duty amounts to prohibition.	Nominal. Their duties prohibit such export.	Increase of American duties has put almost entire stop to the Leek export trade. The direct export trade is very small. There is trade done with the Colonies through the London, Glasgow, Manchester and Liverpool shipping houses.
28. How the artistic exigencies of the silk trade have kept pace with those of France and Switzerland.	Not at all	For some years past the French and Swiss have been in advance in artistic skill.	Not at all	Until recently the have been but few decorative fabrics produced in Leek.
29. Causes which have led to the decline of the silk trade.	Withdrawal of protection. The falling off in the throwing branch caused by the importation of thrown silks, duty free, from the cheap labour districts on the Continent.	I. Changes of fashion. II. Free imports of French and German goods. III. High duties imposed by other countries on our goods. IV. Cost of living, combined with heavier rates and taxes, as compared with France and Switzerland. V. Shorter working hours under the Factory Act. VI. Strikes and disputes between masters and work-people. VII. Want of education in the details of the various processes of manufacture.	Withdrawal of protection.	The Leek trade has been maintained to the present period, except that the newer manufacture of sewing silks from waste, has, on its cheapness, done Leek some temporary damage; but the superior strength of Leek silks is once again asserting itself.
30. Wages of winders, weavers, and dyers.	Winders 8s. per week Weavers 15s. to 20s. per week. No dyers.	Winders 6s. per week Weavers 8s. to 15s. per week. Dyers 12s. to 20s. per week.	Soft silk winders 8s. to 10s. per week. Raw silk winders 8s. to 9s. 6d. per week. Weavers 20s. to 40s. per week. Dyers 21s. to 25s. per week.	Dyers about 15s. per week. Cleaners 7s. 6d. to 9s. per week. Doubblers 10s. to 11s. per week. Spoolers 11s. to 12s. per week. Pickers 15s. per week Twisters 25s. " " Twisters' helpers 5s. to 6s. 6d. per week. Binding power loom weavers 10s. to 20s. per week. Hand loom broad silk weavers 10s. to 25s. per week. Men at spinning an throwing m/1s. 14s. to 18s. per week. Braid makers, about 20s. per week. Warpers about 14s. per week. Lace makers 7s. 6d. to 8s. 6d. per week.

LONDON (including Spitalfields).	MACCLESFIELD.	MANCHESTER.	MIDDLETON.	NOTTINGHAM.
<p>ny goods sent to America, also India and our Colonies, mostly for furniture purposes. Also a small quantity of the best goods for carves and ties are shipped.</p>	<p>Few goods to America, but a moderate business is done with the Continent of Europe.</p>	<p>Not many to America, but some firms have lately exported considerable quantities to Paris.</p>	<p>None at all</p>	<p>Large amount to both America and the Continent of Europe.</p>
<p>til quite recently, of at all.</p>	<p>Very insufficiently but improvement is taking place.</p>	<p>- - - -</p>	<p>- - - -</p>	<p>Very well.</p>
<p>Power-loom competition. Withdrawal of protection. Continental heavily weighted yarn. Want of skill in employers.</p>	<p>I. Changes of fashion. II. Free importations of French and German goods (especially black silks, veivets, and mixed goods). III. Duties imposed by other countries on our manufactures. IV. Cost of living and wages compared with Germany, Switzerland, and Italy. V. Want of technical education. VI. Superiority of Continental finishers in rendering silk goods attractive and mixed goods hard to distinguish from pure material. VII. The public taste for cheapness in preference to quality and durability. VIII. Strikes, occasioned sometimes by the unfairness of the employer, and at other times by the unreasonable demands of the Weavers' Union in times of prosperity.</p>	<p>I. The French Treaty II. The adulterated dyes introduced into England in 1860. III. Since 1860, Continental competition.</p>	<p>The French Treaty of 1860, coupled with the adulterated dyes introduced into England by the French manufacturers.</p>	<p>No decline, owing to the very large increase in the use of silk lace.</p>
<p>nders 10s. to 15s. per week. weavers 15s. to 50s. per week. ers 20s. to 55s. per week.</p>	<p>Raw silk winders 8s. 6d. to 10s. 6d. per week. Dyed silk winders about 11s. per week when at regular work. Weavers 13s. to 14s. per week the year round. Dyers about 20s. per week.</p>	<p>Winders 10s. to 12s. per week. Weavers 15s. to 18s. per week. Dyers 10s. to 20s. per week.</p>	<p>Winders about 12s. per week. Weavers about 15s. per week. Dyers about 10s. per week.</p>	<p>Winders in silk throwing mills 10s. to 12s. per week. Winders in lace factories 12s. to 15s. per week. Weavers of silk stockings 80s. per week. Lace makers 8l. to 4l. per week. Dyers 20s. per week.</p>

SOME FURTHER PARTICULARS OF THE PRINCIPAL SILK CENTRES, SUPPLEMENTARY TO THE FOREGOING TABULAR STATEMENT.

I.—*Congleton.*

The silk industry of Congleton commenced in 1752, when John Clayton, of Stockport, leased a piece of land from the corporation of Congleton for the term of 300 years, and erected thereon a mill, now called the Old Mill, and in 1754 took Nathaniel Pattison into partnership.

The population of Congleton was in—

1811	-	-	4,616
1821	-	-	6,405
1831	-	-	9,352
1881	-	-	11,111

It will be noticed that this shows only an increase of 1,759 in fifty years.

At the time of the introduction of the factory power-loom system of weaving, broad-loom weaving had died out, and hand-loom for weaving sarsnet (or more properly sarceenet) ribbons, and other kinds were then superseded by power-loom.

There are three firms in Congleton employed in the spinning of bourre or silk waste, and about half-a-dozen manufacturers of woven goods.

In 1821 there were 25 firms of silk throwsters in Congleton, and seven in the immediate neighbourhood; whilst in 1859 the number had grown to 40. At the present time there are but 12 throwing mills in Congleton, with, on an average, only about three-fourths of their machinery at work. The disused mills are now occupied with a new industry, that of fustian or cotton velveteen cutting.

Strikes began in Congleton in 1863, and have broken out periodically three or four times since, invariably terminating in favour of the employer. It is very difficult to give the approximate relationship of strikes in Congleton under the cottage-loom system as compared with the factory system. Congleton goods are not much exported directly to America or to the continent of Europe. They are, however, shipped as trimmings on hats and other goods to both markets, as well as to other parts. There is, unfortunately, no spirit in Congleton for the collective interest of the staple trade. The Congleton manufacturers have expressed to me their opinion that a great need in this, as in other silk centres, is a permanent museum such as that described as being desirable for Coventry, which see.

II.—*Coventry.*

The ribbon trade of Coventry has existed since the beginning of the eighteenth century, when it was introduced by a Mr. Bird, grandfather of William Wilberforce Bird, one of the representatives

of Coventry towards the close of that century. William Bird, silkman, was Mayor of Coventry in 1705. Thomas Bird, a silk manufacturer of Coventry, employing nearly 2,000 workpeople, died in January 1746.

According to Bradford's Survey, taken 1748-9, Coventry had at that period 2,066 houses, and 12,817 inhabitants. The population at later periods is given as follows by the national census :-

1801, 2,930 houses	-	16,049 inhabitants.
1811, 3,548 "	-	17,240 "
1821 - - -	-	21,242 "
1831 - - -	-	27,070 "
1841 - - -	-	31,004 "
1851 - - -	-	86,801 "
1861 - - -	-	41,638 "
1881 - - -	-	46,000 "

The descriptions of goods manufactured in Coventry down to 1824 were sarsnets, or more properly "sarcenets," satins, and "satin figured ribbons." 1830, sarsnets, satius, "satin figures," "clipt gauze figures," "lustrings," and brocades. 1840, "plain orientals" and "figured cotton and silk ribbons" 1850, "rich figured," "mixed figured," "heavy plains," "plain striped goods," "damask figures," brocades, &c. 1860, "bookmarkers," "frilling lace," "motto ribbons," "waist bands," "rich figured, elaborately designed, and coloured ribbons," "heavy orientals," narrow office tape, &c.

Present time, see Table, page xxxvi, subject No. 21.

The busiest period ever known in the Coventry silk trade was during the late Franco-German war, when every loom in Coventry and the district was well employed. More business was done then than at any time before or since.

The single hand loom was the first kind of loom in which ribbons were made; a very simple loom in which only one ribbon could be made at once. The next was a much larger loom, the chief difference consisting in the latter being capable of making four to sixteen ribbons at once; the lesser number mentioned being the broadest, and the higher number, the narrowest ribbons, so that a hand loom used in making four wide ribbons would be as long as one used in making sixteen narrow ones.

In 1823, there were five Jacquard looms in Coventry, whilst in 1832, the number had increased to 600. The first power loom factory in Coventry (Beck's) was burnt down by a mob in 1831. After this event another attempt was made to introduce power-loom weaving in factories by a company which succeeded, and from 1838 to 1858 power-loom weaving in factories was greatly developed. Since 1858 many manufacturers have come to the conclusion that in some respects the factory system is a mistake; the trade being constantly subjected to caprice and fashion which take away all certainty of regular employment; consequently a large factory filled with valuable machinery, when standing idle, saddles a

manufacturer with heavy loss. The factory system to some considerable extent has been abandoned, and the bulk of the ribbon weaving of Coventry and district is now done at the weavers' own houses; the looms in some cases belonging to the manufacturers, who charge hire for their use. Some of these looms are still worked by hand, where no steam power is available, but the greater part are worked by power in what is called the cottage factory, that is, a row of cottages with weavers' shops for looms on the top storey, with a steam-power shaft running through the whole of the shops, and the weavers living in the lower storeys of the same houses. There are also a few large factories containing looms worked chiefly by women and young people with a few men to manage.

The statistics of the looms of Coventry in 1860 are given in the table on page xxxii, subject No. 3. At that time many of the "à la bas" looms in weavers' houses were worked by steam power.

Since 1860 hand looms have quite gone out of use for ribbon making, and a great number of the "à la bas" looms and steam-power looms have been sold for one-tenth of their original cost, and broken up for firewood and other purposes. This great loss has been sustained in most part by the better class of weavers, who have generally invested the whole of their savings in new looms or in improving old ones. Many of the old single hand looms have of late been found to be useful in weaving ladies' dress fringes, and no doubt, if the fashion for fringes continues, this class of looms will be in great demand again. Since the year 1861 many ribbon weavers and a few manufacturers have left Coventry altogether, some having gone to America; others have found employment in different branches of weaving, such as dress-piece weaving, elastic web weaving, carriage trimmings and fringe trimmings, as well as cotton spinning, doubling and weaving. All these branches of manufacture have been introduced by the benevolent public and the inhabitants of the city generally, with the sole object of benefiting the weavers, whose sufferings from the decay of trade have for many years past been very great.

An impetus has of late been given to the trade in Coventry owing to the difficulties of manufacturing chenille and other trimmings having been gradually overcome, and London is now largely supplied with these goods by Coventry, which is successfully rivalling the goods made in Elberfeld and Barmen. I think Coventry is to be congratulated on this, and I have no doubt that similar skill applied to the staple trade would, before very long, enable it to compete with Basle and St. Etienne. Already proofs are not wanting of the successful attempt of Coventry to rival in its staple trade the merits of continental manufacturers. There are now looms of first class make, fully equal to any of the continental looms and capable of producing high class figured ribbons and scarves, as is well seen in the cleverly woven illustrations of racing, bicycling, coaching, boating, hunting, &c., produced there. Some of these looms carry two to six sets of shuttles.

There is a little silk throwing done in Coventry. It is said to have been introduced early in the eighteenth century.

With reference to the dyeing and finishing of silks in Coventry, the colour dyeing and finishing of organzine and tram silks is well maintained; the quality in some respects being equal to continental dyeing, but the dyeing and finishing of schappes is not equal to that done abroad. Little or no black dyeing is done here.

According to a statement made in the House of Commons in 1832, the quantity of silk dyed in Coventry was—

In 1824	-	-	-	413,693 lbs.
„ 1825	-	-	-	448,146 „
„ 1830	-	-	-	537,335 „
„ 1831	-	-	-	508,375 „

I am not able to give later particulars.

Strikes in the ribbon trade of Coventry have been the result of want of mutual confidence, and of a better understanding on the part both of manufacturers and of their workpeople, and also to their failing to see how closely bound up together were their mutual interests.

In 1816 a list of prices was agreed upon, but both manufacturers and weavers soon began to break through it; this led to a general strike in 1819. A new list was then drawn up and signed and published on August 17, 1819. This list not being strictly adhered to, brought on a general strike in 1822. This strike succeeded, and the list of 1819 was again established. In 1826 a new list was established, called the “medium list for the plain engine trade.” This was well observed until 1829, when the reduction of duties on foreign silk goods produced such a fierce competition between French and English ribbons that the new list was soon broken. This time the principal manufacturers gave their weavers notice that unless all manufacturers adhered to the list they also must reduce. This resulted in another general strike in 1831. Another strike occurred in 1834, and another in 1835.

Another general strike occurred after the passing of the French treaty in 1860, which lasted eight weeks, and of all the many strikes which have taken place in Coventry, this was the most ruinous. Its effects were so disastrous to the ribbon trade that it has never fully recovered from them. Since 1860 no list price for weaving has been strictly observed, and the Coventry weavers being only too glad to obtain work have helped to establish the elastic web branch which has in part migrated from Leicester and Derby, in consequence mainly of the high trades union lists for weaving elastic goods in these two towns.

The French treaty of 1860 is considered by many as being a one sided, short-sighted measure, as it regards all the silk trade. Many manufacturers and weavers allege it to be the cause of the ruin of the silk trade. Formerly Coventry sent a large quantity of ribbons to America, Canada, and Australia. This, being now

prevented by the import duties, constitutes a cause for the evils from which the trade is now suffering. Great efforts have been made by the manufacturers to uphold the position of Coventry in the market, but unequal competition has almost landed them in despair.

The superiority of the artistic skill of France and Switzerland over Coventry is owing to better technical education in those two countries. Manufacturers and especially workmen have much to learn in connection with many details of the trade, and until a regular system of technical education is established, Coventry will not be in a position successfully to compete with France and Switzerland in design and colouring.

At a public meeting of the citizens of Coventry on November 7th, 1883, convened by the mayor (A. S. Tomson, Esq.), in response to an influentially signed requisition to promote the erection of technical schools, the mayor admitted the above facts in the following words, "I have for many years been more and more
 " impressed with the necessity and importance of this subject
 " through being brought into contact with manufacturers, ware-
 " housemen, and weavers in the daily routine of my business, and
 " thereby know better than almost anyone what are the particular
 " and individual difficulties, requirements, and failings with which
 " they have to contend, and my frequent intercourse with buyers
 " has shown me with what competition they have to struggle. I
 " have seen something of what France and Germany are doing to
 " foster technical training, and am convinced that if we do not
 " follow their example we shall inevitably succumb to their superior
 " organization. I have a strong faith in the honesty, persever-
 " ance, ingenuity, and patience of the English artizan, but to put
 " him without technical training against the foreigner with
 " it, is like sending an army of brave soldiers furnished with the
 " old crossbows, against men of possibly inferior physique and
 " courage, but trained to war and armed with the most modern
 " pattern of rifle."

Mr. F. W. Franklin, at the same meeting, speaking as a ribbon manufacturer, said "he felt sure his fellow manufacturers would agree with him that Coventry had not attained such excellence in its productions as to leave no room for improvement."

Between 2,000*l.* and 3,000*l.* has been promised in aid of technical schools for Coventry.

A uniform system in the make and management of looms for the production of certain ribbons is also of the greatest importance. At present the weavers and manufacturers are left to exercise their own judgment upon very important points, and their judgment is very diversified. Technical education would furnish standard rules for the guidance of the whole trade.

After a period of 20 years the result of French competition is that, until very recently, originality in patterns was very little attempted; designs were in general mere copies from the French, or combinations from them.

Manufacturers being now more alive to the fact that great help is to be derived from technical education have discovered that the School of Art has a work to accomplish in that direction, and many of them have availed themselves of the principles taught, but believe that School of Art work needs developing by more substantial aid from Government, and that better guidance and more direct teaching in the application of art to the requirements of the ribbon trade are necessary.

To a great extent the ribbons made in Coventry for many years were simply plain orientals or satin stripes or other kinds of ribbon devoid of characteristic designs, but since then fashion has laid hold of feather, flower, lace, plush, and many other fancy articles. The ability to construct fancy or figured ribbons to harmonize with other articles in fashion, has greatly taxed the powers for designing, and consequently much interest has of late gathered round the School of Art.

Notwithstanding all this the greatest efforts have been made with a view to cheapen goods rather than to beautify them, owing to foreign price competition.

Coventry has nothing to fear from the competition of any silk centres, except those of Basle and St. Etienne, and the reason she is beaten by these two places in the manufacture of ribbons is the superior technical knowledge they possess, which is chiefly shown in the wise arrangement of their machinery, and the skill and artistic taste displayed in the selection of the quality of silk for certain manufactures, as also in the skilful arrangement of colours and designs.

Plain ribbons, however, constitute by far the bulk of the trade and the extremely low prices of Basle and St. Etienne have drawn off large orders which should have been placed in Coventry, and thus weakened her manufacturers. This has been more especially the case since the adoption of a protection tariff by the United States of America, where a duty was imposed of 60 per cent. on all ribbons from Europe. By this action the tide of continental competition was turned with greater intensity against the English market, and the difficulties of the Coventry manufacturers were greatly increased, still it has had a stimulating influence, so that to day better and cheaper goods are being turned out than ever before. With a less severe competition, such as the re-opening of the American market would bring about, coupled with a fashion for ribbons, the ribbon trade would revive, and gradually get a firmer footing on a sounder basis than ever before.

At the Paris Exhibition of 1878, St. Etienne made a most magnificent display of richly wrought and highly developed ribbons, sashes, &c., which, at that time Coventry was not in any position to emulate.

It would be most desirable to have in Coventry, Macclesfield, and the other silk centres, permanent museums exhibiting silk yarns and fabrics, plain and decorated, of all periods, but especially contemporary type specimens of the manufactures of silk of Europe, Asia, and America, showing their qualities and the prices

at which they can be and are produced in their various centres, year by year.

Such museums would, I think, have an influence in the better regulation of disputes between capital and labour, in showing to both what they had to compete against in workmanship and price.

III.—Derby.

The silk trade was introduced into Derby in 1717, by John Lombe (after a visit to Italy, where he learnt the manipulation). In 1718, he obtained a patent for throwing silk, for 14 years and died soon after. His successor could not get a renewal of the patent in 1832, but received the honour of knighthood instead, and a grant of 14,000*l.* as compensation; a model of the mill was ordered to be placed in the Tower of London.

Derby has been engaged from time to time in the following branches of the silk trade :—

Hosiery, broad silks, velvets, galloons, ribbons, sewing silks, twists, fringes, braids, braid and round laces, gimps, trimmings, cords, elastic webs, and recently surgical bandages and stockings.

At present there are 21 silk manufacturing firms in Derby :—

- 9 Throwsters.
- 8 Trimming makers.
- 7 Elastic web makers.
- 2 Boot tab makers.
- 1 Surgical bandage and stocking maker.

Some of these firms both throw silk and make elastic webs, and some throwsters also make trimmings. Hence there are only 21 manufacturing firms in all.

In 1838 there were 17 silk firms employing 3,000 workpeople.

In 1853 there were 36 silk firms employing 5,000 workpeople.

The 21 firms existing now employ 2,400 hands only, being a decrease of 2,600.

From 1844 to 1854 the weekly consumption of silk, in manufactures in Derby, was 12,500 lbs., including silk thrown in Derby and elsewhere.

The weekly consumption is now 1,200 lbs.

Other figures give the following weekly consumption in 1850, as for :—

Weaving	-	-	-	5,400 lbs.
Trimmings and laces	.	-	-	5,000 "
Hosiery	-	-	-	500 "
Sundries	-	-	-	200 "
			—	11,100

The effects of strikes in Derby have been unfortunate, and have caused employers not to work so much into stock, during depressions in trade, owing to the antagonistic feeling produced against their workpeople, thereby reducing wages in the end.

No statistics of the silk trade are kept in Derby; it can scarcely now be considered a silk town.

The effects of the French treaty were prejudicial to the interests of the Derby silk trade.

Within the last few years the Derby School of Art has made rapid strides, and at the present time is one of the most important in the kingdom. Perhaps owing to the absence of requirements for artistic decoration in the peculiar nature of the Derby silk trade, the School of Art teaching has not had much influence upon that trade, but should Derby again aspire to a position in the manufacture of decorative silk fabrics, there is no doubt that, with technical instruction, the utility of the School of Art in this respect would be as great as it seems to be at the present time in its influence on the excellent pottery now being produced there, which is quite a revival of the old Crown Derby ware, though not exactly confined to the lines of that type of work. There is also an excellent museum and free library in Derby, greatly due to the liberality of the late Sir M. Bass.

IV. Leek.

The staple trade of Leek differs from that of the other English silk towns; Leek being chiefly occupied with the manufacture of sewing silks.

The twisting of sewing silks, which originally migrated from Macclesfield to Leek, has since been confined to the latter, the manufacture of sewing silks having ceased in Macclesfield. There are still to be seen old "wheel-heads" formerly used in twisting in Macclesfield, which are at least from 100 to 150 years old. Some silk was sent from Leek to Macclesfield to be twisted, *i.e.*, made into sewings and twist as late as 1828.

The population of Leek at different periods may be stated to have been as follows:—

In the time of William the Conqueror	-	28
" " Henry VIII.	-	400 to 500
In 1801	-	3,700
" 1841	-	7,950
" 1851	-	9,069
" 1861	-	10,174
" 1871	-	11,331
" 1881	-	12,865
" 1884	-	14,000

In 1673 Leek was described as a poor town. In 1773, Dr. Johnson, whose father, Michael Johnson, was an apprentice in Leek in 1668-70, in the corner shop of the market-place end of Derby Street, in a letter to Mrs. Thrale, writes "I have seen " but one new place this journey, and that is Leek in the Moor-lands, an old church but a poor town."

Mr. Sleight, in his History of Leek, second edition, page 5, writes as follows:—"The earliest incidental allusion to the staple trade " of the place is in an entry in the churchwardens' accounts, dated

“ June 21st, 1686:—‘ Collected shen’ for the french Protestants,
 “ in the parish of Leeke, in ye county of Stafford, the sum of
 “ 6l 5s. George Roades, Vicar of Leek.’ It is, therefore, fairly
 “ assumable, that after the Revocation of the Edict of Nantes, by
 “ Louis Quatorze, on the 22nd October, 1685, these poor
 “ refugees, branching off from Coventry, introduced ribbon
 “ weaving and ferreting into Derby and Leek. Button making
 “ in silk, mohair, and twist, the use of which may be traced back
 “ at least 200 years, when, ‘ curiously wrought with the needle,
 “ ‘ buttons made a great figure in full trimmed suits,’ was its
 “ earliest initiation into the district. Mr. Condlyffe used to say
 “ that James Horton, a Coventry man who had served with the
 “ 87th Foot in America, was the first weaver of figured ribbons
 “ in Leek, for Mr. Thomas Sutton, circa 1800. Joseph Nyrom,
 “ a German, invented the singeing of silk buttons with charcoal,
 “ they having previously been burnt with a liquid spirit. An old
 “ man named Ball, who died some 70 years ago, was the first
 “ twister of sewings in the town, and carried on his operations in
 “ a shed, or ‘ shade,’ in a field now known as Ball’s field, behind
 “ the old church.”

One of the first kinds of manufactured silk made in Leek was a kind of narrow tape called “ ferrets,” a manufacture which still exists here, but now only to a very limited extent. This singular word was no doubt introduced by the French makers of the goods. It is derived from the word “ fleuret,” by the elision of the *l* and *u*, and means a coarse tape-like material of silk, or silk and cotton, or wool. There are only five or six ferret looms in Leek at the present time.

Hand made buttons of three-cord silk-twist mixed with mohair were also amongst the earliest manufactures of Leek. This trade still continues in Leek and the neighbouring villages, principally at Flash and on Biddulph Moor, notwithstanding the great trade in machine made metallic buttons in Birmingham, and those now so much worn, made from vegetable ivory.

A fabric called button cloth has long been made in Leek and the neighbourhood. The old button cloth looms were very small hand looms weaving only the cloth in very narrow strips. A loom of this kind, one of the earliest, is still to be seen at a house on Morridge.

It is thought that the first silk traders in Leek were pedlars, or those who made their goods and then travelled to sell them. Forty years ago, buttons were made with a kind of drab silk cloth, mounted on a mould, with a linen back, to which Mr. Joshua Brough was the first to give the name of florentine. The buttons made by the needle are sometimes richly decorated and patterned, and represent a very clever and tasteful form of embroidery. There are about 300 persons at present employed in button making in Leek and the villages near. They are paid by piece work, and earn from 4s. to 8s. per week.

The woven fabrics of Leek may be chiefly comprised under the term "small wares;" hand facings or linings for the cuffs of coats being amongst the number, galloons, sarsnets, handkerchiefs, bindings, or narrow goods for binding the edges of garments, &c., which are made of all silk, silk warp with cotton weft, and a good many are now made of all cotton. Ribbon weaving was a small branch of the Leek trade from the beginning of the present century, but it became extinct after the lapse of about fifty years.

There are about 500 binding looms in Leek, and about 30 serge looms at the present time.

In broad silks, Leek has long been noted for serges or silk cloth for lining coats, once a considerable trade, but since the introduction of a bright woollen material called Italian cloth and the discovery in France of the heavier methods of weighting boiled-off silk, the Leek trade has suffered so much from low price competition that it can now scarcely be called a branch of trade.

There is, however, no reason why it should not be resumed as far as the requirements of the country in silk serges are concerned, for it has been proved sufficiently that by weighting the silk as heavily as the French serges are weighted, they can be put into the market at a cheaper rate. The Leek serges were made of warp dyed 15 oz. to 16 oz. per lb., and of a so-called "imperial" shute, i.e., tram dyed in the gum and weighted to 24 oz. per lb. The French serges are chiefly of 22 oz. to 24 oz. warp, and 26 oz. to 28 oz. shute, both boiled-off before dyeing, thereby causing the back of the goods to have almost as much lustre as the front, a result which could not be obtained by using a tram dyed in gum. "Levantine" silks for dresses are also made, as well as handkerchiefs, unions, and coat sleeve linings.

Velvets were also made in Leek within the last 50 years.

At the best period of the serge trade in Leek, about 300 looms were employed, and these chiefly in purposely constructed rooms at the top of the weavers houses. A few looms may still be seen at work on both sides of King Street. Beautiful satins, brocades, damasks, and faille are also made in Leek.

The braids made at Leek are of three kinds:—

1. Those made of black silk were formerly the most important, but the quantity produced now is very limited, owing to the substitution of mohair for silk some years ago.

The Leek trade in silk braids was first introduced about 50 years ago. It has been seriously interfered with by similar goods made at St. Chamond heavily weighted, and thereby cheapened, underselling the Leek braids in the London market. This was before the process of heavily weighted blacks was known in England.

2. Mohair braids. There is a considerable trade in black mohair braids. Leek is likely to hold its own in these braids, as it has been found impracticable to weight wool, and the fabrication of braids can be carried on as cheaply at Leek as at St. Chamond or in Germany.

3. Coloured, broad, and narrow woollen braids for women's and children's trimmings. This is a comparatively recent branch, but has already proved a successful introduction, and it is gradually growing.

The method of making braids is by machine plaiting and not by weaving.

Braids are used chiefly by tailors for binding the edges of coats and vests, and for other similar use and decoration.

The introduction of the sewing machine in 1854 gave a considerable impulse to the Leek trade from the necessity that the silk should be made of greater length, with a greater absence of knots and of much better quality than before.

The silk having to be wound on spools for the sewing machine and packed in neat boxes, has caused the lesser branches of spool making, or bobbin turning as it is called, and of box making to be useful industries in the town.

The spooling of the silk, too, was a new department of manufacturing, rendered necessary by the exigencies of the sewing machine. It is an interesting and intelligent occupation for girls and women, who earn higher wages than the winders.

It is said that Leek may be accredited with the first application of sugar for weighting dyed silks. There is no doubt it was first applied by Mr. Richard Badnall, dyer of Leek, author of "A view of the silk trade, with remarks on the recent measures of Government in regard to that branch of manufacture," 1828.

With a solution of sugar, silk can have its weight augmented from 1 oz. to 3 oz. per lb. I am not quite sure that this method of weighting was not first used by the throwsters, as sugar is known to have been used for adulterating and loading gum silk for a very long time, and then the idea was afterwards applied to silk after the dyeing operations.

It is much resorted to for weighting coloured silks by dyers on the Continent, and though a very clumsy method, no substitute has been found so cheap and easy of application.

Bichloride of tin, having chemical affinity for silk fibre, bids fair to extinguish the use of sugar, which, from its hygrometric qualities, has a tendency to ruin the silk to which it is applied, if great care be not taken to regulate the quantity. There is not the slightest use or excuse for the application of sugar, except to cheapen the silk by about 15 to 20 per cent.

Leek has long been celebrated for a black dye of peculiar hue, called raven black, the principal feature of which is a remarkable tone of rich blueness, greatly resembling the bluest parts of the raven's feathers. It is dyed nowhere else in the world. No tinctorial matter is used in obtaining the blue tint, but it is the effect of purely chemical changes and treatment with tannic acid and iron salts. The water of Leek is remarkably suitable to the production of this genus of dye, and its peculiarity has always been ascribed to this cause. There is no doubt that the waters of this moorland neighbourhood are amongst the best dyeing waters in Europe,

rivalling those of St. Etienne, Lyons, Basle, and Crefeld, and that they have peculiar properties which have greatly helped to retain the monopoly which Leek has enjoyed of being the only sewing silk centre in England. Many efforts have been made from time to time in Derby, Macclesfield, and other places to produce the raven and other sewing silk dyes, but without success. Leek consequently does an important dyeing trade for every English silk centre, and even for the Continent, and this is not likely to be taken away from her.

There is very keen price competition in Leek, so much so that I think it is quite impossible for any rivals, if any should arise, to undersell Leek. There are no statistical data compiled from year to year, and I think it is a misfortune that the town has hitherto remained in ignorance of its collective energies. This must also be said of Macclesfield especially. I have had the greatest difficulty in obtaining information, and what I have described may not be very correct. Surely it is a reproach that such highly important matters are not attended to, and with the greatest care. It is high time that public attention was called to this matter, and that Government should insist that proper statistical returns be annually sent up from each locality.

It is to be regretted that Leek has not much direct export trade. A good quantity of sewings, twist, and braids was exported directly to the United States before the heavy protective duties were put on there.

The principal portion of silk exported now goes into the hands of the middle men of London, Manchester, Glasgow, and some other shipping centres.

It would be a great boon to Leek if she could sell her silk direct to the Colonies. There would be less need of weighting the silks, and better remuneration would ensue to the manufacturer by escaping the tax of the merchants' profits.

The present wages of the silk workers of Leek are :—

Cleaners 7s. 6d. to 9s. per week ; Doublers 10s. to 11s. per week ; Twisters, 25s. per week ; Spoolers 11s. to 12s. per week ; Pickers 15s. per week. See table, page xxxviii., subject No. 30, for wages in other branches.

The hours of working are 54 hours per week.

V.—London, including Spitalfields.

In 1629 the silk throwsters of London formed a body of sufficient importance to be incorporated under the style of Master, Wardens, Assistants, and Commonalty of Silk Throwsters.

In 1685 the revocation of the edict of Nantes compelled many thousands of persons to fly from France, and a large number of them, who had been engaged in the fabrication of silk, resorted to Spitalfields.

Improved machinery for throwing, copied from that in use at Piedmont, was introduced in 1718, but there are no throwing mills in London now.

At the best period of the silk trade of London (about 1825) many of the manufacturers, in order to keep pace with the demand, started looms and factories at Sudbury, Halstead, Braintree, &c. At this period the annual consumption of raw silk in London and Spitalfields was one and a half million pounds. It has gradually decreased since and is now 80,000 lb^s. Before the last 20 to 25 years, during which period the trade has been in so depressed a condition, there were constant struggles between manufacturers and operatives. During this period no strikes have taken place. Whenever strikes have occurred in London and Spitalfields, they have ended in a reduction in the weavers' wages, with the consequence of less careful weaving.

Efforts are being made to produce finer goods than ever before manufactured in England, and of the purest dyes, and there is hope that in course of time this will be recognised by the general public, and that they may be induced to patronise home productions in preference to foreign heavily weighted silks.

Great progress has of late been made in design and colouring, as also in the beauty and purity of the manufacture of goods for furniture purposes.

The following are the causes which have chiefly acted in bringing about the decline of the silk trade of London and Spitalfields :—

I. The great progress made some years ago in manufacturing lower class silks by power looms in Manchester and elsewhere, and the consequent reduction of wages of the hand-loom weavers, thereby driving many of the younger men from the trade.

II. The sudden removal of duties from foreign productions and the more recent introduction of goods made with *heavily* weighted dyes, destroying (for a time) the fashion for silk fabrics.

III. The absence of sound practical knowledge on the part of employers, and their inability to produce goods of the highest class, in which only hand looms can be employed.

IV. The fact that, until recently, most persons, who had for the previous 40 years been engaged in the trade, did not appear to recognise that silk manufacturing was a business requiring great taste, study, and experience.

VI.—*Macclesfield.*

I am not able to give so many particulars respecting the history of silk in Macclesfield. The first silk mill erected was for silk throwing, which was commenced here in 1756 by Mr. Charles Roe, although silk goods had been manufactured in Macclesfield for about a century before this.

A trade in the manufacture of buttons of mohair and silk twist was carried on here from the middle of the 17th century, but gradually died out by the end of the first quarter of the present century.

In the Corporation Records of 1698 persons are mentioned as being skilful in the trade of buttoning. In 1749 the chief trade of the town was the manufacture of buttons.

The weaving of Bandanas, silk handkerchiefs, shawls, &c. was introduced in 1780 and 1790.

In 1825 there were 5,325 looms and in 1829 3,000.

Population notes of the Township of Macclesfield:—

1786 -	7,000	1841 -	24,123
1801 -	8,743	1851 -	29,645
1811 -	12,299	1861 -	27,472
1821 -	17,746	1871 -	26,839
1831 -	23,129	1881 -	28,619

The population notes of the Borough of Macclesfield:—

1851 -	39,045	1871 -	35,571
1861 -	36,095	1881 -	37,620

There is only one firm employed in the spinning of "bourre" or silk waste at the present time. No statistics as to the silk trade in Macclesfield exist. In 1866 there was a general strike of the weavers in this town. There was no strike of importance for the next 14 years; but there have been several small strikes since 1879.

The School of Art was established in 1851. In 1863 the number of students was 107, of whom only 20 were directly connected with the staple industry namely:—

- 7 Designers.
- 1 Dyer.
- 6 Silk Manufacturers.
- 6 Silk Weavers.

20 Total.

In 1865 there were 93 students. Of those connected with the silk trade were:—

- 7 Designers.
- 1 Dyer.
- 1 Silk Manufacturer.
- 2 Silk Printers.
- 10 Silk Weavers.

21 Total.

The direct influence of school of art teaching in Macclesfield appears to have been very small, manufacturers preferring to get their so-called designs chiefly from Paris, and the students of the School of Art, as a rule, have had but very little chance of applying their knowledge and skill to the decoration and development of Macclesfield manufactures. There does not seem to have been any collective wish or courage to develop an English or Macclesfield style of work, and consequently, French types and patterns have been mostly preferred. Owing to the high level to which the Macclesfield School of Art has been

gradually raised of late, and that perhaps more especially by the ability and effort of the present master, students are not only doing excellent work, but are showing such capacity for designing as are attracting special notice by the judges at South Kensington. The manufacturers have begun to see the force of this excellence, and several of them have already availed themselves of the assistance of students who have passed through their own school. It is to be hoped that others will follow their example, and gradually cast aside the necessity they have felt for leaning upon French patterns and ideas.

An attempt has been made to establish a technical school, but for want of general support the project did not for some time seem very hopeful. Latterly, however, I am pleased to report, the local interest has much increased, and there is every prospect of the project being realized. The want of such an institution is nowhere greater than here.

VII.—*Manchester and Middleton.*

Other than the information given on pp. xxxiii., xxxv., xxxvii., and xxxix., with reference to the Manchester and Middleton silk trade, I have not been able to gather many facts of importance to this inquiry.

The decline of the silk industry in Manchester and in its immediate neighbourhood, comprising a considerable number of districts, has been very marked. Probably this part of the country suffered most directly and most speedily from the French treaty, and it is not a little singular that the chief advocates for the abolition of the duty on French goods were the silk manufacturers themselves of this large and important silk centre.

VIII.—*Nottingham.*

The principal consumption of silk in Nottingham is for the lace trade, for which Nottingham has become so justly celebrated.

The amount of silk used annually may be estimated at 400,000 lbs. to 500,000 lbs., including both thrown and spun silk. The same looms are employed for making sometimes silk and at other times cotton goods. The lace machines are all in large factories, and are driven by steam power.

Nottingham appears to have been an exception with regard to the bad effect on the silk trade of the French treaty of 1860. It possibly has derived benefit from it; but it must be understood that the silk products of Nottingham have been of such a nature as to command a demand for them abroad, and are of newer and later types than in the towns already described.

The School of Art at Nottingham being one of the very best in the kingdom, has had great influence on the success of the lace trade, producing designers of great merit who have been eagerly sought for, not only in Nottingham and in other parts of Great Britain, but also in France, Spain, and America. The drawings and designs by students of this school have been considered for many years past by the judges at South Kensington Museum to be of superior merit.

Besides this excellent School of Art having classes for designing, Nottingham possesses a good museum, and University College has a technical department in which is a large class studying the construction and use of the lace machine. A dyeing and bleaching laboratory is also about to be added under the superintendence Dr. Frank Clowes. In all these departments of work, and especially in the coming dyeing laboratory, silk comes into consideration.

For the information and statistics of the various silk centres, I have to express my indebtedness to several friends. I much regret that the Commissioners have ruled to omit mention of their names.

ON THE REELING, THROWING, DYEING, AND MANUFACTURING, HISTORY AND OPERATIONS.

The silk cocoon produced by the caterpillar of the *Bombyx mori*, or mulberry-fed silkworm, has first to be reeled in several threads or fibres together, according to the size or thickness required for the first marketable thread called raw silk. This operation is wholly effected in the silkworm producing countries, viz. France, Italy, Spain, Greece, Broussa or Brutia, Syria, the Levant, India, Persia, Tashkend, China, Japan, and some places of minor importance.

The breeding of silkworms and the reeling of their cocoons have been several times attempted in England and Scotland. In Ireland, also some Protestant refugees tried to rear silkworms at Inneshannon, but unsuccessfully. There is a field there still called the mulberry field.

All attempts to rear silkworms in this northern latitude, and to reel cocoons, have failed, as might have been foretold had those who attempted these industries considered that the silkworm can only be reared in climates where the mulberry tree is in leaf when the worms are hatched; and with regard to reeling the cocoons, the price of female labour is so very much lower in silk producing countries than here that it is not possible for reeling ever to pay. Besides this, there are other important reasons why the reeling of cocoons and the breeding of silkworms should be carried on in the same district.

After the operation of reeling, the silk produced, which, as I have stated, is termed raw silk, is put upon the market and passes into the hands of the throwster, whose trade is to fabricate it into organzine (warp), tram (weft), singles, or whatever form or thickness of thread may be required for the species of goods the manufacturers desire to make. This operation is termed "throwing," and the threads so formed are composed of two or more separate compound strands or threads, twisted or "thrown," cable-like, together, and having more or less twist or "throw" upon them.

Fifty years ago the throwing branch in England was a very considerable industry, and important silk-throwing factories were in full operation in Manchester, Macclesfield, Congleton, Derby,

Coventry and other places, as already shown in the table page xxxiv. Large quantities were also thrown for continental manufacturers.

Since then, there has been a great decrease in this important, though elementary branch of silk operations, and but little silk is now thrown for the foreigner.

Silk intended to be used for sewing purposes or for fringes belongs to a different class of manufacture to that for weaving, and is usually prepared from the raw silk by the manufacturer himself, and not by the throwster, and, unlike silk for woven fabrics, does not undergo much manufacturing operation after dyeing.

The two branches of throwing and manufacturing have been held in practice to be quite distinct from each other, each having its own separate interests to guard, unless, as is sometimes the case, the manufacturer throws his own silk from the raw.

At this intermediate state in the preparation of silk for woven fabrics, that is, the thrown silk, be it organzine, tram, or singles, &c., the dyeing and manufacturing operations commence.

The thrown silk is sent to the dyer by the manufacturer, who instructs him to dye it according to his requirements.

That in former times dyeing was held to be of importance, and that its interests and developments were carefully studied and fostered in England, may be safely inferred from the fact that the art had the protection of a guild. The Dyers' Company of London is an institution of much importance and wealth, although it has lost entirely that influence upon the industry which was its original object. At the present time much might be done by silk manufacturers to stimulate and encourage English silk dyers, great difficulty being experienced in keeping pace with the ever increasing changes and developments in the larger continental silk centres. Much of the decadence in the silk trade of this country is attributable to this cause.

On the Continent, the dyers as a class, and with but few exceptions, are men of acute intelligence and highly skilled in their art, and in chemical knowledge, besides being for the most part men of substance, to whom the expense of preparing for a costly development, which has been made necessary by its discovery, or by a change of fashion, is insignificant.

In looking to the future we must admit that the manufacturer will have to learn his trade from the rudiments, to the highest intricacies of his loom, and must be, like the French manufacturer, skilled in the manipulation of the material, and not a mere capitalist, but a thorough teacher of his workpeople; the dyer must be a man of liberal education, well grounded in the history and practice of his art, a well trained chemist, and able to personally conduct all and any of the complicated processes for which he is responsible, and which he must thoroughly understand. The finisher too, must throw his antiquated notions aside with his antiquated machinery, and, by knowledge of mechanics and chemistry, help to turn out the dyed and woven goods in that perfection of style and pleasing finish which distinguishes all continental silks. The only instrument to accomplish all these necessities at present available and at present discoverable is technical education. Technical

schools are needed, in which all these subjects must be taught side by side, and where the rising generation, about to enter the textile industries, can learn, study, and work, with a feeling of mutual inter-dependence.

In a technical school each student should be taught to feel that his efforts can be only perfected by the efforts of those learning the other branches, that it can be only by *combined* cultured intelligence that a fabric can be produced to be at once sound, well woven, well designed, well dyed, well finished, beautiful and durable. All this is accomplished in the silk centres abroad. In England the present generation is only about to witness its commencement.

Among the earliest dyehouses in England were one or more at Canterbury, established by the refugee Huguenots at the time when Archbishop Parker permitted the crypt of the Cathedral of that city to be used by them as a weavers' shed, and gave them the undercroft in the crypt for a chapel, which has been used by their descendants as such up to the present day.

Mr. Smiles relates* that an "important settlement of the Flemings was at Bow, where they established dye-works on a large scale. Before their time, white cloth of English manufacture was usually sent abroad to be dyed, after which it was re-imported and sold as Flemish cloth. The best known among the early dyers, were Peter de Croix and Dr. Kepler, the latter of whom established the first dye-work in England; and "cloth of 'Bow dye' soon became famous."

From that time the fewer and simpler dyestuffs were gradually superseded by others. Madder and weld saw themselves replaced by the tropical and sub-tropical wood dyes of the east and west, kermes by cochineal, woad by indigo, and then, in the course of time, indigo fell to Prussian blue, and later on the more noble dyes fell victims to the results of the splendid discoveries of our distinguished chemists whilst studying the derivatives of coal tar; the first to herald the change being Mr. Perkin, who made the discovery of mauve dye, for which a patent was obtained, numbered 1,984, and dated August, 1856. Magenta was next invented, then violets, reds, blues, yellows, browns, greys, in utter prodigality of outcome, whilst the quiet sober colours obtained from the older dyes became obscured and ignored by the brilliance of the stains of these artificial colouring matters. The madder industry has been almost completely destroyed by the discovery of the synthetical building up of its colouring matter, alizarine. The valuable indigo cultivation of India is similarly threatened by the discovery of artificial indigo.

Thus a constant change is going on, and cannot stop, demanding from the dyer an acquired intelligence only to be derived by well conducted scientific and technical education.

With such a training the dyer will be sure to stand well in the estimation of the intelligent and appreciative manufacturer, who will soon find that it will pay him better to pay more for his

* "Huguenots in England and Ireland."

work instead of less, and thus get a higher artistic and scientific value for what he pays. The silk dyer's business will then be worth following and the necessary investment of capital, which is scarcely the case in England at present.

THE WORSHIPFUL COMPANY OF DYERS, LONDON.

Continuing the subject of dyeing I cannot forbear remarking on the present anomalous position of the Dyers' Company, which by growth of time has become an anachronism, and has no relation whatever either to the art or trade of the modern dyer, nor is there a single member of this Company who is a dyer, or having any interest in this important industry. I think, at least, if it now shuts its doors to its own craft, it should, with its wealth, help on the cause it represents (in name only) by aiding the dyeing schools established and proposed. It would, however, be a great boon to the trade, if this company would endeavour to draw dyers to it and help them to study and guard the collective interests of their art, and afford its aid and protection to those engaged in the effort to be equal to the foreigner.

It is a misfortune to the art of dyeing that it has at present no society or guild for the promotion and discussion of its scientific and artistic interests, which in all its branches, must be confessed to be one of great importance, and never so much in need of collective nurture as in these present days of decorative effort. In England, much is the result of rule of thumb work, and the prizing of so-called secrets. It would be a great gain to English dyeing in both silk, cotton, wool, linen, jute, China grass, and any fibres used for textile work, if there were a society formed like the one recently commenced in Manchester by Dr. Roscoe and other collaborators, and called "The Society of Chemical Industry." Such a society would promote the meeting of dyers in the different tinctorial branches; would help to lessen the manifest evil of price competition, and would lead to the elucidation and development of many difficulties and to much progress.* There ought to be no secrets, but every development should be fully discussed and chronicled just as it is in chemical research. By this means we should get rid of the intolerance of men with supposed secrets, who often hamper and tyrannize. It would also lessen monopoly, we should be more likely to keep ourselves au courant with continental intelligence; and we should help to place the art of dyeing on a pedestal where it would not be so constantly suffering from foreign developments.

I have never yet known a secret long worth the holding; it is sure to be soon out, generally by temptations to treachery by rival dyers to the secret-holder's workmen; the potent bribe, or scandalous inducement to leave employment, doing its work effectually enough.

* Since writing this, a "Society of Dyers and Colourists" has been established at Bradford in connection with the extensive Technical College there, Henry Ripley, Esq., being its first President, and Prof. Sir H. E. Roscoe, F.R.S., giving the inaugural address on May 14, 1884.

Technical schools of dyeing, if rightly conducted, will themselves greatly remedy this evil, but there will still be needed the prolonged culture of dyers, beyond the youthful period of technical education, and a society, such as I have suggested, would cover the field of observation and research, and why should not the fine and historic old dyers' guild re-open its portals as well as its purse, to help on the national progress, and their own art.

There can be no rest and be thankful for a dyer, nor for one who practises any art where science plays so large a part, and I plead for collective development in the way I have suggested.

In these remarks my intention has been far from saying anything that can be construed to be unkind or cynical, for I feel deeply how great is the importance to the art and trade of dyeing of the good will, good offices, and cordial co-operation of the ancient Dyers' Company, at this happy juncture, in furthering the able efforts of the Royal Commission on Technical Instruction.



The arms of the Worshipful Company of Dyers are as shown by the accompanying engraving, and they are thus accurately described by Messrs. G. and C. Bishop, herald painters of Doctors' Commons:—

"Arms.—Sable, a chevron engrailed argent, between three bags of madder of the last, corded or.

"Crest.—On a wreath of the colours, three sprigs of the gaintree, erect vert, fructed gules.

"Supporters.—Two leopards rampant guardant, argent, spotted with various colours. Fire issuing from their ears and mouths proper, both ducally crowned, or.

"Motto.—Da Gloriam Deo."

The hall of the Dyers' Company is No. 10, Dowgate Hill, London, E.C.

The remark "three sprigs of the gaintree" is very singular, and it is not easy to certify accurately its origin. The term "grain," or more properly "ingrain," in dyeing refers to the insect red dye, at first and up to the year 1523 obtained from the kermes or coccus quercus, an insect which feeds on the oak in the Corea, Levant, Algeria, and other Mediterranean countries.

After the discovery of South America in 1500 another insect was found in Mexico by the Spaniards in 1518, feeding on the cactus plant, and was called, from that circumstance, coccus cacti, and familiarly cochineal. The dye obtained from the powdered bodies of the insect soon superseded the kermes, owing to its richer colouring properties. It was introduced into Europe soon afterwards, and in 1523 orders were given for its extended cultivation.

The "gaintree" of the Dyers' crest is perhaps intended to represent the holly tree, and its red berries may have been considered as typical of the beautiful and permanent reds obtained from the so-called *grains* of kermes and cochineal.

The Company was incorporated by Henry VI., upon his restoration to the throne, February 16, 1471, and, therefore, shortly before his death, a few days after the battle of Tewksbury, May 4, 1471, but Mr. Watson, jr., son of the clerk of the Company, states his belief that the exact date of the first mention of Dyers as a corporate body in London was 1188.

I find in referring to the annual report to the Governors of the City and Guilds of London Institute for the advancement of Technical Education for the present year, that the Dyers' Company have contributed 250*l*. per annum for the years 1878-9, 80, 81, 82, and 83, making a total of 1,250*l*. in five years to the cause of technical education. Not knowing this, one might be tempted to ask for what purpose does such a Company exist, no longer representing the interests which it was founded to succour.

There is some hope for thinking there may have been a wise and hidden purpose in the husbanding of resources during the long period of almost fossil repose, so to speak, during which this Company has been divorced by no fault of its own, probably, from the interests of dyeing in London and the country, and we may trust that it may rise, Phœnix like, to help the collective efforts of a 19th century activity, in overtaking the more advanced state of continental dyeing.

ON THE WEIGHTING OF SILKS.

I now pass on to another branch of dyeing quite as important as the tinctorial part of it, a branch not understood, and of course not taught in the schools at present.

It is not a little singular that what is at present taught in all the schools of silk-dyeing, both here and abroad, would not enable any student to conduct a business that would pay. A factor is left out which is absolutely essential to the carrying on of dyeing as it is to-day practised on the Continent and in America. I mean the scientific operations of weighting silk with adventitious matter.

I do not wish to be misunderstood as an apologist, still less an advocate, for this lamentable weighting of silks, but it will be my duty to describe things as they have been, as they are, and as they are sure to continue, until commercial procedure is reformed.

There has been a great deal of nonsense talked about this question, and it is quite time that it was put upon its true basis, and facts and uses explained and left to speak for themselves.

For the English dyers I must say this, they are not fraudulent; they, from the necessity of their vocation, declare their dyes and their weighting upon each invoice, and they, in order to obtain a livelihood, are bound to do the bidding of the manufacturers. Whatever fraud there is, lies in selling this combined product as silk.

With regard to the weighting of silk in England in past and present times, I may say that I, as a dyer, never knew the time when silks were not weighted in some degree. This is but the experience of every English dyer for at least a century past. The

difference between English and continental weighting is in degree only, English silks having always been weighted to a much less extent than foreign ones. For weighting silk the following articles have been used for long times past. For black silks, the various astringent vegetable matters containing tannin, iron salts, etc.; for colours, some tannin matters, principally sumac, for example, and also sugar.

It is often said that English goods wear well because they are always of pure dye, and that French goods wear badly because they are of weighted dye. This is not wholly the truth, and explanation is needed. In the manufacture of English serges and other black broad silks, the dye which has been found to give satisfactory wearing qualities gives a weighting of 2 oz. to 4 oz. per lb. upon the boiled-off warp, and 4 oz. to 8 oz. per lb. upon the unboiled-off weft.

As is well known, silk contains a gum or varnish to the extent of about one-fourth of its weight. This has to be discharged with boiling soap solution for silk threads intended for the warp of a black dyed fabric. Each pound is thus reduced in weight to 12 oz. To this residue of 12 oz. it has been usual from time immemorial, with occasional exceptions, to add from 1 oz. to 4 oz. of weighting matter, to raise it up again as near to its original weight as has been found desirable by the manufacturer in shaping the price and quality of his goods. The weft or shute, being for the most part hidden or covered by the warp threads, did not of necessity require to be lustrous, and so another method of dyeing was and is resorted to. The silk is dyed upon the gum, in the unboiled-off state, *i.e.*, the gum is not discharged; silks so dyed absorb weighting matter easily and the usual proportion was from 4 oz. to 8 oz. of addition, thus making each pound of silk return from the dyer, weighing 20oz. to 24 oz., but in some cases, as for narrow goods, very much heavier. Such dyes are technically known as *souples*, *i.e.*, the weighting matter added being for the most part in combination with the external gum or "silk-gelatine," and not with the fibroin or silk proper.

Now it is a fact beyond dispute that black dyed silk, without weighting matter is not so permanent in colour as when weighting matter is used, and the reason is easily explained. A good black on silk, in fact the best black, is formed as in ink, by the union of an iron salt and tannic acid. Tannic acid has the property of uniting itself with the fibroin* or silk fibre and forming part of its substance, and by so joining itself adds its weight to that of the

* "When raw silk is heated in water under pressure it yields two compounds.

"Fibroin $C_{12}H_{22}N_4O_4$ constitutes about 66 per cent. of raw silk; it is a silky glistening substance which is insoluble in water, but dissolves in strong acids, alkalies, and a solution of cuprammonium sulphate. When boiled with dilute sulphuric acid it yields glycocoll, leucine, and tyrosine.

"Sericin or silk-gelatine $C_{12}H_{22}N_4O_4$ is a substance resembling gelatin. Its hot aqueous solution is precipitated by alcohol, and after drying, the precipitate forms a colourless powder, which, in cold water swells up to a gelatinous mass. On boiling it with dilute sulphuric acid, it yields a small quantity of leucine, and larger

silk. Blacks dyed without tannin are all more or less unstable. A good fast black, unweighted, and proof against light, acids, and alkalies, has yet to be discovered. Therefore, a pure and unweighted black cannot be recommended for any fabric where permanence of colour or durability of dye is wanted.

It will be interesting if I relate the origin of the important method which shortly afterwards enabled the continental dyers to augment so excessively the amount of weighting matter, beyond that which they had previously been able to add to the silk. This process is said to have come by accident, like many developments in this and other trades.

Until the year 1857, blacks could not be dyed on boiled-off silks a heavier weight than 16 oz. per lb. or "*poil pour poil*." At that time the blue which was the most fashionable and the most extensively used was, what was then termed, "Napoleon blue." It was a Prussian blue, formed in the usual method, by mordanting the silk with an iron salt, and then subjecting it to prussiate of potash, the result being, as is well known, a fine blue. Various refinements and developments of this process gradually appeared, the most important of which was that red prussiate of potash (ferricyanide of potassium) was substituted for the yellow prussiate of potash (ferrocyanide of potassium), and a solution of protochloride of tin added to the iron salt mordant bath. The result obtained, was a blue of more substantial tone and of more brilliant hue.

At a small dyehouse in Crefeld, in 1857, a hank or handful of silk, to be dyed black, came accidentally into the prussiate and tin bath, and on being passed into the dye-beck for black, it was found to possess more lustre and blueness of shade than the process then current for black could give, and was more bulky from fibre expansion and heavier. A new experiment when tried, confirmed the accidental result; the gain in weight was 2 oz. per lb. over the old process, and upon a boiled-off pound of silk, (*i.e.* 12 oz.) blacks began to be dyed up to 18 oz. This new black was soon found to be much more permanent than the old one. Further results followed as time went on, and this process has been so handled and developed,

quantities of tyrosine and serine, or amidoglyceric acid." Schorlemmer, "Chemistry of Carbon Compounds."

Mulder has given in the Poggendorff Annales, in 1886, two analyses of silk in the gum, as follows :—

	Soie écrue jaune napolitaine.	Soie écrue blanche du Levant.
Matière fibreuse, soie pure, fibroïne	53.87	54.4
Gélatine, matière azotée soluble de Roard	20.66	19.08
Albumine insoluble	24.48	25.47
Cire	1.39	1.11
Matière colorante	0.05	—
„ grasse et résineuse	0.10	0.80
Traces d'un acide et de quelques sels particuliers	—	—
	<u>100.00</u>	<u>100.00</u>

that dyers in both France and Germany have no difficulty now, by the use of tin, &c., in making their maximum weights up to 40 oz. per lb. on boiled-off silk, to 120 oz. per lb. in souples, and even to 150 oz. per lb. on spun silk.

There are two classes of goods, and always will be; those which must be durable, and those in which durability is of little or secondary importance; a hatband, for example, is not required to last longer than the hat on which it is placed, or a silken dress which is only required for a few occasions, perhaps only for one. There are also two descriptions of dye, and always have been. These are called by the French "bon teint," which are dyes intended to be permanent, and "petit teint," or dyes not required to be permanent. The former, being costly, would not be economical to use where the latter would answer the purpose required.

What is wrong, I fear, is that silks, weighted in the manner I have been describing, are sold as pure silk.

The difficulty would be obviated by a stringent law to compel each manufacturer, merchant, and draper to "declare" the material and extent of weighting when he stated the price, and this course seems to me to be the more necessary now that the French and Germans have become so skilful in loading their silks, and that very heavily weighted fabrics are made by them to look really better than the old-fashioned English ones.

I have a piece of so called black silk ribbon of French dye, the warp of which is weighted to 24 oz. per lb., that is, the net 12 oz. of silk made into 24 oz., and the shute weighted to the frightful extent of 100 oz. per lb., that is 1 lb. of silk made into 100 oz. This is scandalous, and no French silks should be allowed to be imported without the loading being declared, or the adulteration heavily taxed. It is high time this was done, and its effects would be to give the English manufacturer a chance.

The skill of the French in weighting their silks has been one of the chief causes of the decline of the English silk industry. They are at present producing weighted blacks vastly superior in appearance to the old fashioned English dyes, and yet considerably more than quadrupled in weight in the degree of loading.

I think this suggestion cannot be too stringently acted upon. It is necessary the public should know what it is they are buying, and this has become impossible as matters now stand in silk goods, because the art of *deception* has become a corollary with the scientific skill and development of *weighting*.

If the weighting matter were as apparent in the goods as cotton or wool when mixed with silk, the articles would declare themselves, and the reasons for the proportionate cheapness would be at once apparent; but the effort has been so successfully made to incorporate with the silk such excessive proportions of loading, that the weighting matter is no longer distinguishable from the silk itself, inasmuch as, as I have already said, it appears to exist not merely in contact with, but in actual combination with the silk fibre, and to partake of all the qualities which silk possesses, except

that of strength, for I should observe that the strength of the silk fibre decreases in proportion to the augmentation of weighting matter. Even the removal of the natural gum, or, as the French more properly term it, *grès*, of silk by boiling-off, decreases its strength, and to add to the boiled-off fibre any adventitious matter further augments this loss of strength.

The wife of a friend of mine lately bought a dress in London, a black silk faille, of French manufacture, for which she was charged 20s. per yard. In a month the fabric was completely disorganised or cut between sleeve and bodice, although it had only been worn a few times. This was simple robbery, for silk absolutely unweighted would not cost half as much. I examined the warp and weft of this fabric, and found the former to be weighted to 20 oz. per lb., and the latter to 32 oz. per lb. The actual cost of a silk fabric like this in every respect, amounts only to 5s. 4d. per yard, showing a total absolute profit, plunder we may more justly call it, in which the purchaser has had no share of the 14s. 8d. per yard which has been absorbed somewhere. In appearance the silk is everything that can be desired. This is but everyday experience. It would be easy for a chemical expert to analyse the dye of any silk fabric, and declare correctly the amount of weighting. Methods are given in an excellent work by Monsieur Jules Persoz, "Essai sur le Conditionnement, le Titrage et le Décreusage de la Soie." Besides, any chemist would soon devise his own methods, which, when compared with dyes of known purity or with known amounts of weighting, would be perfectly satisfactory. The latter is the plan I have for some years adopted, with excellent results.

It has now become a matter of daily necessity to examine silk threads and fabrics for the English manufacturer, who has to estimate for orders, against the low priced heavily weighted product of his opponents abroad. He cannot do so until he knows the per-centage of loading of the patterns sent to him by the merchant to estimate upon.

EXTENT TO WHICH THE WEIGHTING OF SILKS IS PRACTISED IN THE MAIN SILK CENTRES ON THE CONTINENT OF EUROPE:

As a sequel to the remarks I have made on the weighting or loading of silks, I have drawn up the following particulars from my own personal knowledge and observation of the staple industries in the main silk centres of Europe, and of the usual and maximum limits of weighting practised in them. These will give an idea how serious should be the consideration of the revival of the English silk trade, France sending 9,000,000*l.* worth of these silks into London annually, Crefeld in Germany alone 1,300,000*l.* to say nothing of the immense quantities imported from the several large centres in Switzerland.

I.—*Crefeld.*

1. Black velvets of silk and spun silk with cotton backs. The silk is chiefly weighted about 22 oz. per lb., some of it 24 oz., but seldom much more. The spun silk is weighted from 18 oz. to 24 oz., but some of it less than this.

2. Coloured silk velvets, generally unweighted, but manufacturers are beginning to use weighted colours, both silks and spun silks being now weighted from 20 oz. to 26 oz.

3. Umbrella silks. Warps weighted to 22 oz. and even to 26 oz., and wefts up to 36 oz. Principally greens and browns.

II.—*Elberfeld and Barmen.*

A good quantity of unweighted colours is used.

Blacks for passementerie, chenille, &c., are weighted to 32 oz., and to 40 oz. on boiled-off silk, that is, 12 oz. of pure silk is made to weigh 32 oz. and 40 oz., and a firmer and closer pile is the result on chenille, arising from the greatly expanded thread.

III.—*Basle.*

Trade chiefly in ribbons and also a quantity of spun sewing silk.

A good quantity of unweighted warp in ribbon colours is used, also some weighted up to 24 oz., and some even heavier in souples.

In blacks, warps for ribbons are weighted to 22 oz. and to 24 oz., and shutes by the souple method at least to 80 oz. per lb.

Sewing silks, black from 18 oz. to 24 oz.

IV.—*Zurich.*

In colours, silks for linings, gauzes, and satins, chiefly weighted but not heavily.

In black, satins and weighted handkerchiefs silks for Austria and other places.

Large exports of silks to America.

V.—*Lyon.*

A portion of the silk dyed into colours and white for dress purposes is dyed unweighted, but a large quantity is now being weighted, by the newer processes, variously to 18 oz., 20 oz., 22 oz., 24 oz., and even as high as 28 oz. per lb. In organzine, whilst coloured and white souplies are not unfrequently carried as high as 32 oz. per lb.

These white and coloured silks in all cases look as bright and rich as if unweighted.

Very large quantities of coloured silks are weighted to the extent of 2 oz. to 4 oz. per lb. on the nett or boiled-off silk, and also on souples, with either sugar or sumac as heretofore.

Cordonnet blacks for cheap shawl and dress fringes. Lyons is famous for the excessive weighting of these silks, which is done up to 800 per cent., that is, 16 ozs. of spun silk weighted to the incredible degree of 144 ozs. or 9 lbs. I have an example in my possession so augmented; this article is sold in London as silk at 2s. per lb. Very few of these silks are weighted to less than 200 per cent. The weighting matter for this adulterated commodity is chiefly a tannin extract from the chestnut tree, *castanea vesca*, the edible nut kind.

In organzine for the warp of black silk goods, an enumeration of which will be found in the Appendix to my Report, the weighting is frightful, from 18 oz. to 26 oz. on boiled-off silk, and for souples up to 90 oz. and 100 oz. per lb. The weighting of the boiled-off black silks is chiefly done with the proto and persalts of iron, and the proto and persalts of tin, and with catechu and extract of chestnut as the chief tannin agents.

VI.—*St. Chamond, Loire,*

Braids are extensively made here of soft and souple black dyes.

The principal black dyers of Lyons have branch establishments here, where they send their souples to be dyed into very heavily weighted blacks on account of the remarkable purity of the water of this chiefly volcanic district. I have several times examined the water, and find it to contain not more than 1 to 2 grains of lime and magnesia salts per gallon. The rainfall descends on rocks of the primary formation, which appear to be practically insoluble in rain water.

The very remarkable black souple dyeing done here is the envy of every other silk centre in Europe. The brilliancy, suppleness, strength, blueness of shade, expansion of thread, and extent of weight are unequalled, and consequently a very large dyeing trade is done at St. Chamond with nearly all the other silk centres. I have seen blacks of 100 oz. per lb., so fine in appearance, as to deceive the best judges, better looking in fact than the average of English or German dyes of one-third their weight.

ON WEIGHTED SILKS.

From the foregoing list of continental weighted silk yarns of all kinds, and from the enormous quantities used on the Continent, of which so large a portion when manufactured unfortunately finds its way into England, to the all but destruction of the English silk trade, it must be a conviction, I think, to the Commission that anything short of a thorough teaching of the art of weighting silk, "black art" though we may call it, must fall

very far short of what ought to be the curriculum of a well ordered technical school of dyeing. I state this with much regret.

As in these regenerate days nearly all the science of dyeing, and much of the art of it, has been relegated to the manufacturer of the cheaper artificial colouring matters, derived mainly from coal-tar; the older and better methods of dyeing having disappeared, commercially speaking; the dyer of colours is left more or less simply as a stainer of fibres coloured with products, in the scientific production of which he has had no share.

The scientific energies, therefore, of dyers have been chiefly diverted to the production of silken fibre, incorporated to the greatest possible extent with various chemical and vegetable matters, and in which I do not believe that the fibre any longer remains as silk, but may be compared to such a combination or product as the skins of animals, after having been converted into leather by tannic acid.

In dealing with this portion of the subject, it will be for chemists to consider how far the fibre of silk, which is wholly composed, when divested of its gum or *grès*, of fibroin, can be consistently considered the same thing when it is found, as I shall be able to prove it to be, in absolute combination with many times its own weight of iron, lead, tin, tannic acid, or other loading and tinctorial matter. In my opinion, silk thus treated loses its identity, and becomes a new compound substance.

For a number of years past minute investigations have been made by chemists and dyers respecting the curious absorption by fibroin of the basic salts of iron, solutions of the basic persulphates of iron, especially, having been found to attach themselves to silken fibre with avidity and stability. The same may be said of the salts of tin, particularly the persalt, Sn. Cl₄, which is being now very much used on the Continent, not as a mordant, but to give weight. It combines with the silk very much in the same way, (so far as I have been able to discover,) as the persulphates of iron, leaving a stable compound, apparently as indestructible as the original silk, the compound being capable of being dyed with remarkable regularity and brilliancy. In Lyons, silks are now being weighted by its aid to the extent of 44 oz. per lb., that is, 12 oz. of boiled-off silk or fibroin being augmented to 44 oz. When the gum or *grès* is undischarged from the silk, both gum and silk enter into combination with this substance still more freely, and it is, therefore, becoming much used for weighting coloured souples for the web or shute of goods.

This weighting matter is chiefly employed for colours. Colours and white of all possible shades can very easily be imparted to this compound of silk and tin, and this method is becoming extensively used in Lyons. Thus, weighting, which was until recently thought to apply only to black silks, and from which coloured silks were comparatively free, is now cheapening and

deteriorating the latter in pretty much the same ratio as the former. Thus the proto and persalts of iron, as well as the proto and persalts of tin, including also a large variety of tannin compounds, extracted from such sources as galls, myrabolams, sumac, divi-divi, chestnut, valonia, the acacias (areca catechu and acacia catechu from India), from which are obtained cutch and gambier, &c., are no longer used solely as mordants or tinctorial matters, but mainly to serve the object of converting the silk into a greatly expanded fibre, consisting of a conglomeration of more or less of these substances. A fibre, weighted to 24 oz. per lb. in black dye, occupies a bulk, that is an increased thickness of thread, of about one and a half times its original bulk, whilst silk weighted up to 32 oz. per lb., becomes twice as thick, and so on, until on arriving at the weight of 96 oz. per lb. one pound of silk combined with weighting materials is made to cover, in cloth, a surface of about six times as great as could have been done by the original pound of silk. However much the desirability of this may be questioned, the economy or cheapening cannot be doubted, for, supposing a pound of silk costs 20s., six pounds would cost 6l., whereas the dyeing of a 96 oz. silk costs only 13s. 6d. per lb., or the silk and dyeing combined 33s. 6d., being a saving of 72 per cent.

I have often heard it insisted upon by purely scientific men, as well as by manufacturers, that it is absolutely necessary for a dyer to be a good chemist. I have always thought so, but I am sorry to say the dyer's chemistry is almost wholly needed now-a-days for the weighting of silk, not for the dyeing of it. Nothing is more difficult than to weight silk to the same extent the French do. The tinctorial part, since the introduction of aniline dyes, is easy in comparison.

There is no hope for the silk trade of this country unless the dyers are in constant personal business relations with their clients, mutually helping each other in the production of those perfections and clevernesses of technical detail for which both continental manufacturers and dyers are at present celebrated.

For what is of absolute necessity, as I have said before, is not cheap dyeing but good dyeing, and although there are some dyers in France and Germany who are acting with such determined hostility to the English dyeing interest, these very men at the present time are obtaining much higher prices from their own clientele at home, as I have frequently proved in my continental travels, and by their own continental printed lists of prices. Good dyeing can only be executed on a considerable scale, and by a staff of masters, foremen, and workmen of gradually growing skill and experience, and it goes without saying, that it would take many years for an English dyer, were he to begin *de nova* to attain the results of his foreign rival.

If manufacturers had developed, or cared for understanding the niceties of their art as much as the English silk dyers have

done theirs, since the French treaty, we should not have had to deplore the loss of the silk trade.

The improvements which have taken place in English dyeing have, all along the line, been in advance of the English manufacturing requirements, and there are now important developments in the English dyehouses languishing because of the want of manufacturers to utilise them. I have no doubt that this predilection for foreign dyeing has been really to obtain the greatest increment of loading; on this rock, the foreigner is beginning to split, and for this cause his goods are beginning to be held in but poor repute.

I am inclined to think that if the silk industry is to be re-won, it will not be by capital, but by young men, well trained technically, and taught to love artistic work for its own sake, as distinct from modern fortunemongering, capable of performing all the manipulations to the most minute item of the operations to which they especially devote themselves, being themselves capable teachers and not dependent on superior or more accurate knowledge in persons employed by them, except perhaps the greater facility in handicraft operations, which a workman from habit and from constant employment of his hands must necessarily have. To a great body of young men so working and being content to raise themselves from small beginnings, I believe there is a great future. Then English silks will be preferred again as they were in similar history of past success.

If the million will have very cheap silken or silky looking stuffs, they must have the weighted article, and it is a point well worth considering, beyond purist lines, that, if that cheapened weighted article will wear as long as is desired, there is economy in not spending more money on it than is necessary, but I repeat that what I consider is urgently wanted, is to make it penal for such stuffs to be sold as other than what they are.

What I have been so fully and frankly stating I know will not be approved of by some English manufacturers, and by continental manufacturers generally. It is their object to guard and keep secret all these falsifications, which are but very little known outside the technical outforts of their silk industries. Neither the merchant nor the draper, far less the consumer, have any conception of the extent of the weighting practised, and I hope this exposition may be thought, and found to be, a gain to purity of commerce and righteous dealing.

From a long acquaintance with the principal silk manufacturers of England, I know they are thoroughly averse to the principle and practice of weighting silks, and would hail with delight any prospect of the silk trade being turned into a healthier channel; but as long as low-priced foreign goods are placed before the country in the principal warehouses and shops of our large towns, so surely are they bound hand and foot to follow in the steps of the degradations of continental producers. If, under a lucky star,

the nature of the goods could but be "declared," I think people would shun the false and prefer the true.

THE "SPUN SILK" OR "SCHAPPE" INDUSTRY.

In later times, and after the chief decline of the English silk trade, has sprung up a new and extensive silk industry, namely, the manufacture of silk yarns and cloths from the waste or refuse parts of every branch of the silk manufacture proper. In the earliest operations and processes with silk, waste is made. In reeling the cocoons in those countries where the silkworm is bred, there is much silk that cannot be reeled or wound, for example, the outer threads of each cocoon as well as some portions of the inside fibres. There is, besides, an enormous number of cocoons from which the worm is allowed to emerge for breeding purposes and such cocoons, by being pierced at the end from which the worm, now a moth, has emerged, have their threads so displaced as to prevent the silk being reeled or wound off in the usual manner.

There is also the per-centage of waste in all subsequent operations; in throwing, with its various processes of winding, twisting, and cleaning; in winding after dyeing, and in warping and weaving. All this so-called waste or refuse is carefully collected and saved, and finds its value in quite another market. By the application of machinery similar in principle to that employed in the manufacture of woollen and cotton threads, the silk waste is carded, or torn into staples or broken lengths of several inches, and then spun into threads or yarn in the spinning machines or mills. Although this waste product has not nearly so much value as the reeled thread, it finds by its cheapness an ever increasing use and market. This industry is enormous, and at this time in England is far more important in quantity than the trade in silk proper.

Immense quantities of spun silk are used for woven fabrics, fringes, and sewing silks, and Leek, so famous for its strong and bright sewing silks has had its monopoly shaken by the improvements effected by the spun silk spinning machinery.

This industry has centred itself naturally enough in the cotton and wool spinning and machinery producing districts of Lancashire and Yorkshire. At Rochdale are large spun silk plush weaving operations. At Brighouse, Halifax, and the surrounding neighbourhood, are extensive spinning mills, culminating at Bradford, where are the gigantic spun silk mills of Mr. Liester, where a great variety of threads and fabrics are manufactured in successful imitative appearance of real or reeled silk goods. Spun silk spinning has been very successfully introduced into Congleton, and it is being tried at Leek. I am informed that, at the extensive works at Saltaire, founded by the late Sir Titus Salt, arrangements are being made for the commencement of spinning, and of weaving velvets and plushes, and other spun silk

fabrics, made from the silk waste I have been describing. This branch of the silk trade is ever on the increase. Goods made of spun silk are frequently sold as pure silk, and they, in my opinion, ought, as I have been suggesting with reference to weighted silks, to have their true nature "declared." Large quantities of spun silk are produced in Switzerland, where, in the valleys, great water-power to drive the mills is easily obtainable. France and Alsace also contribute largely to the production.

On looking at the imports of silk, a cursory enquirer may be easily misled into thinking that the silk trade proper of England is in a flourishing state; such is not the case, the quantity being so much swelled by the machine-carded and spun-waste silks, which I have been describing.

These silks, although they may be economical to use and meet with so extended a consumption, are not to be compared with fabrics of silk, reeled directly from the cocoon; they possess neither the same lustre, strength, nor beauty, and they cannot be held in any way to be the same products.

TUSSUR AND OTHER WILD SILKS.

In the East, and more especially in India, besides the ordinary silk of commerce, the product of *Bombyx mori*, there are many species of silkworms, which feed upon other food than the mulberry leaf, the most important being the Tussur and Eria worms.

For information respecting these, and the other wild silkworms, I refer the reader to my South Kensington Museum Handbook to the Collection of the Wild Silks of India, in which will be found a full description of all that is known of, and deduced from them, up to the present time.

These wild silks have a great and important future before them, particularly the silk of the *Antherdea mylitta* or Tussur worm, which has, since the Paris Exhibition of 1878, come into great demand (the silk of this worm is known also under the names of Tussur, Tussah, Tussore, and Tasar); that of the *Attacus ricini*, a worm that feeds on the castor oil plant, and produces a cocoon that cannot be reeled commercially, but is admirably adapted for carding and spinning; and the Muga silk, secreted by the worm known as *Antherdea Assama*, a silk which can be reeled and promises to be most useful, as soon as it is cultivated in large quantities.

Some years ago, at the suggestion of Sir George Birdwood, C.S.I., the Government of India requested me to undertake some researches on the reeling, dyeing, and utilization of Tussur silk. These results are before the world in a wonderfully increased industry, an account of which will be found in my work already adverted to. There is every promise of a very large trade with India; it is increasing every day, and only needs that the natives of India should be encouraged to attend to the collection of this

silk, for any quantity that could be produced would instantly find a market. The Eria silk has also an important future before it, and attention is now being directed to it in Assam, where the Eria worm abounds.

Every stage of the wild silk development and progress from the moths to the finished fabrics in considerable variety of make and dye, may be seen in the Wild silks collection, India section of the South Kensington Museum, and in referring to this collection it would be wrong to omit mention of the great interest taken in, and successful encouragement given to me in my lengthy researches by the Director of the Museum, Sir Philip Cunliffe-Owen, K.C.M.G., C.B., C.I.E., to whose energy much is due in the outcome of this now important industry.

The developments in the wild silks of India are also illustrated by the collection in the Industrial Museum of Lyons, presented by the Government of India to the Lyons Chamber of Commerce, which the Chamber has done me the honour to exhibit very conspicuously, and to name the "Wardle Collection."

In these collections are exhibited all my developments and discoveries up to the present time, including the remarkable improvements in reeling the cocoons of Tussur silk, by experiments which I personally conducted in Italy, at the request of the Government of India; results which are worthy the serious attention of all silk manufacturers, dyers, and printers. The bleaching of this dark coloured silk, and the subsequent dyeing and printing of it in almost any shade of colour, as also the utilizations of it afterwards for a large variety of fabrics are also shown.

SILK PRINTING.

Besides the various branches of silk dyeing which have long been established in London, Coventry, Manchester, Middleton, and neighbourhood, Macclesfield, and Leek, there have been also silk printing works of considerable extent for sometime past in and near London, chiefly in Kent, at Langley, near Macclesfield, Leek, and Glasgow.

These works have been mainly occupied in printing Bandanna handkerchiefs and silk cloths for the Rangoon and Indian markets, also for the home and export trade, and the silks so printed are mostly in Anglo-Indian styles, superseding, yet not as artistic as the old-fashioned Indian printed handkerchiefs.

The Leek printworks, carried on by myself, in conjunction with silk dyeing, are occupied in artistic printing for furniture-work and dress, on silk, tussur silk, wool, cotton, and linen.

There is not much silk piece dyeing in England except upon spun silk plushes and velvets, and this trade is chiefly confined to Lancashire and Yorkshire, together with Leek. The silk plush, so much used now, is all made of waste or spun silk.

SILK FINISHING.

No branch of the silk industry has, on the whole, received less attention in England than this very important one. Whatever of improvement has taken place has been effected by two or three finishers, and rather late in the day.

Silk finishing in Germany, Switzerland, and France, is in a high state of perfection, and great attention is being constantly paid to it. For the first time, I believe, in the history of technical education, the authorities at Crefeld have begun lately to teach finishing as a distinct branch of their technical training. Finishing, then, is no longer a secret, it may be learned, as it is there taught, systematically, with properly constructed machinery for tuition, and under a qualified teacher of finishing. This is as it should be, and no technical school in England will be complete without this branch being taught, and I strongly recommend the idea to the Commission. There are some who say, the creation of an appearance of perfection and finish on fabrics is not necessary, or is bad in art; but I suppose it is not useless to contend that one of the objects of technical schools is to win back our trade from the foreigner, and to produce goods as acceptable and as pleasing to the buyer as are those of our successful rivals, and I am sure, without the finish of continental goods, artificial in many respects though it be, we have but little hope of holding any ground against them.

In velvets and plushes, an elaborate finishing or dressing machine, stiffening and lustreing matter in paste and solution, which have to be applied to both back and front, or as it is called on the Continent, *apprêtissage*, is of absolute necessity, because the pile having to stand erect and at right angles to the fabric, it must go through several elaborate operations for this purpose, in order to remove the crumpled and flattened state of the pile caused by the dyeing operations.

The composition of these *apprêt* mixtures has received great attention, especially in Germany, taxing the most cultured and scientific skill, and exceedingly interesting results are obtained in some Crefeld finishing houses, and, as may be seen from such periodicals as my friend Dr. Reimann's *Färber Zeitung*, the Belgian *Teinturier Pratique*, the French *Moniteur de la Teinture*, and several other like publications, much literary matter, and many processes have been given to the public on this important subject. It would be a good opening for a young man to be sent by his father to the technical school at Crefeld, to make silk finishing his chief study.

THE FRENCH TREATY OF 1860.

There is now no practical good to be obtained by any discussion as to the wisdom or short-sightedness of the French Treaty of 1860; the mischief having been done and the untold misery

endured. It would, I think, have been wiser at the time to have considered this question on its own merits, apart from other questions relating to the French treaty, and perhaps to have removed the duty gradually. But, however that may be, one thing is certain, that, as soon as the French had the opportunity of sending in their goods, duty free, the scales fell from the eyes of the English manufacturer, who saw that he was undoubtedly beaten on his merits all over the field. The young manufacturer, whose father had made his fortune in the better times of protection, who probably thought there was no necessity for renewed exertion on his part, found himself unequal to, and consequently beaten in, the match with his more skilful and more thoroughly grounded continental *confrère*. This also was the case with the dyer, whose occupation speedily went with the fall of the manufacturing industry.

Another thing is equally clear, that to have continued the duty upon silks would have only tended to prolong or perpetuate the ignorance of the English manufacturer. Nothing now remains but to attain to the excellence, in all minutia, which characterises the work of our foreign rivals, never so perfect in all its details as now.

If the English people will give encouragement to the wearing of English silks, whether they choose to buy the cheaper weighted goods or the more expensive pure ones, and also if by some means, such as I have suggested, or any better ones, they can be assured of the exact composition of the article they are buying, there is a sure and certain hope, with the aid of our art schools and a well applied technical education, of the resuscitation and recovery of the manufacturing of English silks at any rate for the English people.

STRIKES.

No one doubts that combinations of workmen for the protection of their own interests have had good results, in securing to them a fairer share of remuneration than they could obtain without combinations. They prove the wisdom, in that respect, of collective action. Nevertheless, it is equally undoubted that disputes, being allowed to degenerate into strikes, have often facilitated the ever encroaching invasion of the foreigner, as well as paralysed industries, and in some instances have driven them wholly or partially away, into other districts or countries.

In the historical account already given of the silk industry, something may be gathered as to the effect of strikes in the several silk centres of England, and I need not further dilate upon them. Whatever advantages the artizans may have obtained during protection have been pretty well neutralized since, for foreign competition has withdrawn so large a proportion of the silk industry, that weavers have, on the whole, been only too glad to obtain work with but little dispute as to its terms of payment.

Employers are in no better position. A few thoughts on the present state of affairs seem to me to be worth stating in this place and at this juncture. That strikes and lock-outs are great evils are admitted. Cannot they be avoided in the effort at a revival of the silk trade? I think so. The chief obstacles to any such revival are the keenness of foreign competition and the cheapness of production, as well as the excellence of continental goods; or where there is not real excellence, the excellence of finish or appearance, *i.e.*, saleability. The English trades' unions should, I think, use all legitimate influence in helping to secure for workpeople all over the Continent, better wages and shorter hours of work. It is no uncommon thing in Belgium and Germany to see mills lit up between the hours of 8 and 10, or even 11, at night. Wages, although gradually rising in northern and central Europe, are wretchedly low across the Alps. The women silkworkers in Piedmont do not earn much more than 6*d.* per day, and some earn even less than that.

The weavers in the neighbourhood of Como are miserably paid, yet they produce beautiful goods, and with them undersell England in the world's markets. Even Lyons is beginning to confess that she feels this low priced Italian labour-competition keenly.

Let working men's associations have for their aim an international brotherhood as well as a national one. Already there is some ray of hope in that direction. Last year, at a Paris Congress, Mr. Broadhurst spoke strongly on the need of this; and I remember speaking to him on this subject two years ago in the House of Commons.

The general feeling of manufacturers in this country is not only not adverse to a bettering of the artizan's condition, but many are anxious that it should be bettered, their hands, however, are tied by the selling price of more cheaply produced continental goods. For Englishmen to compete, in the market, all the conditions must be equal, in these days of quick and cheap international transit, and it is not until the social condition of artizans is bettered all round, that strikes in the silk trade can be justified in any but exceptional cases. I do not think that those who guide trades' unions have taken care to make their bodies sufficiently informed of the costs of production on the Continent. I think, if they were so informed, they would better see the difficulties the manufacturer has to contend with, and would hesitate to place any bar against his effort to compete.

Until lately English dyers have been at great disadvantage compared with the foreigner, owing to difference in wages and length of working days. But changes have been in operation which have made matters much more even. There is not now much difference between the English, German, and French wages of dyers. At Lyons the wages are about 4 francs per day, the better *ouvriers* earning 4 *fos*. 50 *c.* In Germany, the average wages are 1 thaler a day, or 3*s.*, with a tendency to advance.

The working hours of dyers in Lyons are from six in the morning to five at night, with only one hour's intermission from 10 to 11 for their breakfast-dinner.

In Germany the hours are from 6 a.m. to 7 p.m., with two hours intermission for meals, but in neither country do the workmen enjoy the privilege of shorter work-hours on Saturdays. A like effect, will, we hope soon produce adjustments and greater international equalization in the manufacturing branches of the silk trade; it seems to me to be the province of the labour organizations of this country to help to raise their continental *confrères* to the same advantages they themselves are now enjoying.

As a help to this end, I propose (adverting only to the silk industry), that trades' organizations should encourage the display in all museums, of fabrics, showing not only the quality, design, and colouring, but also every branch of detail as respects prices paid, and all costs of production.

This, while helping to steady the action of English trades' unions, would stimulate the operations and aspirations of similar bodies on the Continent. To my enquiries in our English silk centres as to the advisability of this course, it will be seen from the table how almost unanimously favourable the replies were. I had only one exception, an exception which I confess surprised me, in the case of the last year's secretary of the Macclesfield Chamber of Commerce, the present chairman of the Weavers' Association.

With regard to the prevention of strikes, the establishment in France of boards of so-called prudhommes, in which the opposing interests are fairly represented, has been found very beneficial.

In Germany, masters and workmen have power to refer their disputes for legal decision, and I know of a most important case, affecting a large number of weavers, which was decided adversely to a firm of manufacturers in Germany last year, when a dispute had arisen about the adoption of a uniform yard measure. The hearing of the case lasted many months, and both plaintiffs and defendants were obliged to wait until the decision had been authoritatively pronounced by the legal tribunal. Could not something of this kind be adopted in England, and the decisions of some such tribunal be legally binding, at least for a time.

With regard to the cost of transit, our English railway companies, knowing well that small freights between towns placed near to each other, are not so profitable as long runs, have given the foreigners great advantages by granting special rates for long distances.

For example, the Midland Railway Company for some time past have arranged that silks, sent to be dyed from Derby, Leicester, and other places, may be delivered the following day, *viâ* Queenborough and Flushing, at the dyehouses of the Rhine Provinces, at 4s. 9d. per cwt., whilst I find that silks sent to me to be dyed from Derby frequently take three or four days in transit, being

very seldom delivered in two days (unless sent by passenger train at impracticable cost), the cost being 1s. 9d. per cwt. From Coventry the rate is 2s. 10d. per cwt., and the time occupied is most haphazard and irregular; silk never being delivered earlier than the third day, and often not until the fifth. In order to keep any hold upon our trade in these towns it has become necessary to send goods by passenger trains at rates interfering seriously with profit—in fact making profit impossible against the low prices of the Germans. This seems most unfair, and if any English spirit is possessed by boards of railway directors, they ought to hesitate before so far playing into the hands of the foreigner.

The desire for novelty and frequent change of fashion has developed a power or faculty amongst continental producers of rapidly changing from one style or fashion to another, and even from one material to another. This power is regularly in operation now in anticipating and providing for a change in each forthcoming season, so that by the time, and often before it, the continental producer has some development ready for the next season, even whilst he is providing for the requirements of the present one; consequently he is always ahead, and we invariably have to follow his lead, and generally being too long in following.

With regard to the question of cottage hand loom versus factory hand loom work, it seems to me to be pretty well proven that the former is the most economic method, and that the manufacturers not only became a weaker power by the change to the factory system, but were likely to suffer much more seriously when the demand for their goods became slack. Having large investments in mills and machinery, they were not so free as in the more primitive state; the weavers, by combining against them, could leave their machinery idle and seriously damage their interests in that and other ways, which they could not do when they held the machinery in their own cottages. In Scotland, where Macclesfield work is now being made, there are no strikes and no weavers' unions. Supply and demand regulate the prices, and a combined action would not help them. They flourish without combination, but it is at the expense of the Macclesfield weaver, who, with his narrowly conducted union, starves under the arbitrary and illusory power he thinks he wields, but I am willing to admit that this is no argument against workmen and combinations, it is proof only of shortsightedness. It must show positive unwisdom so to tighten the reins as to drive their trade elsewhere; their combined action is too local, it does not reach where it is most wanted, and so they kill the goose that lays the golden egg. This argument is still stronger with regard to foreign competition, if the workpeople in all the silk manufacturing districts were all internationally of the same mind, there would be no difficulty, and this is the end most desirable to attain, and I commend it to the serious consideration of all trade union management.

DECORATIVE OR PATTERN EMBELLISHMENT.

When a good pattern has once been designed it is always a good pattern, and, in my opinion, may and should be used and copied for all time, just as a good dyeing process is used and copied, but it should not be distorted or re-arranged, for it is as much the product of a man's thought and work as a poem or a piece of music.

The English people are as capable of producing original work as the people of any other nation. But I think originality is not quite a proper word to apply to decorative, or pattern, designing. There can scarcely be said to be true originality in this, because in all pattern designing up to the present time there are evident delineations of the forms of nature, conventional or otherwise, or of the forms of antecedent designing (which have originated from the forms of nature), some designers being influenced by classic, some by Gothic, some by Eastern forms, and most often by later French developments.

A good designer must necessarily develop his forms from previous work which he has studied, and the more he has studied ancient forms, the more successful and genuine will be his work, or as some would say the more original, or seasoned with originality.

In all the designs to which it would be most readily accorded that they partake of originality, the influences of earlier designing may be easily detected, and often actual copying of the treatment of the leading types and forms, both as respects the designing and the colouring.

I think it far better simply to copy old and good forms, than to accept at once the unskilled and ignorant productions now so generally presented to us in most wall papers and designs for dress and furniture coverings. The designing and production of good forms will only become right in time, and in proportion to the practice of right motives in life and art. At present, price competition, the wish of the public to have a thing, before all, cheap and the desire of the producer to make money, which, as a rule, is his primary one, make a thoughtful design impossible of production, because the parts in it which are the most artistic and valuable are the most costly, and have to be struck out to make way for those which, under the above-mentioned conditions, are alone practicable.

It seems absolutely necessary that technical education should be brought to our homes, that is, to the spot where it is wanted, and that the teachers' efforts, all round, should be to develop the forces and faculties in the locality in which they may be placed, so as to raise the tone and style of all the arts and trades of that locality.

MUSEUMS.

A museum is, in my opinion, a most necessary appanage and corollary to a technical as well as to an art school. It should contain the best examples of all the industrial work of that kind in which the locality is engaged, arranged chronologically, as well as technically described. It ought adequately to show both the the outcome of its own locality, historically, as well as the outcome of all that has been done in the other localities of the world, which have been or are engaged in similar work.

Take silk weaving, for example: Every conceivable form of textile in any and all materials, from the most barbarous to the most refined, should be available, as well as all the developments of decorative form and colouring which are likely to teach or to warn the student; the bad, to this end, being kept separate from all that is intended to influence and raise the student; the faults of each being adequately described.

There should also be drawings and casts from sculptured ornament, old wrought-iron work, and drawings of it, details of old English wood carving, especially that of domestic work, found in such great profusion and variety on old beds, chests, settles, chairs, cabinets, &c., &c. I do not think any ornament so suitable as this to develope a true English style; wherever possible, examples of the panels themselves should be exhibited.

There ought also to be a more liberal distribution of loan objects from South Kensington, lent for a year and then changed; for by this means the general taste of localities would be unconsciously elevated, apart from the results of the teaching by objects of a more special and technical nature. I think pictures should be freely circulated, perhaps not the most valuable ones, but such as would represent types, styles, individualities, and the best examples of colouring. I have the less objection in suggesting this in consequence of the delight which has been felt whenever a loan collection has come down from South Kensington; the pictures being always the most appreciated, and also from the fact of the facility and all but absolute safety of transit now-a-days. I believe there has never been any accident to paintings, in transit, since the commencement of the system of circulation of loan collections from South Kensington.

There would be a difficulty in supplying such collections all over the country, but I would strongly advocate the plan, recommended by Professor Ruskin, of copying the best pictures. This has been very successfully done by Mr. Ward, and suggestive examples may be seen in the Town Hall of Manchester and other places. Such copies can scarcely be distinguished from the originals. Turner's style of colouring has been beautifully and

accurately represented by this method, as well as those of other great masters.

I should like to lay special emphasis on what I consider a point of great importance, viz., the advantage gained by educating the taste of the people by circulating collections. A fixed collection soon becomes uninteresting. Nothing is generally more stupid than a local museum. It is simply a source of *ennui*, and but seldom visited after the first time. I could name a good many which are not worth visiting at all, and which do positive harm by their monotony and useless contents; chambers of horrors in fact and essence. I think it of immense importance that there should be not only inter-urban exchanges, at least annually, but also international exchanges. Complete typical collections should be centred in London, Edinburgh, and Dublin; but I would circulate all the rest, and even have smaller collections for the villages where really they are proportionally as much needed as in the small towns. And I think such interchanging museums or collections should have definite objects, and should not as is generally the case consist of an *olla podrida* or *pot à feu* of discordant elements, having no definite teaching or interest. These remarks scarcely apply to paintings which I would, notwithstanding their enormous art value, and consequent risk of being damaged, circulate with a liberal hand, excepting always the best examples of the greatest masters, which are of course too precious to be subjected to any risk whatever. I think nothing will tend to elevate the taste and tone of mankind more than the sight of good pictures, and I do not see why the populations of large centres should have such privileges all to themselves. I believe more in bringing art to the people than the people to art. I earnestly advocate that these museums and collections should be opened free to the public on the afternoons and evenings of Sundays, and in this advocacy I wish to avow my respect and reverence for the religious institutions of the Sabbath, which would be strengthened by the opening of places for the refinement and art education of the people.

The influence of travel on art training cannot be too highly estimated. Those students who are buried in the hearts of large towns should have their minds directed to the natural and common objects of the country. It ought to form a systematic part of their training, at once and continuously, to draw from simple nature, and not from the forced flowers and fruit grown in hothouses, which are always bloated and distorted; and more or less hideous in colour and form; this being especially the case with respect to colour.

I think it quite as necessary for an art master to take his students into the country, in order to teach them to observe nature correctly, and to sketch groups and details on the spot, as it is for the geological professor to train students in the field and on the mountain, or for the architectural student to study from ancient examples.

I think the efforts of school of art students generally are at present very poor and sickly, and that it is in a very great measure owing to this want. A vigorous and conventionalised form of ornament cannot be expected from students who have not been trained by lessons in the field and by travel to understand and to love natural objects.

Then again, the advanced art student should, if it were possible, have facilities for travel, both at home and on the Continent. This would help a young man immensely to become a good designer. If he could see, for example, how design and ornament have been treated in stone, with such common and incongruous materials as flint pebbles, as in the Norfolk and Suffolk late Gothic churches; and could contrast in the early English Gothic tracery, the outlines and foliage of our English cathedrals, with the greater freedom and flow of similar work in France, there would be more vigour and expansiveness in his work when he came to produce form for himself, and had to rely on his own powers.

The advantage throughout life of art travel to both designer and producer cannot, in my opinion, be overestimated. The magnificent collections of objects of art of all kinds in the splendid museums on the Continent, both technical and general, could not fail to stimulate and educate a man to development, and to work, and to warm whatever genius and energy he may be possessed of. I think localities ought to be rated for the purposes of museums, and assisted by grants in money and kind from South Kensington.

I have been very careful to ask the opinion of each silk centre as to the advisability or not of contemporary type specimens collections, such as I have mentioned in the chapter on Coventry on page xlv.

From all, with but one exception, I have received the invariable reply that it would be most desirable to see annually what the Continental silk centres were doing, both with regard to quality of goods, colouring, design, and prices. The only exception was from the Secretary of the Chamber of Commerce at Macclesfield, who was formerly, and has recently again become Secretary to the Weavers' Union. His answer was that he did not think such collections advisable, and he said, "They might be pleasing to a few of the devotees of art, but I have the greatest doubts as to their practical value to the trade of the town."

TECHNICAL INSTRUCTION AT CREFELD.

At Crefeld the new technical schools and museum have been erected at the joint cost of the State and of the town; the former paying 55,000 marks (2,750*l.*), and the latter 30,000 marks, (1,500*l.*).

In the month of May I went to Crefeld to see the new technical school, commonly called the weaving school, and to obtain some more accurate and general information than my previous visits to this town had afforded me.

The school is now in full working order, and the museum is being proceeded with, and in course of arrangement. It promises to contain one of the most interesting collections of textiles in Europe.

There is one very large room completely filled with looms, one would say of all kinds and of all countries. There are many students at work in various parts of the room. Fabrics are being woven in cotton, silk, wool, linen, jute, and other materials and mixtures of these, both plain and patterned. Nothing appears to be wanting for teaching and training youthful hands in the art of weaving. I did hear a criticism out of doors, that, notwithstanding the large variety of looms that had been got together, there was still a want in this school at present, in that it did not contain such efficient weaving appliances as those to be found in several parts of France and Switzerland, where the economics of weaving are at the highest point, and the efficiency of *tissage* at its fullest development. If this is so, it only shows that something more is wanted than the ordinary rudiments of weaving, and that nothing short of the most economical training in loom products will be sufficient in these days of international competition.

It is scarcely in my province to say anything more with regard to weaving, and I will pass on to what I understand better, namely, that which relates to the dyeing and finishing of fabrics. I make no apology for venturing upon a short abstract of the prospectus of the dyeing and finishing part of this establishment.* The teaching of this department refers to dyeing, bleaching, printing, and finishing; dyeing and printing both in the skein and in the piece. There is also a laboratory attached to the dyehouse in which all tinctorial and weighting substances are examined as well as the materials for finishing. Both hand-printing and machine-printing form part of the programme. Dr. Lange and his assistant are regularly lecturing on organic and inorganic chemistry in their applications to dyeing and printing.

The dyeing instructor, or, as he is called, *Färbermeister*, is Mr. Lewitzky, whose acquaintance I had the pleasure of making. He told me that his instruction consisted in everything relative to dyeing, and, what I particularly wanted to ascertain, and am glad to be able to report upon, that the weighting of silks formed a definite part of the instruction given, and that, whereas in the case of ordinary tinctorial teaching small samples, such as skeins, are used, in the teaching of weighting silk, not less than a pound of silk is taken for each experiment with the various tannin and metallic substances at this establishment.

This is, I believe, the first attempt on record to teach, with the authority of the State and at an important silk centre, the imparting to the silk fibre of adventitious matter, increasing at once its bulk and its weight, and this I think gives me ample justification in saying

* Prospect der mit der Königlichen Webeschule verbundenen Färberei- und Appreturschule zu Crefeld. Crefeld, Buchdruckerei von Kramer & Baum.

what I have said, in other parts of this report, as to the economies in the production of silk fabrics, although, I repeat, I am no advocate for either weighting silk for its own sake, or for any other object than that of securing cheapness, and obtaining as a result a material which will wear as long as it is intended or desired to wear.

There are two terms in the year, the fees for which are, for a Crefelder 100 marks (5*l.*) per term, for Germans outside Crefeld, 150 marks (7*l.* 10*s.*) per term, for a foreigner 250 marks (12*l.* 10*s.*) per term. This seems a heavy tax on the parents of foreign students, nevertheless I found a fair proportion of foreigners there, chiefly English. The students have to pay something in addition for the use of the more costly metallic and glass apparatus and chemicals, amounting to about 30 marks (1*l.* 10*s.*) extra.

The laboratory is open daily from eight in the morning until twelve, and from two until six in the afternoon, but is closed on Saturday afternoons.

On leaving the institution each student receives a certificate.

The title of the institution is "Königlichen Webe-, Färberei- und Appreturschule." The director, a most intelligent and energetic gentleman, is Mr. Emil Lembcke.

I give a few additional details from the syllabus of instruction, which may prove of interest:—

Mineralogy, electricity and magnetism, mechanics, optics, analysis both qualitative and quantitative, are taught as well as a wide range of chemical re-actions. The teaching of spinning includes the proving of the twist, proving by burning, proving by oil, and destructive proof; the strength of the fibre, the tension of fibres. The examination of all kinds of tinctorial matter, organic and inorganic, is proceeded with as well as the examination and estimation of tannin in astringent vegetable matters, and the study of the nature and use of mordants.

Practical instructions are also given in the dyehouse and in the finishing house, by the chemical professor and the dyeing instructor conjointly. This a great advantage, and a new idea, and constitutes a sensible combination of theory and practice.

In the finishing department, or, as it is termed, *Appreturschule*, instruction is given with regard to albumen, starch, dextrine, gums, and all substances used in the softening or stiffening and finishing of cloth fabrics, and those used in printing.

Prominence is given to the examination and thorough analysis of water—another most important item for the would-be dyer or printer.

The clauses relating to the instruction in the dyehouse and the *Appreturschule* are so very suggestive and so very important, as well as new, that I feel I had better give them in their entirety, relating as they do to the different fibres, vegetable, animal, and insect, used in textile work:—

Practical Lessons in Dyeing and Finishing.

(Dyeing Master and Dr. Lange.)

Lectures on Finishing Machines and Methods.

(One hour weekly, by the finishing master, Hohlbaum.)

The course of instruction in cotton cloth consists of singeing, shearing, cleaning, washing, bleaching, wringing, drying, dyeing, printing, starching, stretching, mangling, calendering, damping, smoothing, gauffring, production of "Moire" effect, measuring, folding, pressing.

Linen cloth.—Instructions in washing, bleaching, wringing, drying, dyeing, printing, starching, stretching, calendering, folding, measuring, pressing.

Net cloth (*Streichgarngewebe*).—Roughening, washing, fulling, dyeing, stretching, drying, napping, shearing, beating, dressing, spongeing, brushing, pressing, shrinking, friezing.

Carded cotton cloth (*Kammgarngewebe*).—Folding, shearing, craping, steaming, boiling, singeing, dyeing, washing, sulphuring, blueing, stiffening, mangling, calendering, smoothing, brightening, drying, lustring, measuring, folding, pressing.

Half woollen cloth.—White cloths for dyeing and sulphuring, alpacas, mottles, satins, serge, cords, chinés, greys, &c.

Silk cloth.—Stretching, gumming, drying, cylindering, watering, gauffring, craping.

Prominence is given to the proper teaching of the use of machinery and apparatus. The importance of this to the would-be finisher cannot be over-rated. There is a good collection of the different kinds of finishing machinery.

One part of the instruction consists of the testing of receipts for dyeing, printing, and finishing. The advantage of this is obvious in enabling the student, after he has left the school, to appraise the value of any receipt which he may have presented to his notice, either by the numerous dyeing, printing, and finishing journals which now prevail on the Continent and in England, or from any other source.

The weaving of Crefeld, and the villages in the large surrounding neighbourhood, is done by piece-work.

The hand-loom weavers of satin earn 15s. to 18s. per week.

The weavers of velvet, both hand-loom and power-loom, earn from 20s. to 24s. per week.

The power-loom velvet costs about 2½d. per metre (39·37 inches) less than the hand-loom velvet, but the quality is not so good.

I was informed by an experienced manufacturer of hand-loom satins, that at present only low class satins can be produced on power-looms, and that they are chiefly made in Switzerland, but he thinks that in two or three years such improvements will be effected in power-looms, as to enable them to supersede hand-loom weaving. This will produce a great change in the silk

industry of the Rhine Provinces, if my informant's prophecy should prove true.

What an opening does not this suggest for the revival of the silk trade in England by power, for no nation can surpass the English in excellence of machinery. I do not say that it is a consummation devoutly to be wished, for I do not think it will bring relief to any class. The cheapened production will be just as liable to the rage of competition as hand-loom work is at present, and in the long run nobody will be better off. The tendency of the movement, unfortunately, is to lessen the excellence of production and deprive it of that care which consists of vigilance of eye and cleverness of hand.

In the village nearest to Crefeld there are about 6,000 hand-loom, all in cottages. The weavers, who live with the fields close by, are engaged in agricultural work when trade is slack, with gardening as an amusement. What a forcible argument is this against our mistaken policy of huddling our artizans in hand-loom factories and closely crowded streets.

The most effectual means of checking the large silk imports into this country, and of restoring our silk industry, would be for manufacturers to see to the more skilful making, dyeing, and finishing of goods. I feel sure there would be then no need of importing fustian cutting as now, to occupy our empty silk factories.

A large proportion of Swiss and German goods go to the United States of America, and although most of them are made with cotton backs, they have to pay the usual silk duty of 50 per cent.

COMPILATION OF STATISTICS OF THE SILK INDUSTRY.

It seems to me that a fitting close to this report may well be made in the form of an appendix, showing some of the statistics from the continental silk centres, from which will be seen the gigantic nature of their trade. I have only taken those of France and Crefeld, though it would not have been at all difficult to have obtained the Swiss and Italian details. Their appearance in this place may serve to show, by contrast, how little has been done in this direction in England. It is with the greatest difficulty I have been able to obtain even the most superficial details connected with the history of each silk centre. In Macclesfield especially, with a Chamber of Commerce, composed chiefly of gentlemen connected with the silk trade, there does not seem ever to have been any care taken to compile the details of the outcome of their industry. Whatever may have been the cause of this, whether intention or negligence, I think it is a deplorable mistake. If anyone will peruse the "Essai sur le Commerce de la Soie en France, par Albert Rondot, Lyon, 1883," and the annual "Jahres Bericht der Handels-Kammer zu Crefeld," published by the Chamber of Commerce of that enterprising town, he will see the most minute attention paid to

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the publication of every statistical detail connected with their industries. We may well infer that it must be of the highest importance to the collective industry of any place that statistical records of the annual progress should not be neglected. I fear the position of our silk centres is, and has been this, that caring nothing for the collective welfare of the silk industry, they have illustrated the moral of *Æsop's* fable of the unbound bundle of sticks. Whatever may be the force and keenness of local competition, if the health of the whole body is not attended to, it is certain that the interests of the individual members of it must suffer.

APPENDIX I.

SILK, RAW.

STATEMENT showing the QUANTITY and VALUE of SILK, RAW, IMPORTED into the UNITED KINGDOM from the under-mentioned Countries, in each of the Years 1874 to 1883, inclusive.

YEARS.	FRANCE.		ITALY.		CHINA.		JAPAN.		BRITISH INDIA.		OTHER COUNTRIES.		TOTAL.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1874	Lbs. 2,222,225	£ 2,092,157	Lbs. 24,050	£ 29,439	Lbs. 2,664,704	£ 1,996,303	Lbs. 20,699	£ 17,404	Lbs. 588,745	£ 466,870	Lbs. 899,880	£ 364,163	Lbs. 5,911,831	£ 4,966,325
1875	326,197	377,755	41,624	52,505	3,464,957	2,409,310	251,207	199,659	278,363	203,706	136,429	149,887	4,487,637	3,443,729
1876	242,703	267,022	24,552	32,641	4,984,800	4,736,462	483,053	432,234	150,233	120,121	176,684	183,871	6,016,927	5,770,341
1877	599,222	602,004	36	36	3,177,092	3,134,977	448,541	473,085	139,386	129,646	109,804	112,037	4,441,691	4,459,045
1878	274,871	275,808	20,971	24,968	3,314,981	2,851,312	346,463	318,113	140,831	129,921	61,899	80,300	4,170,006	3,690,117
1879	295,903	304,071	30,813	39,220	3,142,109	2,672,075	240,406	207,540	135,777	100,699	41,594	61,500	3,886,422	3,384,995
1880	81,361	79,416	36,643	46,100	3,168,935	2,963,850	246,326	204,202	105,006	81,236	44,073	55,792	3,675,946	3,130,666
1881	60,326	57,064	40,646	40,571	2,325,540	1,931,818	291,096	251,925	68,654	45,505	128,946	130,228	2,904,580	2,466,051
1882	267,668	235,278	10,732	23,438	2,528,695	635,933	338,779	287,387	44,549	36,361	179,796	173,665	3,577,119	2,792,069
*1883	Not yet distinguished.		Not yet distinguished.		2,258,417	1,768,448	321,914	290,073	164,034	77,060	501,167	474,202	3,184,182	2,879,783

* The figures for this year have been taken from the Monthly Accounts relating to Trade and Navigation of the United Kingdom.

Commercial Department, Board of Trade,
April 19th, 1884.

SILK INDUSTRY.

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APPENDIX J.—continued.

SILK KNUBS OR HUSKS OF SILK.

STATEMENT showing the QUANTITY and VALUE of SILK KNUBS, or HUSKS of SILK and WASTE IMPORTED into the UNITED KINGDOM from the under-mentioned Countries in each of the Years from 1874 to 1883, inclusive.

YEARS.	FRANCE.		ITALY.		CHINA.		JAPAN.		BRITISH INDIA.		OTHER COUNTRIES.		TOTAL.		
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
1874	Cwts.	£	Cwts.	£	Cwts.	£	Cwts.	£	Cwts.	£	Cwts.	£	Cwts.	£	
1874	10,808	155,518	18	289	11,355	146,668	1,387	17,478	7,595	77,550	8,989	64,860	35,141	466,283	
1875	11,504	159,415	59	815	12,134	148,007	445	6,560	6,154	62,404	3,008	43,894	33,787	415,085	
1876	9,328	130,914	185	2,781	12,417	169,538	882	11,841	3,977	44,203	2,900	40,890	29,683	406,051	
1877	514	62,049	40	901	10,938	114,998	470	3,050	4,004	54,725	2,309	31,373	24,228	327,156	
1878	5,032	60,340	Not distinguished.		16,007	186,035	990	7,189	4,378	44,813	4,580	33,148	32,527	392,560	
1879	9,407	133,527	58	518	20,803	230,207	1,478	16,318	5,427	29,165	2,950	43,064	32,268	479,390	
1880	14,160	289,432	84	1,773	31,408	376,710	2,577	31,054	3,086	36,738	3,634	64,729	55,002	750,456	
1881	12,459	302,730	606	10,606	23,194	343,274	1,683	19,873	2,101	23,509	3,071	48,906	54,119	737,796	
1882	10,184	192,796	19	1,965	23,339	315,355	1,425	15,811	1,980	21,421	2,189	41,061	44,277	583,269	
*1883	-	-	-	-	-	Not yet distinguished	-	-	-	-	-	-	-	61,784	896,912

* The figures for this year have been taken from the Monthly Accounts relating to Trade and Navigation of the United Kingdom.

Commercial Department, Board of Trade,
19th April 1884.

APPENDIX I.—continued.

SILK THROWN.

STATEMENT showing the QUANTITY and VALUE of SILK THROWN, DYED or NOT, IMPORTED into the UNITED KINGDOM from the under-mentioned Countries, in each of the Years from 1874 to 1883 inclusive.

YEARS.	HOLLAND.		BELGIUM.		FRANCE.		OTHER COUNTRIES.		TOTAL.					
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.				
1874	lbs.	£	lbs.	£	lbs.	£	lbs.	£	lbs.	£				
1874	-	-	13,494	9,741	98,021	135,860	3,086	3,750	114,601	148,851				
1875	-	-	23,922	16,715	81,170	81,639	4,918	4,380	110,010	102,734				
1876	-	-	Not distinguished.		15,324	15,962	144,660	177,245	4,056	6,086	164,040	199,298		
1877	-	-	}		}		101,357	96,238	13,060	12,270	114,417	108,508		
1878	-	-					32,033	41,566	3,006	3,070	40,039	49,636		
1879	-	-					69,318	63,514	45,304	51,310	2,119	2,561	116,741	119,885
1880	-	-	Not distinguished.		192,932	242,481	3,609	3,444	208,567	252,861				
1881	-	-	}		}		31,899	28,951	95,013	107,218	4,924	4,793	131,836	140,957
1882	-	-					10,920	9,668	279,462	337,691	3,825	3,894	294,207	351,258
*1883	-	-	-		Not yet distinguished		-	-	-	-	291,337	303,014		

* The figures for this year have been taken from the Monthly Accounts relating to Trade and Navigation of the United Kingdom.
 Commercial Department, Board of Trade,
 19th April 1884.

SILK INDUSTRY.

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APPENDIX

STATEMENT showing the VALUE of SILK MANUFACTURES of all KINDS Countries from which EXPORTED in

	1874.	1875.	1876.
	£	£	£
SILK MANUFACTURES:—			
OF COUNTRIES OUT OF EUROPE:			
From China - - - - -	83,005	90,736	133,054
" British India - - - - -	143,787	136,206	110,313
" Other Countries - - - - -	10,003	10,259	5,994
Total - - - - -	237,895	246,201	250,361
OF COUNTRIES IN EUROPE:			
<i>Broadstuffs, Silk and Satin:</i>			
From Holland - - - - -	31,108	51,750	492,360
" Belgium - - - - -	1,360,628	1,177,948	672,346
" France - - - - -	4,866,747	5,840,745	5,923,907
" Other Countries - - - - -	4,920	275	734
Total - - - - -	6,323,403	7,070,718	6,090,376
<i>Velvet, Plain or Figured:</i>			
From Holland - - - - -	77,091	105,018	348,000
" Belgium - - - - -	880,074	995,963	401,964
" France - - - - -	32,014	32,806	73,794
" Other Countries - - - - -	2,784	2,618	1,680
Total - - - - -	1,012,960	1,086,405	827,606
<i>Ribbons, Silk and Satin:</i>			
From Holland - - - - -	24,880	3,115	30,854
" Belgium - - - - -	210,814	230,291	198,620
" France - - - - -	1,830,004	1,747,424	1,478,102
" Other Countries - - - - -	2,065	2,569	1,306
Total - - - - -	2,077,763	1,983,419	1,711,051
<i>Ribbons, Other Kinds:</i>			
From France - - - - -	222,185	44,112	20,377
" Belgium - - - - -	201,156	99,790	31,127
" Other Countries - - - - -	16,138	10,406	4,581
Total - - - - -	439,479	154,307	75,685
<i>Plush for making Hats:</i>			
From France - - - - -	10,197	20,006	51,498
Other Countries - - - - -	1,221	1,724	109
Total - - - - -	11,418	21,730	51,607
MANUFACTURES OF SILK OR OF SILK MIXED WITH OTHER MATERIALS UNESUMERATED:			
From Germany - - - - -	13,924	13,653	16,172
" Holland - - - - -	37,308	23,143	211,964
" Belgium - - - - -	77,598	91,540	96,258
" France - - - - -	1,746,533	1,662,385	1,608,992
" Other Countries - - - - -	3,306	3,475	1,261
Total - - - - -	1,877,969	1,807,222	1,953,748

* The figures for this year have been taken from the Monthly Accounts Commercial Department, Board of Trade, April 19th, 1884.

SILK INDUSTRY.

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I.—continued.

IMPORTED into the UNITED KINGDOM, distinguishing the principal each of the Years from 1874 to 1883.

1877.	1878.	1879.	1880.	1881.	1882.	*1883.
£	£	£	£	£	£	£
174,017 80,737 5,513	155,873 63,689 5,245	231,453 95,920 3,371	140,614 98,817 10,421	102,432 60,016 6,003	Included in "Silk Manu- factures Unenu- merated."	Included in "Silk Manu- factures Unenu- merated."
220,160	224,787	330,744	239,862	108,461		
1,807,879 93,382 4,880,911 5	2,222,040 46,434 5,063,254 104	1,030,368 30,494 5,034,027 200	625,538 10,478 5,487,737 20	193,769 Not Disting ^d 5,553,534 5,062	226,900 Not Disting ^d 4,665,049 3,967	Not Disting ^d Not Disting ^d 4,295,064 1,712,194
6,701,177	7,333,441	6,004,989	6,123,794	5,767,305	4,895,816	5,973,268
786,411 33,263 13,476 20	381,740 14,308 12,604 60	944,920 2,094 7,006 290	1,737,631 Not Disting ^d 7,024 775	1,475,394 Not Disting ^d 3,706	1,100,956 Not Disting ^d 3,882	Included with "Broad- stuffs of Silk and Satin."
834,175	408,715	954,360	1,745,430	1,479,190	1,109,841	
Not Disting ^d 101,710 1,512,147 3,478	407,223 63,794 1,807,746 1,451	223,540 12,376 1,727,056 350	278,350 13,876 1,888,581 330	119,871 6,187 793,978 735	125,109 1,154,584 467,316 514	Not Disting ^d Not Disting ^d 410,279 1,255,974
1,017,335	2,260,183	1,909,301	1,981,146	922,761	1,747,623	1,965,963
15,963 1,983 651	14,428 Not Disting ^d 603	66,879 Not Disting ^d 627	51,731 Not Disting ^d 643	— Not Disting ^d "	— Not Disting ^d "	Not Disting ^d Not Disting ^d "
18,467	15,060	66,306	62,374	994	13,802	118,968
25,644 470	41,460 —	34,007 129	25,237 220	21,820 —	} Nil.	} Nil.
23,316	41,469	34,136	25,477	21,820		
9,298 1,294,734 83,504 1,941,783 2,005	2,767 624,085 123,738 1,721,411 1,318	2,427 820,337 165,236 1,860,841 831	4,230 736,346 82,706 2,327,713 815	5,090 267,628 636,632 2,465,474 2,009	Not Disting ^d 829,151 314,556 1,983,164 261,120	} Not yet Disting- uishad.
3,341,323	3,462,315	3,806,073	3,156,863	3,376,876	3,407,991	

relating to Trade and Navigation of the United Kingdom.

APPENDIX I—continued.

IMPORTS of SILK into ENGLAND from 1854 to 1883 inclusive.

Year.	Raw Silk.	Knubs or Husks of Silk and Waste.	Thrown Silk.	Silk Manufactures.
	lbs.	cwt.	lbs.	£
1854 - -	7,535,407	19,480	1,021,832	2,365,415
1855 - -	6,618,862	12,106	929,896	2,217,107
1856 - -	7,383,672	17,993	853,015	2,669,172
1857 - -	12,077,931	20,680	640,986	2,077,616
1858 - -	6,277,576	16,765	858,269	2,187,061
1859 - -	9,920,891	20,808	827,462	2,763,379
1860 - -	9,178,647	17,435	224,335	3,248,761
1861 - -	8,710,681	29,627	124,574	5,906,029
1862 - -	10,372,123	28,142	62,227	6,618,501
1863 - -	9,221,145	31,940	59,388	6,689,155
1864 - -	5,655,401	34,876	78,160	7,620,432
1865 - -	7,732,450	33,432	60,130	8,496,825
1866 - -	5,453,864	25,417	66,850	9,434,936
1867 - -	5,849,648	23,031	196,188	9,094,612
1868 - -	7,036,177	30,550	326,574	10,950,784
1869 - -	5,573,366	29,198	209,509	11,908,814
1870 - -	6,307,575	31,360	283,723	15,244,919
1871 - -	8,253,335	38,984	177,386	8,397,928
1872 - -	7,302,083	33,866	63,001	9,429,121
1873 - -	6,443,213	31,815	108,794	10,065,378
1874 - -	5,911,831	35,141	114,601	11,979,459
1875 - -	4,487,837	33,787	110,010	12,264,532
1876 - -	6,016,927	29,663	164,040	11,815,740
1877 - -	4,441,891	24,239	114,417	12,860,988
1878 - -	4,170,606	32,887	40,039	12,755,988
1879 - -	3,886,422	38,268	116,741	12,841,918
1880 - -	3,673,949	55,002	203,567	13,324,935
1881 - -	2,904,580	54,119	131,836	11,727,897
1882 - -	3,377,119	44,277	294,207	11,174,573
1883 - -	3,178,593	62,064	292,433	10,523,920

With regard to the column headed "Silk Manufactures," manufactured silks are imported chiefly from countries on the Continent of Europe, those imported from other countries having from 1854 to 1880 an average value of 242,449l. per year.

The manufactured silks from the Continent of Europe are classified in the Returns of the Board of Trade thus:—

Broad Stuffs: Silk and Satin.

Broad Stuffs: Velvet.

Ribbons: Silk and Satin.

Ribbons: Other kinds.

Plush, for making hats.

Manufactures of Silk, or of Silk mixed with other Materials, unenumerated.

APPENDIX I.—*continued.*

STATEMENT showing the QUANTITY and VALUE of SILK KNUBS, or HUSKS, and WASTE SILK EXPORTED from the UNITED KINGDOM to the under-mentioned Countries during each of the years from 1874 to 1883 inclusive.

YEARS.	BELGIUM.		FRANCE.		OTHER COUNTRIES.		TOTAL.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Cwts.	£	Cwts.	£	Cwts.	£	Cwts.	£
1874	167	3,509	2,193	33,465	1,718	12,897	4,078	40,803
1875	Not distinguished.		766	6,589	1,013	9,005	1,779	15,604
1876	"		3,003	43,509	1,205	10,755	4,210	54,264
1877	"		3,469	43,913	3,970	22,914	7,460	66,827
1878	663	8,229	5,306	66,181	2,063	17,695	8,012	92,105
1879	339	7,762	2,994	34,878	1,606	19,587	5,029	62,197
1880	Not distinguished.		8,335	94,740	996	8,069	9,341	102,809
1881	"		3,434	30,028	1,044	8,464	4,525	44,522
1882	1,214	13,068	4,737	51,784	990	6,632	6,941	71,504
1883*	"		Not distinguished.		"		8,233	47,543

* The figures for this year are extracted from the Monthly Trade Accounts, and are subject to revision.

Commercial Department, Board of Trade,
13th May 1884.

APPENDIX I.—continued.

STATEMENT showing the QUANTITIES and VALUE of RAW SILK EXPORTED from the UNITED KINGDOM to the under-mentioned Countries, during each of the years from 1874 to 1883 inclusive.

YEARS.	GERMANY.		HOLLAND.		BELGIUM.		FRANCE.		SPAIN.		UNITED STATES.		OTHER COUNTRIES.		TOTAL.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1874	Lbs. 47,433	£ 33,095	Lbs. 240,648	£ 217,008	Lbs. 136,759	£ 104,011	Lbs. 1,800,071	£ 2,230,110	Lbs. 117,463	£ 90,927	Lbs. 219,694	£ 217,846	Lbs. 71,780	£ 46,290	Lbs. 2,741,842	£ 2,962,796
1875	30,808	22,010	180,040	133,947	173,024	123,423	1,822,039	1,927,574	113,060	75,580	146,359	129,787	83,011	40,021	2,551,417	1,801,201
1876	18,427	13,888	102,430	94,312	116,068	105,300	2,532,765	2,338,681	101,618	73,850	144,469	145,835	46,018	29,308	3,064,725	2,801,240
1877	14,190	11,130	88,004	81,188	100,808	88,096	1,200,403	1,062,882	91,781	64,746	108,916	108,980	79,075	44,227	1,682,038	1,450,236
1878	44,830	33,322	30,027	24,128	91,112	64,323	1,396,911	1,123,321	60,305	42,007	131,613	114,691	83,107	44,721	1,841,605	1,455,803
1879	24,025	21,481	15,823	12,301	65,097	47,954	1,008,366	844,146	40,737	24,173	100,017	80,516	57,223	30,090	1,375,608	1,068,901
1880	24,335	18,125	790	820	34,463	27,466	751,303	601,354	37,650	22,536	62,312	43,558	46,267	27,781	947,165	741,597
1881	10,701	15,005	2,468	1,800	90,300	77,061	903,114	831,983	31,086	24,407	60,820	60,168	24,000	15,153	903,997	716,271
1882	37,944	32,099	13,688	12,106	104,002	87,703	693,536	573,856	25,918	16,400	6,536	7,606	31,500	19,519	918,773	746,274
1883*							Not distinguished.								684,182	412,000

* The figures for this year are extracted from the Monthly Trade Accounts, and are subject to revision.

Commercial Department, Board of Trade,
May 13th, 1884.

APPENDIX I.—continued.

STATEMENT showing the VALUE OF SILK MANUFACTURES of all kinds (FOREIGN and COLONIAL PRODUCE) EXPORTED from the UNITED KINGDOM, in each of the years from 1874 to 1884 inclusive, distinguishing the principal Countries to which exported.

	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.*
	£	£	£	£	£	£	£	£	£	£
SILK MANUFACTURES.—										
OF COUNTRIES OUT OF EUROPE:										
To all Countries	35,325	54,433	50,408	30,547	39,639	41,048	24,127	24,085	} Included with Silk Manufactures unenumerated.	
OF COUNTRIES IN EUROPE:										
<i>Broadstuff, Silk or Satin:</i>										
To Belgium	7,063	10,494	15,903	8,165	5,343		Net distinguished.			
„ France	135,357	38,469	61,039	63,180	69,871	80,236	55,765	46,494	54,079	Not distingd.
„ Austria	6,950	7,604	15,121	16,967	16,176	17,551	30,246	37,120	47,559	—
„ Other Countries	15,598	10,637	19,910	13,155	15,831	21,733	24,423	37,738	54,272	—
Total	105,778	72,694	108,443	101,468	97,021	119,520	110,464	121,333	156,507	161,000
<i>Veist, Plain or Figured:</i>										
To all Countries	11,587	12,194	15,512	5,164	5,258	13,607	10,728	13,559	17,517	—
<i>Ribbons, Silk or Satin:</i>										
To all Countries	5,937	5,638	6,179	6,801	11,435	4,464	6,302	7,507	13,323	} 10,431
<i>Ribbons of other Kinds:</i>										
To all Countries	1,895	1,476	1,285	1,464	879	1,678	960	134	535	
<i>Plush, used for making Hats:</i>										
To all Countries	—	—	3,926	399	973	2,787	7,863	5,506	} Included with Silk Manufactures unenumerated.	
MANUFACTURES OF SILK OR OF SILK MIXED WITH OTHER MATERIALS, UNENUMERATED:										
To France	77,744	131,925	79,379	41,375	32,323	33,940	63,521	46,130	70,293	} Not distingd.
United States of America	16,094	27,574	21,545	10,827	22,077	14,061	5,947	10,190	8,377	
„ British India	13,787	Not distingd.	9,136		Not distinguished.		4,467	10,503	4,448†	
„ Other Countries	13,141	22,638	11,193	16,185	11,428	16,515	22,504	26,345	60,809	
Total	121,766	182,137	121,301	74,287	66,923	68,116	98,639	91,698	152,026	159,278

* The figures for this year are extracted from the Monthly Trade Accounts, and are subject to revision.

† British India and Burmah.

Commercial Department, Board of Trade,
13th May 1884.

SILK INDUSTRY.

XCV

APPENDIX I.—*continued.*

SILK and SILK GOODS EXPORTED from the UNITED KINGDOM during the Years 1854 to 1883 inclusive.

Years.	Raw Silk.	Knubs or Husks of Silk and Waste.	Thrown Silk.		Silk Manufactures.	
			British.	Foreign and Colonial.	British.	Foreign and Colonial.
	lbs.	cwts.	£	lbs.	£	£
1854	1,094,808	832	465,816	524,917	1,220,564	416,540
1855	2,185,555	1,010	441,751	402,244	1,078,692	360,016
1856	1,438,898	562	1,393,390	292,705	1,758,637	420,001
1857	1,706,225	980	1,082,605	236,523	1,907,324	370,414
1858	2,314,519	2,429	790,400	364,680	1,305,590	264,423
1859	2,152,327	1,505	790,500	254,297	1,562,152	306,091
1860	3,153,963	1,506	839,107	428,808	1,287,308	234,393
1861	4,096,992	835	916,748	82,760	1,595,883	242,239
1862	2,205,801	4,228	1,086,423	137,095	1,224,074	207,900
1863	8,852,919	1,087	811,045	210,903	1,421,261	250,477
1864	3,222,130	844	854,407	334,005	1,460,180	194,736
1865	3,137,232	1,212	767,058	306,701	1,464,281	160,336
1866	1,865,068	13,422	629,110	71,882	1,316,068	311,454
1867	1,902,014	4,626	754,145	16,126	1,024,618	305,905
1868	2,330,205	1,076	1,220,128	58,448	1,083,080	207,727
1869	3,049,151	7,232	1,150,031	36,014	1,110,118	137,570
1870	2,644,402	4,107	1,154,264	39,771	1,450,397	166,297
1871	3,209,775	5,322	1,209,812	41,150	2,053,680	693,007
1872	3,213,057	3,527	1,694,696	41,189	2,190,909	392,156
1873	2,786,303	2,833	1,067,246	20,806	1,878,990	324,695
1874	2,741,842	4,073	1,052,643	21,860	2,104,419	341,673
1875	2,551,417	1,779	890,923	87,924	1,734,519	324,120
1876	3,064,725	4,210	1,080,678	50,202	1,794,565	303,054
1877	1,652,555	7,450	670,969	17,910	1,705,153	229,139
1878	1,841,505	3,012	665,256	40,470	1,922,353	222,133
1879	1,375,908	5,029	694,735	24,461	1,677,290	234,465
1880	947,165	9,241	683,291	7,539	2,030,659	254,023
1881	963,997	4,523	1,068,272	5,361	2,564,730	265,826
1882	915,773	6,941	825,372	0,291	2,692,275	—
1883	624,128	5,216	705,825	5,566	2,426,299	—

With regard to the column giving the exports of foreign and colonial silk manufactures, the average total value of silk manufactures, the produce of countries out of Europe, exported during the years 1854 to 1863, was 233,391*l.* per annum, whilst during the years 1864 to 1881 it was 45,740*l.* per annum. The exports of silk manufactures, the produce of countries out of Europe, have steadily decreased from 292,442*l.* in 1854, to 24,085 in 1881. The decrease in 1864 was unusually great, the value of these exports being 134,410*l.* in 1863, and 80,360*l.* in 1864. From the years 1854 to 1863 the values of the exports of silk manufactures, the produce of countries out of Europe, were more than half the total exports of foreign and colonial silk manufactures, whilst during the years 1864 to 1881 the exports of foreign silk manufactures, the produce of countries in Europe, composed more than half the total exports of foreign and colonial silk manufactures.

The values of the exports of both British and foreign and colonial silk manufactures also include the exports of manufactured silks, of which spun silk forms the whole or part, and also manufactures of silk mixed with other materials.

APPENDIX II.

The following statistics, which will further prove the immense development of the silk trade on the Continent, are extracted from the *Jahres-Bericht der Handels-Kammer zu Orefeld für 1881*.

The total production of Italian cocoons in 1881 was 39,300 tons, and in 1880, 40,930 tons.

The silks conditioned in Orefeld in 1881 and 1880 were as follows:

	1881.		1880.	
	Lbs.	Quantities per Cent. for each Country.	Lbs.	Quantities per Cent. for each Country.
Lombardy, silk	783,220	65	642,771	67
Piedmont "	120,601	10	97,477	10
French "	8,922	1	5,973	1
China "	174,435	14	82,563	9
Japan "	45,315	4	45,141	5
Bengal "	46,409	4	59,954	6
Syrian "	21,753	2	19,285	2
Raw "	5,553	—	112	—
Various "	4,527	—	1,700	—
Total	1,210,742	100	954,996	100

STATE OF THE OREFELD VELVET AND SILK TRADE.

The trade with Germany increased during 1881 more than 200,000. It was 1,550,000. in the year 1872.

The trade with England, which was in the years 1878 and 1879 more than a third of the total amount done, has diminished more than 150,000.

Orefeld pays a duty on cotton yarns of 39s. per 220 lbs. These are chiefly imported from Manchester. There is no duty on the silk imported.

The silk trade of Orefeld consists in the manufacture of satins, failles cravat silks, damasks, umbrella silks, button silks, velvets, velvet ribbons satin ribbons, faille ribbons.

Most velvet finishers are also velvet cutters. The number of work-people employed in Orefeld in finishing and cutting is about 650.

A.—AVERAGE NUMBER OF LOOMS OCCUPIED.

	1879.	1880.	1881.
Velvets and velvet cloths	16,546	17,464	15,716
Velvet ribbons	250	242	240
Faillies, satins, and other stuffs than velvets	15,845	15,196	16,125
Ribbons other than velvet ribbons	88	106	45

* Orefeld, 1882. Druck von Krainer and Baum.

xviii ROYAL COMMISSION ON TECHNICAL INSTRUCTION :

B.—The AMOUNT of the TRADE with each of the following COUNTRIES ;
or the total of the Crefeld manufactures sold.

	1879.	1880.	1881.
	£	£	£
Germany	1,170,470	1,191,585	1,419,897
Austria	60,422	52,811	52,968
England	1,251,218	1,186,581	1,048,046
France	182,217	195,301	240,022
Other European Countries	148,895	141,771	178,821
Countries not European	710,102	956,037	887,180
Total	3,518,524	3,724,086	3,826,428

U.—RAW MATERIAL USED.

	1879.	1880.	1881.
	Lbs.	Lbs.	Lbs.
Thrown silk	806,315	786,638	949,414
Schappe	388,234	468,392	474,221
Cotton	1,862,703	1,811,796	2,068,030

D.—WAGES PAID.

	1879.	1880.	1881.
	£	£	£
Weaving	767,089	828,796	719,453
Winding	89,215	84,158	99,463
Warping	34,720	36,322	42,574
Dyeing	199,152	197,005	228,982
Finishing	91,583	94,260	106,159

NOTE.—The above tables only include work done for the Crefeld manufacturers, and not that done for themselves.

STATE of the CREFELD VELVET and SILK DYERHOUSES.

	1879.	1880.	1881.
A.—Average number of workpeople employed in Crefeld in the dyeing of silk, schappe, and cotton	1,330	1,406	1,539
B.—Quantity of raw material dyed :			
1. For Crefeld manufacturers :	Lbs.	Lbs.	Lbs.
a. Silk	797,192	865,895	941,952
b. Schappe	400,004	463,474	527,560
c. Cotton	1,892,037	1,791,097	1,770,120
2. For other Countries :			
a. Silk	428,128	500,541	637,331
b. Schappe	238,090	247,500	232,760
c. Cotton	297,827	404,627	424,685
C.—Amount of wages paid	£	£	£
	62,535	66,248	70,519

SILK INDUSTRY.

XCIX

SILKS CONDITIONED in the Conditioning Houses of the following Towns.

Names of Places.	Total Quantities conditioned in 1881.	Total Quantities conditioned in 1880.	The Quantities for 1881 were composed as follows.	
			Raw Silks.	Thrown Silks.
	Lbs.	Lbs.	Lbs.	Lbs.
Ancona -	33,792	33,484	33,792	—
Aubenas -	472,618	453,470	220,422	252,095
Avignon -	344,262	348,436	64,471	279,791
Basle -	889,317	574,822	60,194	829,129
Bergamo -	475,677	308,778	338,123	137,548
Brescia -	40,341	33,000	38,119	2,222
Como -	401,085	326,733	87,714	313,321
Crefeld -	1,210,745	955,000	5,555	1,205,190
Eiberfeld -	536,753	414,033	—	536,753
St. Etienne -	1,418,086	1,278,228	145,417	1,267,668
Florence -	300,913	227,455	294,969	5,944
Lecoc -	407,677	324,698	117,876	289,801
London -	156,948	119,248	64,211	92,736
Lyons -	8,517,522	7,398,909	3,331,152	5,126,369
Milan -	8,068,896	6,365,138	3,787,388	4,276,008
Marseilles -	295,224	—	295,224	—
Nimes -	14,762	23,269	10,472	4,290
Privas -	99,198	100,029	54,414	44,783
Turin -	1,810,969	1,506,084	659,422	1,151,497
Udine -	125,477	82,808	95,579	29,898
Vienna -	288,735	228,054	21,920	266,805
Zurich -	1,747,251	1,274,303	85,223	1,662,027
Total -	27,645,588	22,175,979	9,871,713	17,773,868

APPENDIX III.

STATISTICS of the SILK TRADE of FRANCE extracted from the "Essai sur le Commerce de la Soie en France" par Monsieur Albert Rondot.*

With some notes by myself.

COMMERCIAL DISPOSALS of RAW SILK in 1881.

Western Europe.	Lbs.
France -	1,650,000
Corsica and Algeria -	6,182
Italy -	6,523,000
Austrian Hungary -	324,632
Spain and Portugal -	184,800
	<u>8,688,614</u>

* Lyon, Imprimerie Firrat Ainé, 4, Rue Gentil, 1883.

ROYAL COMMISSION ON TECHNICAL INSTRUCTION :

The Levant.	Lbs.
Turkey: Anatolia	158,400
" Salonica, Volo	264,000
" Adrianople	
Syria	365,200
Greece	28,600
Persia and Georgia	550,000
	<u>1,366,200</u>

Extreme East.	Lbs.
China: Exports from Shanghai	6,204,000
" " Canton	2,272,600
Japan: Exports from Yokohama	2,640,000
India: Exports from Calcutta	840,400
	<u>11,957,000</u>
Total in the whole world	<u>23,011,814</u>

It is seen that the country which is the greatest producer in the world is China; after China comes Italy, then Japan, and France ranks fourth.

Of the total commercial disposals :

China furnishes	38·53 per cent.
Italy furnishes	29·65 "
Japan furnishes	12·00 "
France furnishes	7·52 "
The Levant furnishes	6·21 "
India furnishes	3·82 "
The other countries furnish	2·27 "

Thus there are annually about 22 millions of pounds' weight of silk which are disposable for fabrics in the manufacturing countries of Europe and America. The production is really much greater, as the Asiatic peoples, who are great consumers of silk, preserve for their own wants a considerable part of their production.

France absorbs upwards of 8,500,000 lbs. Germany comes next. The manufacturing of Crefeld alone consumed, in 1881, 1,430,000 lbs. of silk, that is to say, 846,000 lbs. of silk properly so called, and 484,000 lbs. of schappe. Returning to the accounts given by the Chamber of Commerce of Crefeld, always replete with facts and very exact, it is found that from 946,000 lbs. in 1877 the consumption has mounted to 1,430,000 lbs. in 1881, with an increase of fifty-two per cent. for the schappe. This progression is remarkable. I am not able to give the statistics for the whole of Germany, but it must not be forgotten that besides Crefeld there are the important silk centres at Elberfeld, Barmen, and Mülheim, besides silk manufactures carried on at Berlin, Langenberg, Viersen, &c.

After Germany must be mentioned Switzerland and the United States.

The United States received, in 1882, 2,800 bales of silk from Europe and 19,100 bales of silk from China and Japan.

Switzerland consumes about 2,640,000 lbs.

Italy consumes about 1,100,000 lbs.

SILK INDUSTRY.

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THROWN SILKS conditioned in FRANCE, GERMANY, SWITZERLAND, AUSTRIA, ITALY and ENGLAND during each Year from 1870 to 1881.

Years.	Weight of Silk in lbs.					
	France.	Germany.	Switzerland.	Austria.	Italy.	England.
1870	4,448,400	1,038,400	1,218,800	288,200	—	—
1873	5,847,600	1,243,000	1,353,000	228,800	5,890,000	289,800
1876	9,350,600	1,507,000	2,178,000	224,400	6,740,800	167,200
1881	8,038,800	1,742,400	2,545,400	266,200	6,219,400	92,400

It must be observed that the total amount of thrown silk conditioned in Germany is much less than the amount of silk which is there appropriated to manufacturing, for the greatest part of this silk is conditioned in Italy. The same applies to Austria.

It is in the United States that the consumption has increased with the greatest rapidity.

IMPORTATION OF SILK to the UNITED STATES.

Years.	Quantities.	Value.	
		Dollars.	£
1876	Bales. 11,293	5,626,299	1,160,424
1882	21,889	14,040,808	2,895,917

The following table shows the production of cocoons in France in 1881 for each Department:—

	Lbs.
Gard	5,118,113
Ardèche	4,579,848
Drôme	3,582,033
Vaucluse	3,477,599
Var	998,355
Mouths of the Rhone	768,858
Isère	694,564
Hérault	855,689
Lower Alps	250,252
Lozère	160,573
Maritime Alps	81,980
Eastern Pyrenees	68,131
Other Departments	231,184
Total	20,362,179

Before the epidemic this production was, on the average, more than 55,000,000 lbs. of cocoons; it fell, in 1876, down to 5,280,000 lbs., and it attained, in 1881, as has just been seen, almost 20,500,000 lbs.

TOTAL PRODUCTION OF RAW SILK IN FRANCE.

Years.	Lbs.
1875	1,608,200
1876	341,000
1877	1,918,400
1878	1,337,600
1879	825,000
1880	1,156,540
1881	1,650,000

IMPORTATION INTO FRANCE IN 1881.

	Quantities.	Value.
	Lbs.	£
Cocoons	4,814,200	990,720
Raw Silks	9,781,200	8,180,640
Thrown Silks	2,204,400	2,205,560
Total Silk Waste of kinds	10,841,600	3,153,920

The total amount of 10,841,600 lbs. of silk waste is worthy of attention. The use of waste has increased much in late years owing to the great demand for low-priced fabrics. The following little table is, in this respect, very significant, and illustrates forcibly the sure and gradual expansion of the spun silk industry.

IMPORTATION INTO FRANCE OF SILK WASTE for the Manufacture of Spun Silk.

	Lbs.
1876 and 1877 (on the average)	5,995,000
1878	7,073,000
1879	7,979,400
1880	9,000,200
1881	10,841,600
1882	10,643,600

PRODUCTION IN FRANCE OF SILK TEXTILES.

It is estimated that in 1874, in France the production of *tissus de soie étoffes, rubans, tulles, passementerie, &c.*, amounted to about 28,000,000*l.*

For the year 1881 the production of the Lyons manufactures, according to the estimations of the *Chambre Syndicale des fabricants de soieries de Lyon*, amounted to 15,968,800*l.*

The following are the different branches this production includes :—

Plain silks, inclusive of those made of spun silk in blacks and colours :—*Failles, Taffetas, Satins, Velvets in blacks and colours, Serges, Foulards printed or dyed, Moires antiques, Furniture silks, Armures for dress silks, &c.*, 6,424,000*l.*

Figured silks consisting of *Damasks, Armures, Drognets, Lampas, Satins, Moires antiques, Velvets, Taffetas, Gros de Tours, Cravat silks, &c.*, 1,040,000*l.*

Mixed goods, silk and cotton, silk and wool, &c. :—*Satins, Velvets, Plushes, Poptins, Armures, Carriage and furniture silks, Serges, Failles, Doublures, Cravats, Shawls, Fichus, Umbrella fabrics, &c.*, 6,220,000*l.*

Silk stuffs mixed with gold or silver; also cotton and silk stuffs mixed with gold and silver, 400,000*l.*

SILK INDUSTRY.

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Crêpes in blacks and colours, 392,000*l*.
 Gauzes and Grenadines, 472,000*l*.
 Tulles, plain, patterned or embroidered, 240,000*l*.
 Lace, Guipures, Lamas, 120,800*l*.
 Ornamental silk for churches, upholstery and military silks, 200,000*l*.
 Upholstery silks mixed with wool, cotton or pearls, 460,000*l*.
 Total, 15,968,800*l*.

Monsieur Albert Rondot is not able to give the value of the manufactures which are spread over the rest of the country. (M. Natalis Rondot says there is not generally sufficient importance assigned to the other manufactures; to those of Calais and of Saint-Pierre-lès-Calais; of Paris, of Nîmes, of Tours, of Avignon, of Roubaix; to those of the Departments of Aisne, of the North, of Oise, of Somme, of Gard, and of Hérault). In his report of 1882 to the *Commission des Valeurs*, M. N. Rondot has given three estimations which ought to be signalized; he has estimated the production of *tulles*, of *rubans*, and of *passenterie* of silk at 8,000,000*l*.

	£
Tulles de Saint-Pierre-lès-Calais et de Lyon	- 3,280,000
Passenterie de soie	- 2,800,000
Rubans de soie pure ou mélangée	- 1,920,000
	£8,000,000

LYONS SILK MARKET.

The present high importance of the Lyons silk market is not very old. Until about 1862 it was secondary to the London market, which was the sole international silk market and the only emporium of silks from Asia.

EXPORTATIONS OF SILKS FROM CHINA (from Shanghai).

Destinations.	Periods of Five Years.			
	From *1862-3 to 1866-7.	From 1867-8 to 1871-2.	From 1872-3 to 1876-7.	From 1877-8 to 1881-2.
	Bales.	Bales.	Bales.	Bales.
England	—	31,696	32,375	19,204
Continent (France, Italy, Swit- serland)	—	9,381	26,452	34,763
America	—	1,339	4,683	7,446
Various	—	649	1,877	3,803
Totals	35,647	42,965	65,386	65,216

* The year is reckoned from June 1st to May 31st

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EXPORTATIONS of SILKS from JAPAN.

Destinations.	Periods of Five Years.			
	From 1862-3 to 1866-7.	From 1867-8 to 1871-2.	From 1872-3 to 1876-7.	From 1877-8 to 1881-2.
	Bales.	Bales.	Bales.	Bales.
England	8,311	7,382	7,032	5,483
Continent (France, Italy, Switzerland)	3,612	5,051	7,157	10,423
America	91	402	141	4,437
Various	5,477	137	745	457
Totals	17,491	12,972	15,075	20,750

Before the creation of the French service almost the whole of the silks from the extreme East, which were used in France, were sent there from England. At present the greater part is sent there directly. The following are the figures in support of this statement :

IMPORTATION INTO FRANCE OF RAW SILKS, OF THROWS SILKS, and of WASTE SILKS.
Commerce général.

1860.	£
From England	6,216,560
From Egypt	56,360
From British India	—
From China and Japan	3,680
1880.	£
From England	394,840
From Egypt	394,720
From British India	273,400
From China	4,785,890
From Japan	1,082,560

IMPORTATION OF SILKS FROM CHINA AND JAPAN to Marseilles and to London, from 1872-3 to 1880-1.

	Peninsular and Oriental Company.		Compagnie des Messageries Maritimes.		Totals.	
	London.	Marseilles.	London.	Marseilles.	London.	Marseilles.
	Bales.	Bales.	Bales.	Bales.	Bales.	Bales.
1872-3	16,028	4,551	10,723	18,654	26,761	23,205
1873-4	12,779	6,982	8,390	18,382	21,169	25,364
1874-5	16,910	11,901	10,380	29,165	27,290	40,966
1875-6	18,942	11,591	14,731	34,137	33,673	45,728
1876-7	11,205	9,850	18,434	42,063	29,639	51,913
1877-8	29,446	9,635	15,288	33,780	35,734	43,365
1878-9	16,171	8,580	12,906	42,583	29,077	51,163
1879-80	15,906	6,302	9,825	42,523	25,731	48,825
1880-1	14,536	6,589	12,267	48,988	26,803	55,577

APPENDIX IV.

SILK MANUFACTURES IN SWITZERLAND.

The periods from 1850 to 1860, and from 1860 to 1870, were specially favourable to the prosperity of the silk industry in Switzerland, demand being steady for the articles produced, and there being no special necessity for Swiss manufacturers to introduce new features into their industrial activity.

Exports to the United States were naturally affected by the outbreak of civil war in 1861, but this was not productive of appreciably injurious results, inasmuch as the free trade measures taken by England in 1860, and the similar action of France in 1864, opened important European outlets for Swiss goods. With the restoration of peace in America, the transatlantic relations of Swiss manufacturers again became active, and the years 1866 to 1872 have been recently described by a Swiss authority as displaying "an unbroken chain of conjunctures favourable to the silk trade."

The tendency of public taste in American and English markets to prefer the heavy tissues called *faïlles*, to the lighter and more brilliant taffetas makes, began to act unfavourably on the Swiss manufacturing industry after the year 1872. This branch of the trade having considered the change of fashion only temporary, refrained at first from carrying out the needful alteration of looms. When the necessity of such a measure was no longer a matter of doubt, and Switzerland produced the class of goods in question, fashion had already begun to take up other articles. The important development of the satin trade, which took place towards the year 1880, has resulted in about one-third of the hand-looms in Switzerland being devoted to that class of tissues. The fancy articles made on Jacquard looms, which have within the last few years taken up such an important position in the silk trade, have not been produced in quantities of any importance by Swiss manufacturers.

In bringing forward the above facts, and other details of interest affecting the subject referred to, the *Central Blatt für Textil Industrie* calls attention to a project for introducing into Switzerland the manufacture of velvets. It is stated that the alteration of looms would not be very expensive, while the favour enjoyed by the article gives the proposal a fair chance of its realisation being a commercial success.

APPENDIX V.

SILK SUPPLY ASSOCIATION OF ENGLAND.

It would not be right in this Report to omit mention of the praiseworthy efforts of this Association, which was established in 1869, and had for its chief object "to stimulate the production of silk in every country where the mulberry tree is capable of giving food to silkworms," and also "to offer practical suggestions and encouragement to producers of silk for improving the quality, for securing better classification, and for ensuring greater care in the reeling of silk."

It had for its President Thomas Dickins, Esq., J.P. The head office of the Association was in London, but Branch Associations were formed at Macclesfield and Coventry.

The President states in a pamphlet connected with the Association, entitled "Guide to Sericulture," that he feels now justified in recommending the growth of silk in this kingdom. The objections as to

climate and labour, he thinks, are easily disposed of, a temperate and cool climate indeed producing the best silk. He refers to the results obtained by Captain G. Mason on a large practical scale, and says that they demonstrate that, under proper management, the disease which has been so disastrous elsewhere to silk culture is not likely to be troublesome here, and that the yield of trees and cocoons and the quality of the silk are fully up to the continental standard.

There is still a difficulty to which Mr. Dickins does not refer, and this lies in the fact that the mulberry tree does not always come into leaf at the same time that the silkworm eggs are hatched.

I do not think there is any hope whatever of successful cultivation of silkworms in England, but our Australian colonies, at the Paris Exhibition of 1878, showed that they had the requisite climatic conditions for producing silk of the highest quality, the only difficulty being the scarcity and high price of female labour.

TECHNICAL INSTRUCTION IN IRELAND.

BY

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OUTLINE OF A SCHEME OF TECHNICAL EDUCATION FOR IRELAND.

In the following sketch of an organized scheme of Technical Education for Ireland, I must confine myself to general suggestions, without attempting to give details, not only because to do otherwise would occupy too much space, but because in any such scheme the details must depend very much upon varying conditions which can only be determined when the scheme is about to be carried out.

I shall consider the subject under four heads: 1. Art, 2. Science; 3. Agriculture; and 4. Trades. Instruction under each of those heads may be carried on: *a.* in schools merely; *b.* in schools with illustrations in the workshops; and *c.* in the workshop. In the first case the teaching is entirely theoretical, in the last entirely practical. No scheme of technical education would be complete which did not take cognizance of the industrial training of the poor.

Each head necessarily includes the teaching of both sexes.

I. ART EDUCATION.

1. *Drawing in Primary Schools.*—There already exists in a few Irish towns the nucleus of technical education, as regards Art, in the shape of an Art School, and the elementary drawing classes of the national schools. The art schools are, however, few in number, and require reorganization, more aid, and enlargement of scope, and the art classes of the national schools are comparatively barren of results, notwithstanding the laudable efforts of Mr. Vere Foster to provide cheap drawing books. Simple outline drawing of common objects is of as much

importance to the artizan in many cases as writing, and should consequently be made an obligatory subject in town schools, or, at all events, should be placed on a level with writing as regards results payments. Nor should it be neglected, even in rural schools, for it has a high value as an agent of mental training.

One of the masters in every model school should be a certificated teacher of drawing. In any town with several national schools, having an aggregate number of pupils learning to write, of 250 or more, there should be provided a certificated teacher of drawing, who should give drawing lessons in each school at certain fixed times. In rural schools drawing should be encouraged by the payment of good results fees.

The drawing in primary schools should in all cases be restricted, so far as the payment of results fees is concerned, to outline drawing from the flat, and of common objects from the round. Assistance might be afforded by a supply of copies, models, &c. for the schools, and of inexpensive drawing materials for the pupils. The latter would be one of the best methods of encouraging boys and girls to learn to draw.

Art Schools.—The employment of a visiting art master for the primary schools of a town would afford the opportunity of establishing an art school there. The town should organize a local committee under the Science and Art Department, who should provide a drawing-room and appliances, arrange to light and heat it, and to keep it clean. The committee should also provide a suitable place properly fitted up for a small art museum, towards the furnishing of which the Department should make a contribution of objects, and a small money grant. Donations and loans of pictures and other objects of art should be contributed by persons interested in art education in the neighbourhood, and the committee should purchase from time to time objects not otherwise obtainable. In forming such a collection, and in the general working of the school, actual or possible industries in the locality, into which design entered, should be specially kept in view. The formation of small art museums on this principle would be one of the easiest and most effective ways that could be adopted for promoting technical-education.

The pupils' fees, and the results fees earned from the Department, should go in whole or in part to the teacher. His salary as visiting teacher of primary schools, together with such fees should, I think, offer sufficient inducement to a good man to settle in a town where it would now be impossible to establish an art school. The fixed salary is therefore the essential element of this part of the scheme.

County Schools.—Towns having a population of 20,000 or upwards should aim at having art schools of a higher class, supported out of the rates, under the Public Libraries' Acts. Such schools should be provided with a good series of casts and models, a small art library, and a suitable place for the exhibition of loan collections and the works of the pupils of the school. As in the smaller schools, every effort should be made to keep these

schools in touch with the local industries in the way I shall point out afterwards. Liberal donations of objects and money should be made to establish art museums, and building grants and loans at the lowest rate of interest possible should be made to induce towns to form such collections, which are more necessary in Ireland than elsewhere, owing to the absence of fine buildings, pictures in churches, or any means to excite a feeling of art in the young.

Provincial Academies.—Finally, there should be in the chief city or cities of each province still larger art schools or academies, having provision for not only a large collection of casts, but also a permanent collection of pictures and other objects of art. Here, too, in forming the art collection, regard should be paid to existing local industries or possible local industries as well as in the teaching, without, however, losing sight of the higher functions which such schools should perform. In such schools a sufficient salary should be provided to induce an artist of merit to connect himself with the school. Travelling scholarships should also be established to enable the best pupil or pupils of the year to visit the great art centres during at least two years. In view of the great importance of such art schools, a liberal building grant should be made to enable towns placing themselves under taxation for art and science schools to erect suitable buildings and to form permanent art collections. And loans should be made at the lowest possible rates for the same purposes. Considering the general condition of most Irish towns, and the absence of wealthy citizens able or willing to found art schools, or to furnish art museums, it is absolutely necessary to treat Ireland in an exceptional way, otherwise there seems no hope of such schools being founded in the majority of Irish towns. Cork is the only provincial city which is making real exertions to provide itself with an art school suitable to its importance. It is now erecting science and art schools, which, when completed, will cost between 18,000*l.* and 20,000*l.*, and will have provision for a large collection of casts, a permanent picture gallery and art collections, and an art library. In no way could public aid be given to promote, not merely technical education, but general culture also, with better effect for the present and the future, than by a liberal grant to the school for the purchase of examples of art, and of assistance to found some travelling scholarships for artizans.

I wish to note here that modelling should be taught in all art schools of whatever grade they may be. If the masters of the smaller schools be not fully competent to teach it, the difficulty might be met by employing a good teacher of modelling in the provincial school, who might periodically visit the smaller schools and teach a class specially prepared to profit by his teaching. This system of visiting teachers might be adopted in many other cases also; e.g., for wood carving, lace making, ornamental leather work, &c.

II. SCIENCE EDUCATION.

Science Teaching in Primary Schools.—The teaching of the elements of physical science should be specially encouraged in all primary schools, provided it be done without injury to the ordinary essential school work. In forming science classes in primary schools the following rules should be strictly adhered to: 1. To limit the range of subjects so as to avoid converting the system into a mere agency for earning fees. 2. To specially encourage an exact knowledge of the fundamental sciences; for instance, no result fees should be paid for passes in such subjects as experimental physics, unless the pupil had already shown a sufficient proficiency in mathematics, and so on. In this way a pupil would be led to follow a regular course of study. 3. regard should always be paid to the special circumstances of the locality. Thus, in agricultural districts, elementary mechanics, land surveying, heat and steam, meteorology, chemistry, the biological sciences and geology, would be the most useful subjects to encourage. Mathematics, except as the essential basis of all accurate physical science, and so far as may be necessary to understand mechanics, surveying, and heat, would in general be of much less importance than to artisans in towns. In manufacturing towns, on the other hand, special encouragement should be given to mathematical sciences. Results fees alone would not be sufficient to pay for the teaching of such subjects in any of the Irish towns. They would not do so in Cork, except under special circumstances. As in the case of elementary art schools one or more visiting science teachers should be appointed in every town of a certain size, who would form classes in the various schools in those branches of science not included in ordinary school education. These classes should not be confined to national schools, but might be formed in denominational or even private schools, if desired by the managers of those schools. The same rule should apply to art classes.

Encouragement should be given towards forming collections of diagrams, models, instruments, and collections of raw materials, and specimens illustrative of the processes of manufactures. In carrying out this suggestion the greatest care should be taken that the articles should not be useless toys, as is very generally the case, and that the specimens should be correctly labelled.

Science Schools.—The employment of visiting science teachers for the primary schools of a town would supply the most important part of a special science school. A town desirous of having a science school should form a local committee, which might be the same as that for the art school if one existed—indeed a single committee for both purposes would be the better arrangement in all cases. The committee should provide accommodation for the classes; this should include a laboratory inexpensively fitted up, and a small museum of typical specimens, a collection of raw materials, and one of *real* physical instruments for demonstration. Aid might be given to the committee to

provide the necessary plant. Small, well selected, and well arranged collections of this kind, and the similar collections of art examples are, I cannot repeat too often, the most essential parts of any real system of technical education. Looking at the peculiar circumstances of Ireland, they would be of more importance there than anywhere else. The existing industries of the town and neighbourhood, and the possible industries should always be steadily kept in view, and the art and science collections should be arranged in connection with each other. The science and the art schools should work in harmony, and should afford mutual aid, especially in those scientific courses which have direct bearing on art.

As the science teachers would have moderate salaries as visiting teachers of elementary schools, they would not be too dependent on numbers in order to earn results fees, and consequently could afford to give really sound teaching to their pupils. Special encouragement should be given to such subjects as pure and mixed mathematics. And classes should be formed in connection with any branch of trade, of sufficient importance in the district, to supply pupils for a special class. The course of instruction for such a class should bear entirely on their trade. Each trade might be taken up in succession, and if the ordinary teachers of the school were not competent to supply the special instruction required in any particular trade, someone might be specially invited to give it.

Polytechnic Schools.—Without a college for the teaching of the higher branches of science, and which, for convenience, I shall call a Polytechnic school, no system of technical education would be complete. It is the centre of life of the whole system, for it is there the science teachers of the secondary schools would be educated. It is chiefly to such higher schools that the success of the systems of technical education established in various European countries is due. Four institutions fortunately exist already in the country, which, with moderate development, would supply all that is required to complete a system of technical education for Ireland, namely, the Royal College of Science in Dublin, and the three Queen's Colleges.

The Royal College of Science.—This institution was, in fact, specially founded as a technical school, and possesses everything required to constitute a first class Polytechnic school; laboratories, apparatus, and teaching appliances of every kind; an admirable library of scientific and technological books; the nucleus of a good technological museum, or rather it had at one time such a collection, but the value and importance of such a museum not having been sufficiently understood, the space occupied by it has been encroached upon to make room for laboratories, and nothing has been done to develop and keep it up to the level which such an essential factor in technical education should attain.

The people of Dublin, who have been crying out for technical education lately, do not seem to know that they have had it

their midst for the last 20 years one of the most complete Polytechnic schools in Europe. If it has not done so much good as it might have done it is the fault of the people of Dublin. Had they taken the interest in this admirable institution that they ought to have taken, its excellent technological collections would now be among the very best in Europe. If it has shortcomings, and wants development and modifications, which it does, it is the fault of the people of Dublin, who could have had everything done that was requisite if they had taken an intelligent interest in the work and bestirred themselves in the matter.

The chief extension the school requires is a staff of assistant professors, or science teachers, to carry out, under the direction of the professors, a department of evening teaching for artizans. The staff of professors might also be increased by one or even two additional ones. If these changes were made, Dublin would possess a Polytechnic school of the first class, if only the people for whom it was founded recognised the fact and availed themselves of its advantages.

The Queen's Colleges.—Each of these colleges has already a successful engineering department, which might at very small cost be expanded into a fully organised Polytechnic school for the province in which it is situated. The additions necessary to be made to effect this object should be: 1. The foundation of two or three additional chairs, according to the special industrial wants of each province, 2. Assistant professors to some of the Chairs in Belfast and Cork, who should assist the professors and conduct the artizan classes under the direction of the professors. These artizan classes might be carried on in the colleges, or where, as in Cork, there may be a municipal science school, they may be conducted more conveniently in the science school. This arrangement would have the advantage of keeping the higher education in direct touch with the secondary schools, and, above all, with the industrial classes; 3. Enlargement and improvement of chemical and physical laboratories; 4. Workshops; 5. Technological and model museum. A moderate sum would effect these improvements. When completed, Ireland would have as complete a system of higher technical education as any country in Europe. This enlargement of the scope of the Queen's Colleges, which would cost so little to effect, need not interfere in any way whatever with the existing functions of the Colleges.

III.—AGRICULTURAL EDUCATION.

Agricultural teaching should undoubtedly constitute one of the most important parts of any system of technical education devised for Ireland. In the first place, it is the main occupation of the people, and no matter how handicrafts may hereafter be developed, or whatever large manufacturing workshops may grow up, it must, for obvious reasons, always be the main occupation of the people of Ireland. It is an industry which can derive immense

benefits from the application of science, and in its present condition it stands in much need of all that theoretical and practical teaching can do for it. It also presents this great advantage over all other branches of industry that practical teaching may be carried out to any extent without infringing on the real or supposed rights of workmen, or competing unfairly with existing manufacturers. So far from this being the case, every addition made to the skill and knowledge of the farmer, the agricultural labourer, and the dairymaid, is a benefit to the whole community. This, too, is a favourable moment to establish a sound system of agricultural education. The farmers have obtained a substantial interest in their farms, and thorough security that the profits of knowledge, skill, labour, and capital, applied by them to the land, shall be theirs. On the other hand, unless they have the knowledge and skill they will only realise a small part of the fruit of recent legislation. Again, they must see that unless they bestir themselves and acquire the highest knowledge and skill and apply them with unremitting industry to their land, no legislation, however favourable, can enable them to withstand the competition of North America, to which will be gradually added that of two other continents.

Agricultural teaching in primary schools.—The present system of agricultural teaching in rural national schools is good, so far as it goes, but it is very imperfect, and cannot bear the fruit it might otherwise yield for two reasons: 1. the teachers are not themselves trained agriculturists; and, 2. because, as regards agriculture, they are not in touch with the farmers. These defects in the present system may be remedied by first teaching the masters agriculture, and then supplementing the book teaching of the schools by demonstrations to the senior boys on neighbouring farms on Saturday afternoons, and after school hours, when the days are long, but above all by agricultural conferences.

Agricultural conferences.—When a master is a thoroughly trained agriculturist he should be encouraged to invite the neighbouring farmers to conferences on Sunday afternoons, at which the best methods of farming, the action of manures, the selection of seeds, &c. should be discussed, and the latest information contained in the agricultural journals be read out. An agricultural book club might also be established which should subscribe to one or two farming journals which, when read by the members, should be filed for reference at the school. The journal or journals so subscribed for should be furnished with a strong cover for keeping the same clean while in circulation. The teacher should receive a small salary for his labour in connection with those conferences. The master of a conference should in all cases be a trained teacher in agriculture, and have a certificate that he possesses the necessary knowledge of the collateral sciences of agriculture. One way of working such conferences, which might be made to do incalculable good in the backward

districts, and which, among other benefits, might lead small farmers to co-operate for getting machines, &c., would be the formation of a local committee who would collect a small sum annually for the expenses of the club. A contribution in aid, proportionate to the amount collected, should then be made. The proportion contributed from public funds should be very elastic, and the local contribution would perhaps have to be dispensed with altogether in some very poor districts.

Conferences of farmers' wives and daughters.—Agricultural instruction should not be confined to boys and men. National schoolmistresses, or a fair proportion of them, should be encouraged to become trained in all the agricultural work which is usually done by women, e.g., dairy management, the rearing of calves, the rearing and fattening of poultry, cooking and general domestic management. This kind of knowledge is not outside the power of good literary teachers to acquire, and ought not to interfere with their ordinary school work. One of the most competent women, I have met, in this kind of work happens to be also a successful teacher having a first class certificate under the National Board. Theoretical teaching might be carried on, as now, in the school, but there should also be conferences of the wives and daughters of the farmers under the management of a committee of women. If a joint committee of farmers and their wives could be formed to work both conferences it would greatly add to the success of the movement. Indeed, if the women could be made to see the value of practical and scientific teaching, and they could not fail to do so in the case of butter-making, poultry-management, bee-keeping, &c., they would soon press their husbands, sons, and brothers into the movement.

As it must take a long time before we can have a class of schoolmasters and schoolmistresses capable of teaching agriculture and household economy, competent agriculturists, and dairy-maids trained at the Cork Dairy School, or at that recently set up at Glasnevin, might be sent round a district to hold a series of conferences. If the managers of schools, who are almost all clergymen, could be enlisted in such a movement, it would be certain to succeed. The priests of Ireland could not do a more useful or patriotic work than this.

Conference for dairy work and household management.—One of the simplest and most effective methods for working the womens' conferences would be for the members of the womens' committee, or where a joint committee is formed for the female members, to place in turn their houses at the disposition of the committee for the conference. The best mode of making butter should be illustrated in the dairy, and the cooking lessons given in the kitchen, each member of the conference contributing the materials of some simple dish, which should be cooked as an illustration of the lesson, and upon which those assembled should then lunch or dine. Every conference should be devoted to a different subject, butter-making, cheese-making, calf-rearing,

should be taken up in succession, but perhaps the cooking lesson might be always a feature of the conference. The successive meetings would produce a healthy rivalry in cleanliness, and in the arrangements of the dairies and kitchen, &c., which would soon work a revolution in the country. The payment of the mistress of the conference should be provided in the same way as that of the master. Whenever the school buildings admitted of it, facilities might be afforded for exhibiting a collection of the best, simplest, and cheapest dairy utensils and culinary apparatus. Manufacturers would be willing to make such an exhibition at their own risk. Conferences of this kind would bring home to farmers and their wives the value and necessity of agricultural education, and would soon lead them to give their children the advantage of a more complete training.

Agricultural Normal School.—The success of agricultural teaching in the primary schools of Ireland wholly depends on the technical training of the masters and mistresses. That should be given to them at Glasnevin Farm, which should be converted into an agricultural normal school for the technical training of the masters and mistresses of rural primary schools. The teaching of the men and women should go on simultaneously, separate residences being provided for them. There seems to be no reason why these buildings should not be so arranged that the sexes should be separated, and further, if the work could not be otherwise carried on, provision could also be made for the different religions; the carrying out of the necessary arrangements might be entrusted to the respective religious bodies. In this way the teachers in training in the Denominational Training Colleges could get, in common with those in the State one, all the advantages of a great practical training institution, without the least interference with their religious views. It is needless to say that a practical training school could not be provided for every religious denomination.

No literary instruction should be given in such an institution; the students attending it should be already prepared for ordinary school work. But instruction should be given by competent lecturers in all the branches of science bearing on agriculture. The rest of their time should be devoted to practical work and the studies connected therewith.

Secondary or Intermediate Agricultural Schools.—A considerable number of such schools existed at one time in Ireland, but after the expenditure of a large sum of money in the erection of buildings, and in working them for a number of years, they were given up, some of them too hastily, as it now appears. Only one has escaped, the Munster Dairy and Agricultural School. The chief causes of the failure of these schools were: 1, the state of the land tenure; 2, they were centralised institutions having no local connections, and consequently were not in touch with the farmers; 3, the majority of the farmers did not understand the value of scientific farming; and 4, the buildings, cattle, and methods of

farming did not in general offer examples worthy of following. If some of the suppressed schools still existed it might have been worth retaining them in operation, now that the chances of success are much greater. But it would not be wise to resuscitate them. The time is not come for such schools. The surviving one at Cork, which is worked under a local committee, and which has done such good service as a dairy school, should be enlarged and developed so as to test the want of such schools and to serve as a model whenever the country shall have learnt the value of them. Everything that can be done to improve this school and to make it successful, should be done, and in the meantime, if the conference system be worked, and the training of teachers actively proceeded with, the single school at Cork will be enough to test whether there exists a want for schools of this type in Ireland. And this can be done at a very small cost.

The Cork School should be made a complete school so as to serve the threefold purpose : 1, for the education of young farmers in theoretical and practical farming ; 2, for the education of girls in dairying, calf-rearing, the management of poultry, bee-keeping, cooking, and in all other kinds of womens' farm work ; 3, as a place for the practical instruction of those students of the Polytechnic school of Queen's College who intend to pursue professions or trades connected with, or requiring a knowledge of, farming, *e.g.*, large farmers and graziers, engineers, veterinary surgeons, seedsmen, agricultural implement makers, and manure manufacturers. These three functions are perfectly compatible with each other, but more land would be required, and a moderate increase of buildings, to enable the education of the girls and boys to be simultaneously carried on. If the engineering school of Queen's College, Cork, were extended, as above proposed, into a Polytechnic school, which should of course include provision for teaching agriculture and veterinary science, the scientific teaching of the Agricultural School would be provided for by the assistant professors, as in the case of the Municipal Science or Trade School. In this way close connection would be established between the higher teaching and the lower grades of the trade and agricultural schools. This connection should be an essential feature of any scheme of technical education.

Higher agricultural teaching would be provided for, as just suggested, in the Polytechnic school of the Queen's College, Cork, and should include, besides the branches of science directly bearing on agriculture—mechanics, experimental physics, chemistry, zoology, and botany, which form part of all higher technical instruction—practical agriculture taught at the farm, and veterinary medicine, which should constitute a separate but essential department of the scheme. This scheme, if so framed, would give Ireland one of the most complete organisations in the world for teaching agriculture.

Forestry and Reclamation Schools.—Thirty years ago I proposed that instead of building expensive agricultural schools in

districts where agriculture was already comparatively advanced, patches of waste land in the western counties, from Donegal to Kerry, and in the central bog region, should be acquired, and schools for teaching the best mode of reclaiming waste and bog lands and plantings should be established on them. My idea was that the school buildings and farm offices should be of an inexpensive and temporary character, and capable of being easily removed to a new site so soon as the work of reclamation and planting of the first site should have been completed. Had this project been acted upon at the time, the Agricultural Department of the National Board would not have so barren a record to show as it now has. The projected migration and re-forestation schemes, which I sincerely trust will be soon in operation, would not lack skilled Irishmen trained to execute the required work in such mountain schools. Such schools are equally necessary now, and would have much more chance of success. I hope, therefore, to see one or two of them tried, either as part of a general scheme of technical instruction, or as necessary adjuncts to any serious attempts to reclaim Irish waste lands or to re-forest Ireland on a large scale.

IV. TEACHING OF TRADES IN WORKSHOPS.

So long as we confine our technical teaching to the scientific principles which underlie the processes of manufacture, and the rules of art which apply to form, colour, and ornament, we do not contravene the maxims of political economy. We may even teach practical agriculture, because we only thereby increase the supply of food, but do not practically compete with other agriculturists. But when we come to the teaching of handicrafts the matter is beset with difficulties of many kinds.

We may consider this part of our subject under three heads:—

I. Experimental Workshops attached to Schools.

The establishment of experimental workshops for the purpose of bringing the designer and the workman into contact, showing the first what is possible to be done in any given material and by any particular mechanism, and showing the workman the importance of art, in varying the products of his labour and enabling him to compete successfully with his rivals, can readily be attempted in connection with existing schools. As, without such workshops, art schools must be barren of results, I consider their establishment in connection with art and science schools to be an essential factor in any scheme of technical education for Ireland. As examples of the trades in which experimental workshops might be established, if the number of workmen in the locality and other local conditions justified the expenditure, I may mention the following:

1. Weaving of figured stuffs; 2. Lace, &c.; 3. Wood carving and furniture; 4. Moulding in plaster; 5. Metal moulding; 6. Ornamental wrought-iron work; 7. Stamped paper and leather work and bookbinding; 8. Stamped and spun metallic ware; 9. Wall papers and house decoration generally; 10. Decorated pottery and stained glass, and in fact any branch of manufacture into which art largely enters, and in which good work can only be executed by the artist-workman. There are also many trades into which scientific processes largely enter, and in which the principles of science could be best taught by demonstrations during the actual processes, *e.g.*, dyeing, colour making, &c. In all such handicrafts and trades it is not only perfectly legitimate but absolutely indispensable to establish experimental workshops in connection with art and science schools, wherever the state and importance of a local industry justifies it, and where the workshops require only moderate sized buildings, and inexpensive plant and tools. It would not be difficult to devise a simple building provided with a motor, such as a gas engine, and a supply of water, and which could be transformed into a succession of different workshops at a trifling cost, according to the trade to be illustrated. Where such a skeleton workshop is attached to an art school, or to a science school, a special building grant might be made for it. The special technical teachers should be supplied by the Science and Art Department, or a grant might be made towards the payment of a competent foreman for each course of demonstrations under the direction of the art and science masters. Results fees should be paid for work done, and prizes awarded to the workmen, or workwomen, as the case may be. The locality should find the plant and tools, and pay for the necessary fittings and materials.

II. *Workshops for Teaching Trades not existing in a locality, or for the Improvement of existing Trades not included in the foregoing category.*

This is a very serious matter, and could only be tried under exceptional circumstances, and only as a temporary measure. I believe that, in the present circumstances of Ireland, it would be justifiable and useful to try the experiment of introducing a new trade by educating the workmen or workwomen in the way in which the same thing was done in Belgium, in 1847 and following years, by the establishment of apprenticeship workshops (*Ateliers d'Apprentissage et de Perfectionnement*). Such an experiment should be made with great prudence and forethought, and by persons thoroughly acquainted with the business to be undertaken. The conditions under which such an experiment might be tried, the extent to which it might be carried, and the mode in which it could be worked, may be studied in the admirable example of Belgium above referred to, full details of which are

given in the pamphlet quoted below.* If public aid were to be given for this purpose, it should be as a special grant, and not as part of a general system of technical education.

III. *Workshops in Poor-Houses and Industrial Schools.*

I have said above that no scheme of technical education could be considered complete that did not include the training of the destitute poor, and I accordingly intended to include this subject in my scheme, but on second thought I think it properly lies outside the present inquiry, and in any case it is so vast and complicated, and involves so many considerations, that I think it better to say nothing on the subject.

I will conclude with the following expression of opinion as to the principle that should govern every scheme of technical education:—All institutions, save reclamation and afforesting schools should spring from the wants and wishes of the locality, which should bear part of the burden of maintaining them, but that, in the exceptional condition of Ireland, the State should liberally help. That the management should always be in the hands of local authorities, subject to careful and competent government inspection, and rigid audit of expenditure.

* On the Industrial Training Institutions of Belgium, and on the possibility of organizing an analogous system in connection with the National Schools of Ireland by Tristram Kennedy, M.P. and William K. Sullivan, Professor of Chemistry to the Museum of Irish Industry, Dublin. Brown and Nolan, 1855.

The account of the Belgian system in this pamphlet first appeared in two articles in the *Journal of Industrial Progress*, edited by Prof. W. K. Sullivan, Dublin, 1854.

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OF

MINUTES of EVIDENCE in Vol. III.

HAEFFELY, MR. ROBERT. Pages 1 to 10.

Has experience of calico-printing in England, France, and Germany, 1. Is now employed as chemist. Superintends laboratory and samples print patterns, 2-6. Superintendence can be learnt in a laboratory, sampling only in practice, 7. The two duties might be performed by different persons, but sampler should be a chemist. Alsatian calico-printers produce cheaper and better work than English. Few chemists are employed in English works, while continental managers generally study chemistry at Mulhouse for 2 years, the last half-year being devoted to the theory of calico-printing. The laboratory instruction there is confined to chemistry. Students do not enter before 17, having had an ordinary classical education, 8-23. The Mulhouse training is the best for calico-printers, but advance in chemistry has made the 2 years insufficient, 24-27. Knowledge of chemistry rather than of designing is required by managers in England, as in France and Germany. French designers have advantage of museums, &c. in Paris, open daily, Sundays included; they also design for the Lyons silk industries, which govern fashions in prints; many also are trained as apprentices in ateliers, 28-35. Englishmen have as much art ability as foreigners, but the education of colourist chemists here has been neglected, English export trade requiring brightness rather than delicacy of colour or beauty of design. Such education is indispensable, as many Lancashire calico-printers now see, 36-41. The Mulhouse Society has many schools where cheap technical instruction is given in various branches of the calico business, and successful students receive large sums for travelling instruction and introductions to works, &c. on their journeys, 42. Except the insufficient development of our colourist chemists, there is no reason why English calico-printing should not equal that of Mulhouse. Most of the machines in continental works are English, 43-44. The Société Industrielle of Mulhouse comprises most of the Alsatian manufacturers and managers, who voluntarily subscribe. It administers some educational legacies. Will furnish official records of the Society's work, if desired, or the President would give any information. Similar societies exist at Rouen, Epinal, &c., 45-54. Was 2 years at Mulhouse laboratory, and 3 years an apprentice in print works there, where he learnt sampling, 55-56. Mulhouse printers mostly buy their designs from the large and numerous Paris ateliers, which supply both silk and calico-designs, although there is a school of design at Mulhouse. This was not so 5 or 6 years ago, and is attributable to the museums, &c. to which Parisian designers have access. The Society is striving to become independent of Paris, but its success is problematical, 57-65. The chances of a similar movement in Manchester would not be great. It should be commenced by a study of general art, and foreign designers should be attracted, or the students apprenticed to such. Calico-designing cannot be learnt in art schools, but special courses might be given there, and calico-printers might take students into their works for instruction, 66-74. The English have more oriental examples in their museums than the Parisians, which is an advantage in training designers for the trade with distant markets, but in this trade continental manufacturers could never compete with them from other causes, 75-77. Alsatian colourist chemists are employed as managers all over the

HAEFFELY, Mr. Robert—cont.

continent, 78. Is acquainted with the printing trade of Rouen, Germany, Austria, and Switzerland, 79. Rouen work is inferior to English. Perhaps half the machinery there is from England. The English printers are as good or better than those of Rouen, and the Rouen works are very badly fitted up, 80-84. German and Austrian works are not superior to English. Franz Leitemberger's, at Cosmanos, is the only establishment on the continent producing goods equal to those of Mulhouse, 85-86. Leitemberger's works supply the principal towns of Austria with fine prints. The Austrians supply Italy and the Danubian provinces with both high and low class prints, principally low. They are near those markets. They cannot compete with England in Germany, the United States, or South America, 87-91. English workmen are stronger and better trained than French, and require less overlooking, 92-93. Does not think English workmen careless; they assist the managers rather more than Alsacians do, 94-95. The high education of both large and small Alsacian manufacturers is a principal cause of their great public spirit, 96-99. Does not know much of the London ateliers. Buys designs in Paris but not in London, 100-101. Does not think the attempt to revive designing at Mulhouse will succeed, as they will not there have the Parisian advantage of designing for silk, 102-5. A school of design at Manchester will be under the same disadvantage. The English silk industry has declined, and the best designs in silk come from France, 106-7. Should the silk industry revive, and the designing for it and calicoes be combined, the English designer would still be prejudiced by want of access to museums, &c., 108-12. Large collections of patterns, &c. are required, 113. The shop windows, &c. in Paris are an advantage to designers, 114-6. The Mulhouse designers are producing designs, but are not successful in their novelties, 117-9. Saw some splendid collections of lace at S. Kensington Museum. Paris has excellent textile exhibitions, 120-1. Thinks the character of English silk designs would lend itself to calico-printing, 122-4. English print works, though equal to French in management and appliances, are not in chemistry, and consequently French styles bring higher prices than English, 125-6. A certain class of English goods, principally furnitures, sell in France because of their cheapness, but in the higher class, where science and art have most place, France has a practical monopoly, 127-30. A museum at Manchester showing all the different styles of patterns, as at Mulhouse and Paris, would be a great advantage, 131-2. English styles in pottery, &c. are sometimes copied in France, 133.

PERKIN, Mr. WILLIAM HENRY, F.R.S. Pages 11 to 19.

History and statistics of production and consumption of coal tar colours in England and abroad. Attributes German success in this manufacture to absence of patent restrictions, attention to detail, and superior training of the chemists employed, 134-61. Our patent laws have operated adversely to England in this industry; foreign infringements kept down prices and prevented our manufacturers taking out licences. The specifications revealed the processes to foreign manufacturers, who developed and improved them, while English manufacturers were prevented from using them. The imperfect protection given has been advantageous to the industry but a disadvantage to this country and the patentees, 162-7. German chemists, while students, are generally obliged to conduct original researches, hence their practical superiority; the same training is given to those intended for industrial and for purely scientific pursuits, 168-70. Our training for scientific men is satisfactory but too short; in Germany it is longer and therefore more thorough, 171-5. In the German polytechnic schools the studies are specialised during the last year, but not at the universities, 176. A boy training for manager of chemical works should have a sound general education, and should study chemistry and natural philosophy from 13 or 14 to 16 or 17. He should then go to such a college as Owens, or S. Kensington to study more advanced chemistry and natural philosophy, and should then conduct original research. He should stay there 2 or 3 years, then enter a good technical school, *i.e.*, neo where manufacturing processes and their scientific principles could be studied together, 177-94. Several such schools exist here, but all more or less in their infancy; if properly conducted they would be very useful. They

PERKIN, Mr. William Henry—*cont.*

should experimentally teach the various processes, their principles and defects, and the efforts that have been made to improve them, 195-7. The college training should be in pure science mainly, that in the school more technical. The scientific principles would be better and more quickly learnt there than in a factory, while at college they could not be learnt with such detail unless the necessary appliances were provided, 198-202. The student would so get a valuable knowledge of businesses related to his own, 203. The student so trained should be able on entering a factory to grasp quickly all that was going on, to look out for improvements, &c., but would still have to learn nature of special machinery, management of men, &c., which could not be thoroughly learnt in a school, before he would be qualified for management. In a technical school for chemical manufactures, mechanical drawing and machine construction should be taught, 204-12. The long period occupied by this training would in some cases be a difficulty, 213. Boys earning their living in the daytime could not acquire the necessary knowledge in the evenings, 214. In Germany the low fees enable parents to keep boys at their studies longer than in England, and education is more highly appreciated there, 215-6. Foremen would be improved by technical instruction, but it is difficult, as they are generally chosen from the workmen, the general body of whom are, after work, too tired for study. Attendance at science and art classes would render a man more fit for a foreman, 217-222. After a three years' course of general chemistry at college one year would be sufficient to acquire a knowledge of coal tar chemistry. German chemists usually go straight from the university to the works, 223.

BELL, Mr. ISAAC LOWTHIAN, F.R.S. Pages 19 to 30.

Is an iron manufacturer, owns coal and ironstone mines, has been a chemical manufacturer, and has served on exhibition juries, 224-8. Has had a scientific education, and written several works on the theory of iron manufacture, 229-30. Is acquainted with the training of iron workers in England, America, and continental countries, 231-4. In many cases, perhaps the majority, no scientifically educated person is attached to British ironworks, but the number of such employed is daily increasing, 235-7. In Middlebrough the managers are more scientifically trained than in most parts, and the economical results have been advantageous, 238-41. Scientific training is becoming more appreciated; 15 or 20 years back Cleveland district was much on a level with other places, 242-3. As regards malleable iron works there is not so much difference; the managers are and always have been good practical men, but without scientific knowledge, 244-7. The labourers have no scientific knowledge, 248. Foremen as a rule have no scientific education; some scientific instruction is gradually finding its way among classes below superior managers, 249. Such instruction would be useful in making foremen more attentive to instructions and less disposed to trust to "rule of thumb," 250-1. Would be glad to see workmen receive some scientific instruction, but does not think it would do much good economically, 252-3. Foreign workmen are as ignorant technically as English. In Germany, where they have received better elementary education, and even in France, there is perhaps less difficulty in introducing new inventions than here, but that may be owing to national idiosyncracies, 254-8. The scientific knowledge of German and French foremen is about the same as of British, 259. In France and Germany we more often find scientifically educated managers and proprietors of ironworks, yet this country is immeasurably before others in inventions concerning iron, and is generally admitted abroad to be so, 260-4. The British Iron and Steel Institute is looked up to all over the world as a great authority, but some of the continental societies are older, and industrial scientific research has been for a long time more cultivated on the continent than with us, 265. Our immeasurably greater contributions to the perfection of iron manufacture are owing to our great mineral wealth, which drew more capitalists; while we were not so timid as others in making trials; still, with more knowledge greater progress would have been made; the history of the hot blast shows this, 266-70. The scientific knowledge of German and French ironmasters does not cause them to advance more rapidly, even under favourable circumstances, than the English. Cannot account for

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BELL, Mr. Isaac Lowthian, F.R.S.—*cont.*

this, 271-3. Cannot say if they would advance as rapidly if less educated. They inform themselves as quickly as possible of British improvements, 274. In the United States the importance of technical instruction is fully recognized, and great pains are being taken to advance it, 275. The advance in the American iron trade has been so rapid that it cannot be due to educational facilities, it being very difficult for the latter to keep pace with it, 276-8. The high cost of labour there may facilitate the introduction of labour-saving machinery, but on the whole neither they nor any continental nation are in advance of us in this respect, 279-80. American workmen in the iron trade, which tests ingenuity as much as any, are not superior in any important respect to British, 281-2. Is satisfied with present schools for training metallurgists, but would like to see such schools established in the great metallurgical centres and in larger numbers, 283-4. Some men from Royal School of Mines are well trained, 285-6. The demand for scientific training is increasing every day, and it will soon become a necessary condition of employment, 287. We cannot look to private exertions to establish metallurgical schools. There is now a College of Physical Science in Newcastle, established by subscription and assisted by Durham University. Previous efforts had failed; the present endowment is insufficient, and attempts to increase it have not been very successful. The founding of such schools should be compulsory on Government or municipalities. The Newcastle College embraces a wider field than merely the iron trade. Report for last year handed in, 288-90. In any technical school established there instruction should be given in those principles of chemistry, &c. which apply to iron work and all other manufactures, 291-3. It is better to have the School of Mines in London than no metallurgical school, but it would be better still to have 4 or 5 smaller schools in the great industrial centres as on the continent. The expense would be greater, 294-301. Does not know of the action of the Guilds Institute in this direction, 302. Practical instruction in iron manufacture cannot be given in schools for want of the necessary appliances. Students at schools should learn science, and leave practical instruction until they enter the works, which should be while still young. Does not agree with Mr. Perkin on this point, 303-7. They should study the sciences bearing upon their future avocations, and also their application. Any scientific study, even though only as mental gymnastics, would be better than attempting to master the mechanical details of their future businesses by the aid of tools little better than toys, and which cannot easily be kept up to the improvements of the day, 308-14. Among coal miners the viewers or mining engineers alone have scientific instruction, the underviewers and workmen generally none, 315. Both viewers and underviewers should be fairly instructed in science at special schools before entering on their work, 316-20. This would be practicable if the underviewers, whose responsibilities are increasing, were taken from a higher class. They need not have worked in a mine as boys, although that is advantageous, 321-2. Neither this nor other countries have recently made great improvements in the art of coal mining, because there is no scope for it, 323-7. Does not know of any successful mining schools specially for colliers. That at Newcastle has had fair success considering the appliances at disposal. We have nothing to learn from foreign countries in coal mining, 328-31. In coke making we are rather behind the rest of the world. The French are coking coal in a way that secures all the ammoniacal salts and tars. The process was tried in Durham, but abandoned. The Bairds are trying to collect the products of distillation from blast furnaces in order to obtain their ammoniacal salts and tars, 332-4.

BAINES, SIR EDWARD, and CURZON, MR. FRANK. Pages 31 to 50.

(*Sir E. Baines.*) Is president of Yorkshire Union of Mechanics' Institutes, 335. (*Mr. Curzon.*) Is secretary of same, 336. (*Sir E. Baines.*) Has had long experience of it and previous institutes, 337. Gives a short history of the origin, &c. of mechanics' institutes, 338-40. In Yorkshire 13 institutes with 3,500 members entered into union in 1837, and in 1881 the Union comprised 256 institutes, &c., with 49,800 members, 2,950 of them females, 341-2. The work of the Union was mainly elementary, but it has now a large and

BAINES, Sir Edward, and CURZON, Mr. Frank--*cont.*

increasing number of science and art classes, 343-5. Number of teachers, lecturers, &c., 346-55. The Yorkshire Union examinations, embracing 11 departments of study, are usually conducted by gentlemen from the Science and Art Department or Whitehall on papers drawn up at Whitehall and S. Kensington, and by the Society of Arts. They do not earn grants from those departments, but the Union has prizes of its own, 356-9. The teachers are not all teachers of departmental science and art classes. Many are certificated. The examiners are either from the Science and Art Department, or unofficial men of eminence. When they are official the papers, which are those of the Society of Arts not of the Science and Art Department, are sent to London, 360-3. (*Mr. Curzon.*) The examinations are distinct from those of the Science and Art classes connected with S. Kensington—separate examiners, subjects, and results. The prizes are given by the Clothworkers' and Goldsmiths' Companies and others. The Whitehall examination does not touch the Union's. The Society of Arts examination is a little more advanced. They supply questions and the Union prizes. There were 800 candidates last year. *Sir E. Baines handed in a programme of examination, 364-6.* Examinations, prizes, &c. There are special art teachers in each principal institution. There are in the Union 16 schools of art and 90 additional drawing classes connected with S. Kensington, 367-76. The S. Kensington examiners examine for S. Kensington classes exclusively, 377-8. (*Sir E. Baines.*) The Union has also a village library, and a central library. (*Mr. Curzon.*) The circulation from the centre is 26,750, from the villages 80,250 volumes; each village library is in charge of a committee, and no denominational distinctions are allowed, 379-80. The classes are those of individual institutes—the examinations are instituted by the Union, 381-2. (*Sir E. Baines.*) The Union holds annual conferences of delegates, the places of meeting being varied, 383. (*Mr. Curzon.*) All the institutes are inspected periodically by the secretary, 394-7. The funds are almost entirely provided by subscription. (*Sir E. Baines.*) Each institution has its own subscriptions and pays its own expenses; Union expenses fall upon a general fund to which a number of noblemen and others subscribe, 388. (*Mr. Curzon.*) The Union funds amount to 1000*l.*, the entire income of the institutes to about 44,300*l.* *Sir E. Baines handed in a report with statistics.* (*Mr. Curzon.*) Abstract of the statistics. (*Sir E. Baines.*) The agent and lecturer sees that efficient staffs are employed, and points out defects, &c. Suggestions are readily accepted, and for 44 years there has been no quarrel or misunderstanding, 389-93. (*Mr. Curzon.*) The institutes are generally self-supporting. (*Sir E. Baines.*) The Union only assisting the village libraries, forming scholarships, and holding scientific classes, 394-8. (*Mr. Curzon.*) The Union devotes itself to carrying forward primary into secondary education and to technical instruction, and works through the institutes and by its prizes, 399-401. (*Sir E. Baines.*) Will furnish copies of annual report of Union, 402. (*Mr. Curzon.*) In the institutes the work of the evening classes, in consequence of the growth of elementary education, is changing. There has been a great increase of special subjects. Recommends that Government should widen the evening class curriculum so that higher literary and other instruction, including that of adults, should be paid for as science and art now are. The design of the country languishes from want of preliminary culture of the designers in literature and art, 403-20. Acquaintance with our poets would refine their tastes and improve their designs, 421. The West Riding Designers' Association is a body of textile designers, who meet monthly to discuss designing. They belong to the lower middle class—the best men among the weavers, &c.—and are mostly employed as designers in the works. They know little of art, literature, &c., and are in no way specially educated, as they should be. They obtain material for their designs by copying from each other and pirating Parisian designs, 422-32. The masters, as a rule, are as ignorant of art as the men, 433. Has for 3 successive years seen at the exhibitions designs from various parts of Yorkshire, and they show great elaboration but no thought; thinks this injurious to our trade, 434-5. Cannot compare foreign with Yorkshire designs, 436. The designs exhibited are the work of students, but the designers, manufacturers, and merchants visiting the exhibitions all agree as to the want of thought

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BAINES, Sir Edward, and CURZON, Mr. Frank—*cont.*

and originality, 437-8. Figured designs are not common in the woollen trades, and when used are usually adaptations of silk designs. This is cheaper than procuring original designs but perhaps not better. At Huddersfield Institution there was an art master, a practical trained designer, and in the loom class-room was a designer teaching the work of the fabric, the former giving tone and taste, the latter practically working it out. The result of this combination was invariably successful. Recommends its general adoption, 439-45. The Huddersfield trade specially requires originality, 446. The new Government Code insists that pupils shall enter night schools in a standard above that they last passed in a day school, and as 2½ or 3 years elapses between and the pupils retrograde in the interval, they cannot pass the examinations or earn grant. This will have the effect of closing the village night schools, as masters cannot be obtained, 447-56. Government must either pay grant in the night schools for standards already passed in day schools or pay the masters. Private assistance is already very slack, and although the pupils make payments they are insufficient, 457-9. The science and art classes in Yorkshire do not adapt their work to the district industries. Provincial art galleries are wanted, which could be furnished from material now wasted at S. Kensington—replicas or copies of good works of art—with competent men to teach principles, 460-2. From want of instruction in design and of sufficient examples of art, the teaching of art, &c. in Yorkshire is very defective, although it compares well with other parts. There is no sufficient anatomical art school in England, not even at S. Kensington, and few life schools. In modelling it is worse; knows only 3 or 4 good schools, 463-7. The Union, 10 years ago, offered money prizes to induce art schools to study the adaptation of nature to manufactures, but as it cannot afford to pay masters the schools will not undertake it, 468-9. Art masters should be employed in all primary schools, and cultured art schools, under the best men, should be established in great industrial centres, 470. The drawing taught in elementary schools is of little value; professional teaching is needed there and a higher class of teachers—artists—in art schools, 471-4. The organization of such a system would be easy. We should get the cream of the pupils, and the masters could be grouped to reach the pupils without difficulty. Masters now follow the old routine, 475-6. Better men must be got at the centre, such as Mr. Poynter, under whose administration art studies manifestly improved, 477-9. If his system were continued and greater rewards given for design, would be satisfied with the S. Kensington system. Men must become artists first and designers afterwards. The complaint that S. Kensington is making artists and not designers is untrue, 480-1. S. Kensington is doing good service in teaching design in London, but district centres have not the same advantages; provincial institutions should be furnished with objects for cultivating design, some kept permanently, others circulated. They are now insufficiently provided, 482-9. Provincial art galleries should be well supplied by Government with duplicates of specimens of textile or other articles relating to the district industry, and of the best examples of the human figure contained in the national collections, and also some originals, the local authorities providing buildings, 490-8. Art training, as a preliminary to design, might be given in primary schools, 499-501. Elementary art teaching should be given in primary schools, the present art schools elevated, and a still higher grade established throughout the country, 502-3. Science teaching in Yorkshire has not until recently been connected with the textile or district industries at all. The teachers cannot always impart the knowledge they possess. Probably 75 per cent. of the pupils pass now against 50 per cent. 10 years ago. In a village you may have 1 year a class in mathematics, the next 1 in botany, then 1 in steam, and so on, without connection. There should be district inspection and some system of grouping to give aim to the teaching, 504-6. Yorkshire science classes are generally well supplied with apparatus, &c. The present system of inspection does not touch the evil of unsystematic teaching, 507-11. Subjects should be grouped. Preliminary training for the classes, which might now be given by the institutes, would be advantageous; the Clothworkers' Company have given funds to the Union for the preparation of a text book for that purpose, 512-5. New conditions should be introduced gradually, first by persuasion and

BAINES, Sir Edward, and CURZON, Mr. Frank—*cont.*

afterwards by compulsion. They should include grouping of pupils, teaching in succession of certain sciences, and a more serious inspection of classes, 516-21. Payment by fixed salary and part grant will not meet the difficulty. There is no uniform action between villages. The same teacher begins instruction in a variety of subjects, 522-3. The Union has no funds with which to offer inducements to change the system. Government, being educated, should lead the way, local effort may follow, 524-6. Yorkshire science and art classes are doing good service, but are not adapting themselves to the wants of the textile industries, 527. Really good art and science schools would go far to supply the technical education which is needed; present classes do not. Much more might be done with the same machinery and infinitely more with better, 528-30. The Yorkshire institutes are doing great good to the 10 per cent. who reach secondary schools, but 90 per cent. do not, and the schools are not adapted to the wants of the country, e.g., the art schools are not likely to produce good designers, 531. Lace-making, &c. should not be taught by Government, but the maker should; the principles of art, &c. should reach the art schools, 532. The technology classes meet the wants of the district very inadequately, but better than they did. They could be improved by art masters assisting the practical teachers, 533-5. (Sir E. Baines.) Yorkshire College has not been in existence long enough to have had much effect on the local industries, but the weaving and dyeing schools are acquiring a great reputation and the number of pupils is increasing. A mining department has recently been organized, 536-40. The expenditure is considerably in excess of the income, but perhaps the manufacturers give as much as they can afford, considering recent depression in trade, &c. 25,000*l.* has recently been raised for new buildings, 541-4.

GEE, MR. WILLIAM, and REYNOLDS, MR. JOHN HENRY, junior.
Pages 50 to 68.

(Mr. Gee.) Is agent of the Union of Lancashire and Cheshire Mechanics' Institutes, 545. (Mr. Reynolds.) Is secretary of Manchester Mechanics' Institution, 546. (Mr. Gee.) The objects of his Union resemble those of the Yorkshire Union, but his has no village lending library, and attaches more importance to examinations, both its own and S. Kensington, especially in science, 547-50. Its examinations are attended by more candidates than those of the Yorkshire Union, and its arrangements with regard to scholarships, &c. are more complete. Its prizes are worth about 200*l.* per annum, 551-3. In addition to its own, it has examinations in connection with S. Kensington, upon which prizes and exhibitions are given, and with Whitehall, and also encourages advanced adult elementary education by examinations in and prizes for the three R's, upon which the Whitehall authorities pay grant, and more advanced subjects, for which Government pay nothing, 554-60. Number of pupils, and grants earned, 561-3. The Union acts as an examining board for the institutes in stated subjects, 564-6. Most of the institutes have good Science and Art Department classes, (list produced) progressing, but not so good as might be expected. They are tolerably well furnished with apparatus, 567-9. Agrees with Mr. Curzon's evidence in the main. Teachers should be certified for groups of cognate subjects, not for single ones, and their qualifications much higher than the pupils', 570-4. They should have some literary ability; perhaps this would not apply to mechanical drawing, 575-9. The scholarships, &c. of the Union (enumerated) are all held at Owens College, and are highly appreciated and keenly competed for by working men, who alone can hold them. They certainly advance the industrial career of their holders, 580-8. Except the Rumney scholar, the students pay their own fees, varying, but always less than 50*l.*, out of the scholarship amount; the residue would be much less than they could earn as workmen, and therefore the fact of their availing themselves of the scholarships for the full term, or until they gain a higher, is proof of their appreciation of the instruction gained. Some are tenable at the evening classes at Owens, so that the holders can work for their living during the day, but the holders of

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GEE, Mr. William, and REYNOLDS, Mr. John Henry, junior—*cont.*

these have to pay travelling and other expenses, 589-98. Except in the case of the Crewe exhibitions, the railway companies offer no advantages, and have been asked for none, 598-600. Institutes in Union vary greatly in importance. Ways in which the Union assists them, 601-4. As to Whitehall regulations, the Council think that evening class subjects should be extended, age restriction abolished, and standard restriction altered, 605-6. (*Mr. Reynolds.*) Has no suggestions regarding Science and Art Department beyond those already made, 607. (*Mr. Gee.*) 12 of the institutes have classes (some several) connected with the Guilds Institute, and others send up competitors for its rewards, 608-13. The work of the Guilds Institute is of great importance in calling attention to the need for technical education, &c.; the Council has made several suggestions, *e.g.*, as to raising standards without due notice, 614. Thinks the results of these classes practically useful to the district industries; some practical men object that the technical men are conceited, and that the time spent in acquiring general training might be better spent in workshops, 615-8. (*Mr. Reynolds.*) The history of Whitworth scholars supplies an illustration. It is said that many of them, from conceit of their knowledge, cease to take an interest in, and are therefore spoilt for, practical work, and desire to take up teaching, although they do not make good teachers. This may not apply to the awards of the Guilds Institute, but it has prejudiced practical men against technical instruction. (*Mr. Gee.*) Was told by the manager of some iron works that the Whitworth scholars there were inferior to ordinary men. They should not have been put to work at which they were inferior, 619-26. Thinks employers generally believe that a better educated workman is a better man; probably such cases as those described by Mr. Reynolds are rare. The Guilds Institute system is too recent for us to judge of its effects, but sees no objections to it. Standards should not be raised too rapidly, 627-33. The Council suggests the following scheme for their area:—Owens College to be the centre for higher scientific technology, Manchester Mechanics' Institution to be an intermediate technical school, technical classes to be encouraged in the institutes, with exhibitions to the technical school, and schools promoted in connection with workshops which apprentices should be obliged to attend, *e.g.*, Messrs. Mather and Platt's school. 2 members of the Building Trades' Institute pay their apprentices' class fees, 634-8. Manchester and Salford Building Trades' Institute is chiefly a workmen's institute of joiners and builders for studying the scientific part of their trades; they have science classes, connected with S. Kensington and the Guilds Institute, taught by practical builders; they seem satisfied with the S. Kensington curriculum; the masters at one time gave them assistance, but do not give much now, 639-46. They used to have as many as 200 students, but have fallen to 40, owing to depression in trade since the joiners' strike in 1877-9. (*Mr. Reynolds.*) At that time they lost the sympathy and support of the masters, 647-51. (*Mr. Gee.*) The institute being small its beneficial influence is very limited. The only similar school he knows is that of the carriage builders, 652-3. This is a very important experiment; if the associations of masters as well as the men would take up technical education the difficulty would be half solved, 654-5. In Oldham one large employer is a great patron of the institute, which is thoroughly effectual for its purpose, 656-7. Practical men are in favour of the introduction into secondary technical schools of standard machinery illustrating principles, but not of that which is rapidly changing; the teacher of the Macclesfield silk class speaks highly of the use it has been to him; cannot give the opinion of the silk trade there, 658-63. An engineering works' manager was strongly opposed to it; except as above cannot speak as to the textile trades, 664-6. The opinion of competent witnesses is that time would be lost by teaching manual skill in schools; many of the students are practically working all day, while others might gain some knowledge of practical work by visiting workshops, &c., 667-9. Is satisfied with the system of scholarships, &c. from the Manchester and Cheshire institutes to Victoria University, but more of them are needed, 670-1. (*Mr. Reynolds.*) The directors of the Manchester Mechanics' Institution desire to give up their general work, except in commercial subjects, and to make it the technical evening school for artisans in Manchester, much on the model of

GEE, Mr. William, and REYNOLDS, Mr. John Henry, junior—*cont.*

the Oldham school, 672-9. To do this they would organise science and technical instruction to embrace the trades of the district, especially mechanical engineering, and take students, mainly artisans, of 14 years and upwards; no entrance examination is proposed unless the applicants exceed the accommodation. The building is well adapted for the purpose (gives particulars), and the instruction would be confined to the evening, 680-S. A few typical machine tools would be provided for the benefit of draughtsmen, who in certain shops get little practical knowledge of the machines used. Young draughtsmen frequently complain that they are confined to the drawing office and cannot gain this knowledge unless they pay heavy premiums to go through the various departments, 689-701. There are many young men in Manchester employed in very mechanical descriptions of drawing who do not see the machines, hence the need for introducing a few typical ones, such as lathe, drill, &c., which would also be of use to the teacher in illustrating his instruction to other pupils, 702-7. Such an institute would attract capable artisans, and give instruction not easily obtained in the workshop, 708-9. The institute is now successful; it is not social; it is proposed to exclude the elementary evening classes, day classes, music, dancing, &c.; the fees would be low, and payable in one sum, 710-6. More time should be given to certain sciences, which should be taught by practice as well as theory; recommends that Government should give additional grant for a practical examination in metallurgy; the directors are willing to fit up a laboratory, 717-20. The present payment would be supplemented by grants from the institutes, trades unions, &c., 721. The only employers acting in the matter are the carriage builders, who have established a class of 35 at the institution, pay its teachers, &c., and award prizes. This class had originally 70 members, but many were not sufficiently educated. The students pay one fee, and are entitled for that to attend other classes; the teacher has a fixed salary *plus* grant, 722-30. The workmen in trades unions have not assisted nor shown hostility, 731-2. (*Mr. Gee.*) Concur. (*Mr. Reynolds.*) The experiment might reasonably be made with present means, trusting to future support from employers and the public, 734-5. At present 18 science subjects, about 7 technological subjects, design for calico printers, modelling, dyeing, &c. are taught, some with considerable success, 736-8. There are many dyers in the neighbourhood; they give no encouragement, though applied to, 739-42. Some of the calico-printers subscribe and send employes for instruction, 743-5. The science and art and technological examinations are not sufficiently practical, and in the latter the standards are too high and the questions do not fairly bring out the students' knowledge; they have, however, called attention to the practical value of such knowledge, which is realised by the students, 746-53. The departmental qualification for teachers is too low, 754-5. The institute training is valuable both to the workmen trained and their employers; has not traced the careers of students. (*Mr. Gee.*) Some are traced in the reports; they are generally successful in after-life, 756-60. Recommends students to take a course of pure science before joining technological classes, 761-2. An extract from the Union report, referred to in 759, follows.

RAWLE, Mr. JOHN S. Page 68 to 73.

Is head-master of West London School of Art, and has been connected with S. Kensington since 1858, first as student, then as master at various schools, 763-6. All the principal art schools are connected with the Department. They are encouraged by grants and local contributions, 767-8. The only case he knows of a municipality assisting is at Nottingham, where the corporation gave the school site for a nominal payment; the building was erected by subscription and grant; it cost 8,000*l.* or 9,000*l.*, 769-71. Many apprentices to the local industry of lace-making attend the school as a condition of their indentures, and are taught art and lace designing. There is no falling off in numbers, 772-82. At first the employers were dissatisfied with the designs produced, but taste in lace has improved, and they now acknowledge, though not fully, that designs produced by those trained at the school (many of which took very high rank at S. Kensington examinations) are successful, and students now readily obtain employment, 783-90. When he first went to West London

CXXXIV ROYAL COMMISSION ON TECHNICAL INSTRUCTION :

RAWLSE, Mr. John S.—*cont.*

School in October 1880 the teaching staff was insufficient. The school was founded by a committee some 19 years since to cultivate design; it is now desired to cultivate decorative work and designing more thoroughly than hitherto, 791-5. Number, &c. of students, fees, grant, &c., 796-807. A previous knowledge of art is desirable for students in the designing class, 808. The teaching staff is insufficient, and in some respects inefficient, accommodation insufficient, and casts, &c. incomplete. The students could come to S. Kensington to see books and casts, but do not, 809-13. The City Guilds will be appealed to for help, and, failing that, the school will be closed, 814-5. School instruction in designing may be adapted to the various industries, 816. Only knows the work of French designing schools from the objects in 1867 Paris Exhibition; much of it was hurried and badly done from bad examples, 817-20. Believes there has been a great change in France since then, 821. Does not believe that designs for furniture, wall-paper, &c. are largely imported from France, the English designers being quite equal to the French; one of his Nottingham students who failed there was engaged to manage the designs for fabrics of a Parisian firm which designs for the trade, 822-5. The Department could assist the study of design by preparing a classified catalogue of works on decorative art, and by making the instruction at the National Training School more practical; technical men—professional designers—should be engaged to teach concurrently with the art masters; to get suitable men high salaries must be given, 826-34. Technical instruction should be given at various industrial centres; there might be difficulty in obtaining suitable teachers; the Nottingham employers objected to their designers teaching, 835-8. Text-books on technical art would be very valuable, but in some branches there are no persons who could prepare them, 839-41. The social status of designers is too low. The Royal Academy ought to recognise them as artists, 842-4. There is a tendency among manufacturers to suppress designers' names, in some cases from the conditions of manufacture and division of labour, 845-7.

ARNOUX, M. LÉON. Pages 74 to 80.

Has been 33 years art director at Mintons', 848-9. Was previously engaged in pottery in France, 850. Was pupil of the École Centrale, 851. Many French manufacturers of pottery, &c. have a scientific education and send their sons to the École Centrale for training. The teaching there was in his time purely theoretical. Thus students training for ceramic work were taught as chemists. This may now be altered, 852-860. Young men who are to take a leading part in manufactories require a varied scientific training, and the École Centrale has been very successful in giving this; the students get there a good idea of the general theory of their business; they soon learn the technicalities when they get to the works, and have great influence on the men, 861-8. Pottery making cannot be learnt in a school, but the sciences connected with it can; art should also be studied, but is not taught at the École Centrale; geometrical drawing is very valuable in that and most other manufactures, 869-72. Art could be studied at the Louvre and in art schools, &c.; artists of great repute sometimes receive large numbers of pupils, 873-5. Foremen are best taken from the workmen; specially trained ones are often conceited, and the men do not like them, 876-8. Concerning the training of workmen—when he was in France there were night classes for mechanics, &c., 879. French art workmen are more facile, English more patient; this comes from their training in shops and studios, not from elementary school training nor from a particular disposition; English art school students spend much time on highly finished drawings, French make more rapid time studies, 880-4. Continental pottery manufacturers do not have special schools for their men, 885. Cannot speak as to Parisian and other night classes nor of the Sèvres school, 886-8. The art school at Limoges was established and supported by local effort, but has since been placed entirely in the hands of the Government; thinks this a step in the wrong direction; such schools are best managed locally, 889-94. Is on the committee of Stoke Art School. The training there has not been so beneficial as it might have been. A special master is required in such schools for each class, 895-8. The success of the schools of the Christian Brothers is

ARNOUX, M. Léon—*cont.*

mainly owing to each teacher taking one subject which he knows and teaches thoroughly; the training they give to lower class boys is better for industrial purposes than any other; in their higher classes the teaching is almost scientific, 899-900. A reform in that direction in England would give better results; the cost would be much greater, but it would be better to have fewer schools and better masters and to pay more attention to the training of teachers; the pupils should not be called on for higher fees; municipalities should support and manage the schools, 901-10. At Burslem and Stoke the Public Libraries Act is in operation; schools of art should be brought under it, and the maximum rate increased if necessary; the potters would not object; there are now museums and libraries in various places in the Potteries, 911-7.

See also Mr. GODFREY WEDGWOOD's evidence.

WEDGWOOD, Mr. GODFREY. Pages 80 to 96.

Is senior partner in Wedgwood and Sons, and has been connected with the business 30 years, 918-9. Had an ordinary modern school education, and no special training beyond a year's chemistry and natural philosophy. Has no time to apply his scientific knowledge; his brother has found the same thing, 920-1. Most successful potters have risen from the bench by thrift and practical knowledge of details. Pottery may be greatly developed by men of scientific aptitude and training. English pottery is the best, except that of such specialists as Messrs. Deck, 922-5. A scientific potter should have aptitude and love of research, and a liberal education ending with applied sciences; he would then have to learn the business practically in the works, 926-7. There are difficulties in the way of employing men with purely scientific training; they must know how to apply their science to commercial advantage, or work under someone who does, 928-9. Josiah Wedgwood was himself obliged to employ a chemist, and was advised by other able men; he also took a partner who attended to the artistic part, 930-2. Does not now employ a chemist; gives his reasons, 933-6. These would point to the employer himself being trained. Mintons' have trusted M. Arnoux with marked success, but doubts if there is another man so qualified as he in the world. No other potter employs a chemist, 937-8. Has visited Sarreguemines works; an engineer has charge of the machinery and construction, and the organization is admirable, 939-40. (*M. Arnoux.*) Does not know where the director was trained, but 2 engineers with him are from the École Centrale, 941. (*Mr. Wedgwood.*) One of the partners controls the machinery and scientific part at the admirably arranged Maestricht works, 942. Does not know the Limoges or Paris potteries, 942a-3. Mr. Deck is an artist, not a commercial manufacturer, 944. Agrees with M. Arnoux's remarks on foremen, 945-6. Scientific education would be of no value to pottery workmen, owing to the minute division of labour, but drawing might with advantage be taught in elementary schools to those who will be engaged in certain branches, to whom it is essential, but even the foremen in other branches would be no better for it. Concurs with M. Arnoux as to deficiencies in our recent art school training. It does not give facility in copying nor in original designing, 947-57. Apprentices and others training for the branches mentioned generally attend schools of art. His firm pay the fees of certain apprentices, but these do not attend so well as those who pay their own, 958. The want of appreciation of art schools is due to the fact that children can earn money at an earlier age in lower than in higher branches, and to the imperfect education given, 959-61. Boys trained at them are generally slow draughtsmen, 962. Great advantage would follow from improved art and science culture of employés in certain branches, therefore schools giving it should be encouraged, 963-5. Better teachers are required. This would be more expensive, and little more assistance can be expected from manufacturers. A museum also is necessary, 966-7. Cannot say if Chambers of Commerce would assist, 968-9. Would like municipalities to conduct and support technical schools, but doubts if they would do so, 970. If the schools were made of practical utility to potters they ought to pay more towards them, 971. Has employed artists and others trained at the schools, 972-3. The art schools have done great service, 974. If the schools in the Potteries were to

CXXXVI ROYAL COMMISSION ON TECHNICAL INSTRUCTION :

WEDGWOOD, Mr. Godfrey—*cont.*

work together, and employ special masters for special subjects, great good might be attained. The instruction has now no special relation to the district industry, 975-9. (*M. Arnoux.*) Has under him 9 highly skilled artists, of whom 2 were trained at S. Kensington, 2 at local schools; the remainder are foreigners, 3 trained in foreign schools. There are also a number of skilled men trained at the works, but who attend or have attended the schools. All apprentices are obliged to attend them, 980-6. The art school instruction is of service, though not so practically valuable as that at the works, 987-8. Cannot say that the schools make workmen more docile or intelligent, 989. (*Mr. Wedgwood.*) A school where scientific researches on colours, glazes, &c. could be conducted would be advantageous but impracticable, except as to colours, from the size of the ovens, &c. required. Is doubtful if any manufacturer would allow students to perform experiments at his works, 990-3. Applied mechanics, natural philosophy, and a general theoretical knowledge of the processes employed in manufactures is useful to manufacturers, 994-6. Certain colours are made on the works, but most are bought. Colour making has become almost a separate business. Does not use and the trade does not demand such a complete palette as M. Lauth at Sèvres has got, 997-9. It is of great advantage to the trade to bring out new colours, and in this and other respects science might be brought to bear. Continental discoveries have largely benefited the trade, and it is important that investigations should be continued, but has not time to organize them, 1000-2. The enormous progress of English pottery is due to results attained by practical, not scientific, men, 1003-4. (*M. Arnoux.*) There is a vast field for scientific research in pottery. The advanced state of English pottery is due to the exertions of practical potters. Foreign potters have for a long time bought the bulk of their colours of English makers. The old porcelains, the standards for colouring, &c. towards which all aim, were the work of empiric experimenters, not chemists. Has not seen M. Lauth's colours, so cannot criticise them. Would not recommend a young man to go to the proposed school of pottery at Sèvres; gives reasons, 1005-7. English china and earthenware, and continental artistic faience, but not hard porcelain, show great improvement since 1851, mainly due to competition and the employment of better men, and, to a limited extent, to the schools of art, 1008-13. Thinks there has been as much improvement on the continent as here; French faience has taken the place of English porcelain ornaments in the English market, 1014-15. The English manufacturer is in much the same position as before. (*Mr. Wedgwood.*) Concur, 1016. (*M. Arnoux.*) The Italians show a great advance, especially in reproducing old ware, 1017-8. (*Mr. Wedgwood.*) There are a few inferior collections in the Potteries, but no good museum. It would be a great advantage to have one. Reproductions and duplicate originals of works of art, &c. should be lent from S. Kensington to a greater extent, and municipalities might properly contribute from rates, 1019-23. Such collections are most important, 1024. Three places in the district have such collections largely made up of objects circulated from S. Kensington, 2 of which are under the Public Libraries Act, 1025-8. (*M. Arnoux.*) The English pottery districts are as well provided with museums, &c. as the French, but thousands of young men are trained in the shops and studios of Paris, while in London the opportunities for practical training are very limited, 1029-31. Paris has an abundant supply of industrial facilities far superior to anything we can command, partly owing to superior facilities for study, but more to the number of small establishments where artistic pottery can be seen. With us as soon as an artist can paint well he leaves the potteries. The English have as much artistic aptitude as continental nations, and by due education, &c. we might create for ourselves a supply of artistic power equal to theirs, 1032-5. (*Mr. Wedgwood.*) The technical instruction in schools he has sketched would occupy the student up to 23 or 24, general education occupying till 18 or 19. It is customary to enter business earlier, but the more education a man has the better, 1037-40. He would be so much later in acquiring practical knowledge, and be less qualified for managing a factory. Was looking rather to a scientific adviser working in concert with a commercial manager, 1041-4. This would only be

WEDGWOOD, Mr. Godfrey—*cont.*

possible in large works; small manufacturers cannot afford to experiment, and must be content with the knowledge gained in practice, 1045-6. English potters are commercially as successful as French, 1047-8. Failing further support from Government or municipalities, the manufacturers would not contribute more to art schools unless the teaching were better adapted to their requirements. Government should consult with the manufacturers. Has not himself made representations to S. Kensington; cannot say as to others, nor whether the officials there are anxious to meet the views of provincial schools. (*M. Arnoux.*) Manufacturers would do more for the schools if they got more from the schools, 1048-54. The Art Department show the greatest willingness to assist the schools in every way, and already do all they should. The rest must be left to local effort. Special teachers for special departments are needed, and could be got without greatly increased expense if the schools would act together. They should be artists, not necessarily from S. Kensington, 1055-9. The expense should be borne by manufacturers and the municipalities, or if the latter refuse it would be advantageous for the manufacturers to do it themselves, but doubts if it would pay them even with the present grants, 1060-4. (*Mr. Wedgwood.*) Does not think that localities or manufacturers would support schools where 3 or 4 masters were employed for special departments, 1065-6. A combination of 3 or 4 towns would greatly diminish the expense, 1067. Pottery workmen are exclusively employed at one branch, and technical training would be of no use to them. It would not enable them to change from one branch to another, as they could not acquire the necessary manipulative skill, 1068-71. The committees of art schools are mostly manufacturers, which shows that manufacturers take an interest in the schools, 1072-3. (*M. Arnoux.*) Some drawing is taught in elementary schools; cannot give an opinion as to its value. Pupils when they first come to the art classes know nothing of drawing, 1074-9. If children between 10 and 13 were taught linear, not freehand, drawing in elementary schools they would advance more quickly at the art schools, and it would assist them in their profession, 1080-3. (*Mr. Wedgwood.*) Colour makers are kept acquainted with the progressive requirements of ceramic art by the demands of their customers. An acquaintance with the peculiar chemistry of that art is presupposed, 1084-5. The greatest choice of new colours is found in Paris, but he purchases his mostly in England, or makes them. Knows nothing of the training of continental colour makers, 1086-9.

SPARKES, MR. JOHN. Pages 96 to 111.

Is Principal of National Art Training School, 1090. Was master of Lambeth Art School from 1857 to 1876. It is still under his superintendence, 1091-5. Has had under inspection about 5,000 children in various elementary schools at one time, who were taught drawing by the national school teachers under his supervision, 1096-9. Method of teaching in London schools. Hundreds of children could be taught at the same time by the art master, the national school masters, and the pupil teachers. The grant was and is still 3s. per successful child, of which the art master up to 1865 took 1s. and the schoolmaster 2s., 1,100-7. In that year art masters ceased to inspect national schools. The work now prescribed in the Directory is the same as regards the children, 1108-10. Many of the students know how to draw when they come to Lambeth Art Schools; assumes they learnt in national or middle class schools, 1111-3. Experiments, &c. which led to the connection between Lambeth school and Doulton's works, 1114-6. Stoneware is an old German manufacture, but the colours at Doulton's are produced on entirely new lines, owing to the different fuel used. The ornamentation (impressed forms) is founded on the German, but the designs are original, and never repeated except in pairs. No piece is moulded; each is thrown as an independent design, so that throwers and decorators are rather artists than artisans, 1117-23. In Lambeth Art School general art training precedes the special. Girls pass Second Grade free-hand examination before entering the art pottery. Those for the simpler work (dots, &c.) may only have passed First Grade, but are then sent to the art school to study for second, and receive extra factory pay for each examination passed, 1124-8. The school has been self-supporting

SPARKES, Mr. John—*cont.*

for 12 years. It is connected with Doulton's for mutual convenience only, and might equally well work with any other factory if one were established, 1129-32. It is supported exclusively by fees and Government grant. The Guilds' Institute has taken up certain classes apart from, but previously connected with it, and have given a new building in which to carry them on, 1133-8. The school co-operates with Doulton's by giving their employes special training. In the art school the work required by the Department is done; in the technical school elementary design in pottery is taught. Students can attend both. There is also a class for higher design, 1139-40. The difference between Lambeth Art School and others is that the former has always had life, designing, and modelling classes, which have now been taken over by the Guilds' Institute. The morning classes in these subjects are still carried on by the art school. There is also a class of pottery painting, not yet taken over from lack of room, which is entirely self-supporting, 1141-3. The technical classes furnish instruction for Doulton's factories and other trades also, 1144-5. Design can be taught, given taste, both in cases where form is the basis and where the design is on the flat, 1146-7. Adaptation of design to materials is taught as far as is possible without access to factories other than Doulton's. A man trained as a general designer would soon learn the conditions of any trade in which he may be employed, 1148-52. Students entering the Technical art school must be able to pass Second Grade, 1153. There is a class for wood engraving there which has had remarkably good results on the careers of its pupils, half of whom are girls. Both the Central School and art schools have been hampered by the rule that no grant shall be given for anything that can be considered trade work, 1154-5. As citizen thinks Government should not subsidize trade, but as art master has felt it hard that designs in pottery should have no more recognition than a sketch on paper. The Guilds Institute supplies a want in this respect, 1156-7. It is difficult to draw a line between general and technical art teaching. Access to the machines, &c. at the Guilds' Institute would be a great aid in teaching design at the Central School, 1158-9. The same kind of opportunities might be more easily and advantageously given in the various country industrial districts, but the best designing will probably always be found in London, 1160-1. Few English art schools have modelling or life classes, 1162. Results of teaching at Lambeth school on careers of certain students, 1163. There are about 100 students in the school connected with the City Guilds, 1164. In other trades good results have been obtained, though they are more difficult to follow. Of 250 art workers at Doulton's, probably 240 are from Lambeth School and 2 are from the Central School, 1165-6. The English have greater natural art capacity than any other people. The opposite opinion is held only in England, 1167-9. Calico-printers buy designs in Paris to a less extent than 20 years ago, and it must be remembered that there are English designers working in Paris, 1170. Nottingham art school has been a great assistance to the lace trade there. A Nottingham designer has gone to Paris to design lace, probably for England, 1171-3. With proper training we could hold our own in design against the world. We have developed men of more original artistic talent than any foreign country. Gives instances. A designer must be first trained as an artist, and a person who can design pictures could probably be as successful in ceramic or textile designing, 1174-82. In Lambeth technical school teachers are paid, with one exception, at the rate of about 100*l.* a year for five evenings a week. In art schools the classes under the Department can be controlled but not morning classes, and in the latter courses of teaching inferior to that prescribed by the Department are often followed as more profitable to the masters, 1183. The payment-on-results system is bad for anything beyond elementary work owing to the difficulty of testing results. Teachers should be paid partly on results and partly by subsidy, 1184-5. Before 1864 payment was partly by results partly by a fixed payment depending on what certificates the master held. It was proved that those with a larger number of certificates obtained greater results than those with a smaller. The principle involved between that and the present system is that of a fixed payment from Government to the master. A life class would probably, and a modelling class certainly, have to be subsidised by the

SPARKES, Mr. John—*cont.*

holder, 1186-90. Government were unwilling to admit that modelling, life, and higher designing classes should have higher rates of subsidy than those of lower aim. If that were recognised, payments by results would be possible while giving the required encouragement to art; but it would be difficult to test the results in higher stages. A further graded system would meet many objections, 1191-4. Government do not subsidise trades or fine art but only industrial art. Defines industrial art, 1195-9. Art as applied to trade should be encouraged, but not trade. Government tried to establish schools of practical art, but manufacturers objected on the ground that it would make their trade secrets known. Believes the feeling is very much changed now, 1200-4. It is difficult to distinguish between general design and designs for a particular trade. The success of Lambeth school has been largely owing to the harmony between its teaching and the practical work of its students in the factory. Government recognises a pottery design as well on paper as in the ware, allowing nothing for technical difficulties, 1205-6. Pupils after passing second grade and obtaining employment still attend one or both schools, 1207. Probably 80 per cent. of the art workers at Doulton's who have passed through the school remain in connection with it after graduating. With one exception, all the capable ones remain permanently in the manufacturer's employ, 1208-12. Art school students in the Potteries district are from the same social class as, but perhaps are less educated than, those at Lambeth, 1213-5. The fees at Lambeth are 2s. 6d., and for morning classes 10s. 6d. a month. The classes there correspond with the artisan classes in the Potteries. The fees and grants cover expenses there because of the high fees of morning classes, which the Potteries schools do not have, 1216-9. 20 per cent. of the morning students attend with a view to earning their living, 1220-1. S. Kensington Museum is of great value in teaching design, giving students in London an advantage. There is nothing like it in English or French provincial centres, 1222-4. The tuition in French art schools and night drawing classes is less exact and systematic than in ours. The students draw with interest and get facility of hand but not exactness, 1225-7. In England good designers will frequently leave designing and take to painting pictures; this is not so in Paris. In France picture painters frequently design patterns also, 1228-9. English art training is sounder and more exact and systematic than Parisian, 1230. We are setting about training designers in a better way than they do in Paris. There they have more trade experience, but they have nothing approaching S. Kensington Museum, which makes up to us for all their advantages, 1231-2. Large numbers of workmen come to S. Kensington to study; Doulton's sometimes pay half-time to certain of their employes when so engaged, 1233-5. The free instruction at Parisian and Belgian schools increases the numbers and regularity of attendance. Would not recommend free instruction in England. That which is paid for is most valued, and the attendance in Belgian and French schools is very perfunctory, 1237-9. Thought the art schools were getting self-supporting. Cannot discuss the proposals as to Staffordshire schools. The training of artist workmen, &c. there is prejudiced by minute division of labour and the bailies, 1240-3. At Lambeth assistants rise to be artists, the schools supplying instruction and the work stimulating and testing invention, 1244. The girls for elementary work in the potteries there come direct from national schools; they have always passed in First and generally Second Grade drawing. In day schools would add mechanical to the present elementary drawing, or substitute it for object drawing, 1245-8. Judging by certain designs shown the Kindergarten system is a valuable one for children and a sound basis for subsequent training in design, 1249-52. Better elementary drawing instruction in infant and day schools would not aid subsequent training in design; the children are too young, 1253-4.

FOSTER, PROFESSOR GEORGE CAREY, F.R.S., and AYRTON, PROFESSOR W. E., F.R.S. Pages 112 to 124.

(*Prof. Foster.*) Is professor of physics at University College and examiner in electricity and magnetism for Science and Art Department, and has been examiner in physics at London University, 1255-8. Technical education aims at producing (1) skilful workmen, (2) intelligent foremen and employers.

FORSTER, Professor George Carey, F.R.S., and AYRTON, Professor W. E., F.R.S.—*cont.*

Manipulative skill can be taught in the workshop, the nature and reasons of the various operations, in technical schools, &c. The latter is a matter of applied science, and must be founded upon an extensive knowledge of pure science generally, which should be tested by strict examination before commencing applied science instruction, 1259-61. The instruction at University College is mainly in pure physics; there is no special class of applied physics, 1262-3. Instruction in applied physics following that in pure science would be advantageous. It would deal in detail with the application of the principles previously learnt, 1264-6. The machinery, &c. required would be such as to show the essential conditions of practical success in the various processes, but need not be on a manufacturing scale, 1267. Such instruction is mainly needed for employers and foremen, though in some trades a certain amount of technical education would be valuable to workmen, 1268-9. There is no course of applied physics at University College, although there have lately been a number of engineers there; they took the same course as others. A course of pure physics, irrespective of its application, is useful in training men for industrial pursuits, 1270-2. (*Prof. Ayrton.*) Was professor of physics at the Technical University in Japan. This is distinct from Tokio University. The students, of whom there were a large number, were trained in all branches of engineering. Will put in a syllabus of instruction, 1273-6. Is now professor of technical physics at the Guilds' Institute, and has a considerable practice as an electrical engineer, 1277. Workmen cannot be expected to learn much pure science; they should rather be taught science through their trades, 1278. Many of the students under him are actual workmen; some are foremen, masters, &c., 1279-80. Technical training in physics can be given to workmen with advantage. Many employed in electrical engineering are mere machines, and the result is careless and wasteful work and consequent high prices. The same would probably be true in other branches of engineering, 1281-4. Similar training would be valuable to intending opticians, if practical opticians with scientific knowledge were engaged as teachers, 1285. Considerable difficulty would be found in obtaining suitable teachers with practical knowledge of special trades, but there are such, and more would be found as wanted, 1286. Knows of no school for the teaching of opticians; the same was true as to electric engineers 2 years ago, but splendid results have since been obtained, 1287-8. Provincial classes in practical electricity are being started, 1289. For managers and foremen a good training in pure physics would be a great advantage. They would afterwards have to be taught technical physics, but a great saving of time would be effected, 1290. Sir W. Thomson, under whom witness studied, is professor of physics, but is largely engaged as an electrical engineer, hence his instruction is a fair example of what technical instruction should be, 1291-2. Technical instruction could not supplant workshop training, their objects being distinct, though it might shorten apprenticeship, 1293. An intermediate course between the course of pure physics and workshop training would be desirable. The students should use tools for experimental investigations, not learn trades, 1294. Technical instruction might or might not make men conceited and unteachable according to the class of teachers and course pursued, 1295. The objections that technically instructed men (1) think that they know everything that can be learnt, and are unteachable, (2) insist on discarding all old methods and substituting new, are both met if the teacher is an experimenter and engaged in actual professional practice, 1296. There would be some difficulty in obtaining teachers at first, but men would be found who from love of teaching would give up a part of their time for remuneration somewhat less than but comparable with what they could gain in professional practice. They should either be actually practising or have practised, that their teaching may be practical and keep pace with improvements, 1297-1300. The professor of physics at the École Polytechnique in Paris does not practise any profession but teaching. Cannot speak as to other professors there or at the École Centrale, 1301-2. Teachers of pure physics in universities, &c. need not be practising engineers, &c., but teachers in technical colleges, &c. should have been professional men, even if not now in practice, 1303. The great engineering success of England is mainly due to our material resources and national

FOSTER, Professor George Carey, F.R.S., and AYRTON, Professor W. E., F.R.S.—*cont.*

powers of application; technical education was started in foreign countries to enable them to compete with us, 1304-5. The masters should pay the cost of technical instruction either directly or as a tax administered by Government. They engage to teach their apprentices, but the conditions of trade (large factories, &c.) prevent them from doing it personally, and therefore they ought to bear the cost of doing it otherwise. Much good might be done by technical schools attached to large factories, the funds being provided by the masters, and access to the works given for teaching purposes, 1306-8. In cases where no apprentices are taken masters should not be compelled to give technical instruction; but it would be to their interest to do so, 1309-10. Factory schools would supply the intermediate course mentioned in 1294. A number of works of the same kind might establish a central school to be attended by apprentices from all. (*Prof. Foster.*) It would be impracticable to require workmen to go through a course of pure science. Students must be examined in pure science before being allowed to commence a technical course, or a number of candidates would come without sufficient general knowledge to profit by it, and this the teachers would have to supply to the detriment of their special instruction. (*Prof. Ayrton.*) Teachers for workshop schools might be men practically acquainted with their trades and the application of science to them, who had distinguished themselves in technical examinations. They might be trained at S. Kensington, part of their expenses being paid, 1311. A few workshop schools have been established, with successful results, 1312. When a course of technical instruction is properly started a great desire to attend it is shown; if there were more such courses a very wide desire for such instruction would be found to exist, 1313. It is not the fact that foreigners come to England to get them out of scientific technical difficulties,—the Americans do not as to engineering, some chemical trades connected with dyeing have left us and gone to the continent, and in electric lighting we have adopted foreign machines,—they come to us to get money, 1314-8. Among his night-class students has workmen, foremen, masters, and teachers; some when they come have good mathematical knowledge, others practically none, 1319-20. The artisans have usually learnt some mathematics and science but forgotten them; they would not see the value of pure science; must at once begin teaching the application of science to their trades, 1321-2. Boys in elementary schools should be taught more experimental science. Not much could be done in technical science before the age of 14; that must come after, 1323-4. Success of his technical teaching in Japan, 1325-7.

See also DR. SIEMENS' evidence.

BROWN, Mr. HARRY. Pages 124 to 125.

Is assistant secretary to University College, 1323. The technical instruction there costs 5 times as much as the students pay, the college supplying the deficiency, 1329-30. It helps to fill other classes, but is still a loss, 1331. The remedy would be funds for apparatus and professors, which could only be got from Government, private sources having failed. The City Guilds' give 400*l.* a year, 1332-4. To make the schools a success the fees will have to be reduced. Many would like to attend them but cannot afford to, 1335-6. Students sacrifice what they would otherwise be earning. Poor boys could not attend unless they had exhibitions, 1337-8. The students are sons of well-to-do people, with a certain number of poor students from the Guilds Institute. The difficulty as to fees is felt even by the former, although the instruction is appreciated, 1339-41. Fees, &c. for certain courses, 1342. The cost to students is greater than at Owens from lack of endowments. The number in the 2 technical departments is 80 or 90, and is increasing, 1343-5.

SIEMENS, Mr. C. WILLIAM, D.C.L., LL.D., F.R.S. Pages 125 to 143.

Is president of Midland Institute, 1346. Is native of Germany, and was educated there, but has resided nearly 40 years in England, 1347-9. Has

SIEMENS, Mr. C. William, D.C.L., LL.D., F.R.S.—*cont.*

come much in contact with masters, foremen, and workmen in Germany, France, and United States, and still more in this country, 1350-3. Received a general but limited education, (1.) partly classical, (2.) technical, at Magdeburg, (3.) scientific at Göttingen, 1354-8. The foundation of all technical instruction is pure science preceded by a general education, including languages and mathematics, 1359-60. A little elementary physical science should be taught even in board schools to children of from 12 to 14. No child should be allowed to leave school before 14, whatever its knowledge or aptitude. Children of 12 may be exceptionally allowed to work as half-timers in Germany, but are not apprenticed till 14, 1361-71. The period of workshop training in trades might with advantage be shortened if boys remained at school till 14, 1372. Instruction in the use of tools, &c. before that age would occupy time and turn their thoughts from more valuable mental training, 1373. Sufficient dexterity, &c. can be acquired after 14. Up to 20 mind and body can be moulded to the shape required for a later life; witness the effects of military training on Prussians of 19, 1374. Such instruction in manual work as is given in certain Parisian elementary schools would have no industrial value, though it might have a general training value, 1375-7. It might if done as pastime give a taste for manual work and an appreciation of the dignity of labour, but should not be treated as an introduction to future work, 1378. Boys in elementary schools (remaining at school till 14) should be taught the elements of drawing, perspective and the rudiments of practical geometry rather than free-hand or machine drawing. Object drawing is more useful than copying, as it exercises the mind, 1379-87. Foremen, both here and in Germany, are selected from the workmen and not specially trained in schools. This is a good practice, 1388-93. Managers, masters, &c. should have a general education, including languages, ancient and modern, mathematics, and natural science, and should stay at school until 16 or 17. This should be the general course of education. The Germans who have long had separate classical and modern schools are now gradually combining the two, 1394-8. At school the object should be to lay solid foundations, to exercise the mind and awaken interest, not to teach higher branches of knowledge, and for this an ordinary school course is long enough. Too much time is usually given here to classics, 1399-1401. The training for all should be the same, whether they were to leave school at 16 or 18 or to go afterwards to college, and irrespective of natural bent. This would involve no loss of time whatever branches of study they may afterwards follow, 1402-5. Having left school at 18, the future master or manager should have some college training, devoting himself mainly to branches of study connected with his future avocation; those leaving at 16 would go directly into practical life, 1406-8. For certain professions a high education in pure science is needed, and those intending to follow such should go direct to college; others should at 18 either divide their time between actual work and college instruction, or engage in practical work for a time and then go to college, otherwise they would lose the aptitude of becoming practical men. The handling of materials and routine business could not be thoroughly learned in a college. The Germans have attempted it, but unsuccessfully, 1409-12. In the workshops, &c. at University and King's College the practical work should be such as illustrates principles, not all the minute detail of practical manufacture, 1413-4. The very advanced mechanical drawing taught in German and Swiss polytechnic schools is apt to cause students to mistake details for principles and to become unteachable, 1415-6. A young man intending to be a practical engineer should enter the works at 16, or at 18 if he intends to be an engineer of the first class. Civil engineers should be mechanical engineers first, so the same applies to them. He should remain in the workshop for 2 or 3 years, and then proceed to a higher school, not a polytechnic school where he would go through prescribed courses of detailed applied science, but a university where he might devote himself to those branches of science that would be most useful to him, where the principles underlying his business would be taught, and opportunities given for original research. In the former routine would be taught, in the

SIEMENS, Mr. C. William, D.C.L., LL.D., F.R.S.—*cont.*

latter original thought would be developed, 1417-29. Supposing it were thought desirable to give such a young man of 18 a school training, instead of sending him into a workshop, a better training would be obtained in a university where all branches of science were taught, including branches bearing upon certain applications, than in a polytechnic school, 1430. There is no such institution at present, but there are several institutions in this country that only need development to become such, 1431-2. The German university and polytechnic school were suited to the circumstances of Germany, but not of England, and should not be copied here, where questions of cheapness, &c. are of greater importance, 1433. A considerable number of the young men in question would return to school at 21 or 22, and it would be better for those who would not to enter business at 18 and pick up further instruction as they can than to follow a course of technical education up to 20, 1434-5. Does not agree with Prof. Foster that pure science teaching should be followed by a course of technical applications before the youth enters the workshop, 1436. A manager or manufacturer who has been taught to the age of 18 the necessary elementary knowledge should then enter practical life, and afterwards return to the study of science if so inclined, 1437. Applied science might be taught in evening classes to persons of a somewhat inferior grade, 1438. Much good might be done by giving to those who cannot afford to return to school, and to foremen, opportunities to complete and renew acquaintance with scientific principles. Principles can never be over-taught; a knowledge of them causes a man to hail with delight each new advance in science, whether pure or applied. Science in its applications can be over-taught, since processes constantly change, and the old methods may not at all help a man to understand the new, 1439-40. Would not object to the teaching of applied science if the previous education in pure science were sufficient, but the time given to education is limited, and by dwelling too much upon particular applications, you discourage the study of principles (1) by reducing the time that can be given to it, (2) by causing students to regard the applications as more important than the principles on which they are founded, 1441-2. A young man who at 16 or 18 entered a workshop where only one class of work was done would have to gain experience of other branches before he would be a good mechanical engineer. After acquiring a certain amount of knowledge he would be able to obtain employment in a number of firms in succession. The important thing to learn in practice is the qualities of materials, &c., not the absolute mode of construction. Thus, the marine engine differs from the locomotive only in details. A good locomotive engineer ought to make a good marine engine after giving a little attention to the difficulties of arrangement, &c. If scientific principles had not been lost sight of the advance, which has taken place during the last 20 years in marine engineering, might have occurred much sooner, 1443-9. Classes like those of the Guilds Institute are highly useful to men of limited education. The teachers of applied science would of course remind students of the first principles underlying it, 1450-1. Understood Prof. Ayrton to say, and agrees with him, that an artisan, understanding the effect, wants to know the principle underlying it. (*Prof. Ayrton.*) Meant to say that with an artisan you must take a machine as he knows it, and analyse with and for him the principles underlying its action. That he would not teach the actual making of the machine, but only why it is made as it is, and why certain changes might be made in it for scientific reasons, 1452-8. (*Dr. Siemens.*) In a school of dyeing would teach the principles upon which and conditions under which dyes and mordants combine. Chemical apparatus would be required, not that in use at dye-works, 1459-60. Would not teach receipts, but the principles on which they are prepared, 1461. The student would not so well acquire the principles of chemistry applicable to dyeing by being taught gas analysis, &c., so would specialize to a certain extent the instruction given, i.e., would teach those principles. (*Prof. Ayrton.*) In electrical engineering would not teach a man to lacquer, &c. the instruments, but would take a dynamo the man was accustomed to use, and explain why wire of a certain thickness and why particular materials were used. Would not teach him how to construct the machine

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or the dimensions of parts, but if there were scientific reasons why one part was 3 times as thick as others would explain those reasons. On that account the teacher should be practically engaged in the art he teaches. It would be essential to have the machines for illustration, &c., 1462-8. (*Dr. Siemens.*) There is great difficulty in getting good teachers. One with practical knowledge alone would do only negative good. (*Prof. Ayrton concurs.*) Does not agree with Prof. Ayrton that there should be 2 classes of teachers, (1.) Men of science purely to teach pure science, (2.) Men of science and practice to teach its applications. There might be 2 classes, but they should be one for the teaching of elementary science, and a higher composed of scientific teachers with a knowledge of the processes of special manufactures sufficient to enable them to understand those processes and see the difficulties that might arise, 1469-70. Would not consider it necessary that a teacher of the theory of mechanical engineering should be in practice as an engineer or know all the latest advances. Is not sure whether Sir W. Thomson's engineering practice, &c. renders his teaching more valuable, but his exhaustive information on secondary questions makes it invaluable, 1471. The instruction in connection with the Guilds Institute is specially useful in teaching an artisan the principles underlying his trade, 1472. The instruction in science and art classes connected with S. Kensington and other similar classes is useful, as teaching principles, leaving it to the artisan to ascertain their application, 1473-7. Has received students from both King's and University Colleges, who, from their training, have shown great aptitude in applying science, 1478-9. The system at University College of ascertaining strength of materials by tests and calculations is most valuable. It gives knowledge that would not be obtained in a workshop, and which should be taught at such colleges. (*Prof. Ayrton*) In Japan, all the students had the same training between 16 and 18, and between 18 and 21 spent half of each year in factories appertaining to their trades, and half in the college, 1480. (*Dr. Siemens.*) If such a system were practicable here, it would answer the same purpose as 2 years' practical work and a subsequent return to college, 1481. English workmen have more method and produce more results with a machine than French or German, but the German has more patient application in adjusting &c., 1483-4. English foremen keep better at their work, foreign have more theoretical knowledge; cannot say which are better, 1485. The old class of English employers were rather commercial than technical; from want of technical education they took no interest or pride in the operations carried on, and were more prejudiced against innovations than foreigners; but that is changing now, and a taste for science is springing up, 1486-9. The only branches of mechanical engineering in which continental nations excel us are those where great personal care and application are necessary. In others no country is in a better position than this, owing in a great measure to our large production, 1490-1. Where material advantages are equal and excepting instruments of great precision, relatively greater progress has been made on the continent than here during the last 20 years. We have progressed, but other countries have progressed more, 1492-3. English locomotives, for instance, are well adapted to their purpose, but foreign builders have produced excellent types, of their own design, adapted to their own wants, 1494-6. In hydraulic machinery England stands first, 1497. Germany has produced better steel guns, &c. than we, and America has advanced more than we in agricultural implements, owing to their more intelligent purchasing public, 1498-9. It is difficult to say whether English or continental manufacturers produce the best instruments of precision. In English workshops where such are made many German workmen are employed. (*Prof. Ayrton.*) Some of the chronographs sold by Dent are made in Germany, though perhaps not the best chronometers, 1500. (*Dr. Siemens.*) Masters should be bound to send their apprentices to evening classes. Those connected with S. Kensington are of a satisfactory character. Scholarships might be useful, but the supply of efficient teachers and good appliances is more important, 1501-4. The ration should largely support educational institutions rather than establish them, 1505.

GRAHAM, PROFESSOR CHARLES, D.Sc., F.I.C. Pages 143 to 149.

Is professor of chemical technology at University College, 1506. Is engaged in teaching future masters, &c., 1507. After an ordinary school education they should go to a college where general literature and science are taught. A foundation might be laid there in general education, then pure science, and afterwards applied science, taught, 1508-10. Has technical classes at University College, and curricula have been drawn up to show the courses considered most desirable; they are not compulsory. It is suggested that students should attend those classes in their third year, i.e., after courses of pure science; the application of that science would then be taught by witness, 1511-2. Subjects of his lectures, 1513. Some attend the applied science courses who have had no previous training; they profit much by the instruction, but not so much as if they had previous chemical education, 1514-5. Quotes from the prospectus the suggested course for students in brewing, &c., 1516. Composition and instruction of his brewing class, 1517. Does not give much time to the study of scientific principles but comes to applications in second or third lecture. Does not find much difficulty in explaining the chemistry of processes with which the students are familiar and imparting knowledge of great value to them in their trades notwithstanding their lack of scientific training. The younger men have generally some little knowledge of chemistry. With the older men there is difficulty in teaching the more complicated reactions, &c., 1518-20. Brewers value the courses and attend them, sometimes incurring the expense of a second course, 1521. In the laboratory each student conducts experiments independently, 1522. In a brewery a man is merely taught the practical part of brewing. Only a few brewers in England have chemical laboratories, 1523-4. Is not acquainted with Dublin breweries, but Guinness's second brewer arranged to study the subject with witness, so presumably he had not the facilities there, 1525. The chemists in breweries do not give systematic instruction, 1526. His course is somewhat expensive. The cost for the laboratory for 10 months is 25 guineas; would prefer to see it lower, 1527. Mr. Brown's statement that the practical teaching costs 5 times as much as it brings does not apply to witness's department, which pays its expenses, but may to others. It would apply more to Prof. Kennedy's department, 1528-9. Has no definite suggestion to make as to meeting these extra expenses, but voluntary subscriptions would be most useful, 1530-1. Some of the German brewing schools are founded by the State; prefers public subscriptions to State aid, as giving greater freedom, 1532-4. No attempt has been made at University College to obtain funds for establishing a school of brewing. Brewing is not a special feature there. More than 20,000*l.* was subscribed towards a new building, but brewers as such did not contribute. Does not think that brewers would contribute largely towards a school of brewing. Does not approve of special technical schools. The scientific principles that underlie such arts as brewing or agriculture can be better taught at colleges like Owens or King's, and the practical part in breweries or on farms, 1535-9. Experimental farms are useful, but it is not useful to have a farm where a number of lads pretend to work. A lad had better go to one where he will have to work like other employes, 1540. "Agricultural stations" are very useful, but they should be devoted to experiments and not attempt profitable farming, 1541-4. The German brewing schools are not examples to be followed, 1545. Considers his course of 10 or 12 lectures on the chemistry of brewing sufficiently long for all practical purposes. Devotes the time entirely to principles; does not teach practical details, and consequently it is not necessary that he should be acquainted with them, 1546-7. It would be impossible that he should have an intimate acquaintance with the latest developments in the trades with which he deals, but, without it, can impart valuable knowledge that would not be acquired in a factory or by studying pure chemistry, 1548-50. Agrees with Dr. Siemens that principles are all essential in any trade, but in educating a middle class lad we should at least try in the last stage of his college career to enable him to acquire technical knowledge quickly, 1551. Does not teach processes but explains the reasons underlying them, 1552. His laboratory at the college is distinct from that for pure chemistry, and the courses are distinct. Technical instruction should be given in a college where literary and scientific instruction is given, so that when a student in his third year is studying applied science he might at the

GRAHAM, Professor Charles, D.Sc., F.I.C.—*cont.*

same time have an opportunity of continuing his education either in literature or pure science, 1553-8. A large number of students in brewing come to witness who have not that knowledge of pure science which is desirable, but still the instruction given has a distinct commercial value to them, 1559-60.

MORRIS, Mr. WILLIAM. Pages 150 to 161.

Designing is an important element in his business, 1561. Makes his own designs mostly. Requires originality, and it is difficult to get that among designers, 1562-5. Englishmen possess originality. The superiority of the French in design is to a great extent the result of training; they are masters of style, but have less innate love of beauty in lines and colours than the English. The French have a natural tendency towards system in all things, which in art leads to style; in some respects they overdo this, preferring it to beauty, 1566-73. In textiles the French designers have a greater reputation than ours. We copy and purchase from them, 1574. Wall papers are more used in England than in France, and our designs are more original and better than theirs, 1575. Does not know what the French do in printed furnitures, but they have an enormous variety of woven stuffs for furnitures, and show great cleverness in adaptation of material, &c. Has been amazed at the cleverness shown in samples from the South of France. Does not know where the designs were produced, 1576-8. If the technical designers did the greater part of the drawing, instead of only adapting the work of mere artists like some of the Paris designers, better results would be produced, both as works of art and in the long run commercially. It would, perhaps, raise prices, but division of labour while lowering prices lowers quality, 1579-80. Believes there would be a demand for a high class of goods designed by an artist who also arranged its being put upon the loom, although cheaper goods would command larger sale. In France there is a large market for high class goods, 1581. In low class goods we can command the markets, but the French do a great deal in cheap artistic figure weaving for furniture. In high class goods we have to compete with articles designed by Parisians (who, as he believes, design for all the textile trades) and woven in the provinces. To hold our own we want an education both general and technical of all our workmen. This should be obtainable in their own towns without coming to London, 1582-5. We should not attack the French on their own ground, but try to produce our own styles; we might in time produce as good paying results as they, and even command the French market for designs. Some of our designs are already attracting attention in France and America, 1586-8. The artist and designer should be one. He must study old examples, but should check conventionality by constant study of nature, 1589-91. A man who is to be a designer wants to be taught to draw thoroughly. The course at the Departmental schools of art is good on the whole. Concerning the complaints that rapidity is sacrificed to elaboration in our art schools, considers rapidity a good thing if not carried too far. Too much value used to be attached to extreme finish, but is not now. The judges in the national competitions always value the fundamental qualities of the draughtsman. It is a mistake to suppose that high finish is necessary to obtain a place in these competitions, 1592-6. Does not think any changes are essential for preliminary training; in the present curriculum some masters work too much in the direction of picture painting, 1597-1600. A student training for, say, lace designing, should, besides studying from good models and nature, have easy access to good examples or drawings or prints of old lace, &c. The same applies to other trades, 1601-4. There should be in each locality a complete set of historical examples of the local industry, and a collection of beautiful objects in other manufactures, 1605-7. Localities should establish their own museums, but national aid might be given, 1608. S. Kensington Museum should not be to any extent broken up, but superfluous objects might be sent to provincial museums. Does not approve of the circulation system, although it is of use in cultivating general taste for beauty, because (1) there is danger to specimens in transit, (2) museums are most useful when arranged in a permanent manner. Large manufacturing towns should have their own museums of original specimens and copies, typical of their own manufactures, 1609-12. Agricultural towns should also have

MORRIS, Mr. William—*cont.*

museums to cultivate public appreciation of excellence, 1613. Would make the central museum the first care, and, without entirely suspending the circulation system, give aid to the foundation of permanent provincial museums having special reference to district industries, 1614-5. Museums in the Potteries towns would be worthy of aid. Reproductions of objects at the central museum should be distributed among provincial museums; they would often be almost as valuable for study as the originals, 1616-9. The circulation system makes museums more attractive by supplying novelties; it might be continued as regards articles that can be safely circulated, 1620-1. In the S. Kensington collection of Indian fabrics, and the Bock collection of textiles, there are many specimens that might be sent to provincial museums, 1622-3. Some of the specimens of blue pottery in the Persian collection might be spared. S. Kensington is also very rich in ancient pottery and majolica, of which, though reproductions cannot be made, drawings might, which would be almost as useful, except in Potteries towns; a few examples would be sufficient, together with drawings, 1624-8. Recommends lithographed drawings rather than reproductions of metal work. Preparing these drawings is capital education for students in the art schools, 1629-33. Weaving designers are trained in art schools, and draw passably, but have finally too much to do in the mechanical line to attend much to drawing, 1634. Knows no more of weaving schools than that they exist and are very perfectly carried out, 1635-6. Opportunities should be afforded in art schools for learning the practical part of designing. Since apprenticeship has become less common young men in workshops are very badly taught their trades; there should be some systematic training, 1637-9. Looms might be introduced into art schools with advantage. A designer should be able to weave, and this might be advantageously taught in the schools if practicable. The student would be less hurried than in a factory and could be put through a systematic course; in workshops it is often the interest of those who teach him to keep him back, 1640-2. Our textile industries have suffered in competition with other countries from want of school training in designing, 1643. It is commercially important that the designer should be thoroughly acquainted with the machine on which the article designed is made, otherwise he either works by rules and is cramped by them, or, if a great artist, produces impracticable designs, which are altered and often spoilt by the manufacturer. This applies to all work that has to be put through a machine, but especially to such work as calico-printing, where the number of colours in a pattern is limited, 1646. It is essential that the designer should have knowledge of the material and machinery used. Cannot say if or how this could be taught in art schools, 1647. Elementary literary instruction has much influence on the ultimate success of workmen, 1648. Everyone should be taught to draw, 1649. Knows that drawing is taught in elementary schools, and is going to visit one to see what is done; will put in observations upon it, after he has seen it, 1650-2. Men intended for designers should generally draw more or less from the human figure, but for some plant form is better. They should continue general art instruction after entering on actual employment, 1653-4. The French have style innately, and generally take great pains to develop it, 1655. With an improved system of art education the style of English design might be greatly improved without sacrificing individual or national idiosyncracies, 1656. Does not think there is in London a school of professional designers similar to that in Paris, but there are many half-professional designers, generally uneducated in the technique of the arts they design for. Does not think they supply the provinces to any great extent, 1657-8. Carpet designing is mostly done where the carpets are made. The carpet designs in the national competition come mostly from Kidderminster. Some are prepared for the purpose of adoption by the Kidderminster manufacturers. Designs are sometimes made too fine for profitable execution, 1659-61. We export carpets to America to a certain extent; cannot say as to France. The Americans manufacture carpets. They sometimes buy small pieces from Kidderminster and copy the designs. Our only carpet importations from Europe are a small quantity from Aubusson, and hand-made ones from Holland, 1662-5. It would encourage designing if prizes were given in the national competitions for goods themselves and not merely for designs for goods. Sufficient attention is given to the employment of experts as judges, 1666-9.

cxlviii ROYAL COMMISSION ON TECHNICAL INSTRUCTION :

PEACE, MR. MASKELL WILLIAM. Pages 161 to 169.

Is secretary to certain Mining Associations, &c., 1670-3. Wigan Mining and Mechanical School, of which he is honorary secretary, was founded in 1858. In 1867 it was closed, as the operatives for whom it was intended did not attend, 1674-5. In 1869 it was reopened. The principal employers give preference in promotion to workmen obtaining prizes, &c. at the school, with beneficial results to themselves and the school. The certificates given to successful students have been a great inducement to join and have advertised the school, 1676-8. Instruction is given on 3 evenings and 1 morning per week, and occasional visits are made to the principal works, 1679-80. List of classes with number of students and progress from 1867; it cannot take more students from want of accommodation, 1681-2. The number of students is less than in 1878, but more prizes and certificates are taken than at any previous time. In 1877 and 1878 lecturers from Cambridge lectured in the schoolroom on geology, Shakespeare, and other subjects, mainly scientific; this gave a great impetus to the school, 1683-5. There is a special section for the technical education, theoretical and practical, of colliery managers, 1686-8. Gives a sketch of the scheme of examinations for mine managers' certificates. The examinations test knowledge required for safe working, not commercial success. Machine construction is not included, 1689-90. Appointment, &c. of examining boards and examiners, and control by Home Office, 1691-4. Intending colliery managers are at Wigan school induced, if possible, to attend the ordinary classes there, and their instruction in practical mining work is given in special classes. The students pay the expenses of the class, and the school provides rooms, competent teachers (named), and, with the aid of the Science and Art Department, apparatus, 1695-9. In the general classes instruction is given in sciences connected with the district industries, 1700. Of the 165 students at the school proper in 1881 a large proportion were working artisans, a fair proportion working miners, and some underlookers, but few foremen, 1701-6. Men aspiring to be foremen attend, as passing the examinations gives a claim to promotion, 1707. One half of the successful candidates at the last Government examination at Owens College were from Wigan school, 1708-9. It has produced a class of people scientifically trained for the district industries. It is highly appreciated both by employers and employed, and is becoming more so by the latter. Education of miners in sciences connected with mining promotes safety in working, 1710-14. No tax is levied upon miners for its support. Some subscriptions have been gathered and land bought for a new building, to cost 12,000*l.*, but the scheme is in abeyance owing to depression in the coal trade. The committee think of erecting a temporary building. Prizes are given by colliery owners and others. The principal officials at nearly all the local works are past or present students of the school, 1715-6*a*. It is now carried on at Hope Street Schools, 1717. The apparatus is sufficient and very extensive; it has been acquired by grants in aid and presentation, and the committee provide more as required, 1718. The instruction in chemistry is practical, in geology by specimens, 1719. Cannot tell the nature of the instruction in iron and steel given in connection with the City Guilds. Will furnish syllabus of the course. It comprises smelting, rolling, &c., and is given by practical teachers (named). The number of students is increasing. This class is suited to the wants of the district. Men holding appointments in certain ironworks in the district are or have been students at Wigan school, 1720-5. The teachers in iron and steel appear satisfied with the examination, that it is of a practical nature, and well calculated to test practical knowledge, 1726-9. The mining examination in connection with S. Kensington does not show labour spent in teaching coal mining, which is the mining of the district, and necessitates teaching general mining, which is not required; there should be a special examination in coal mining. The Employers' Liability Act will encourage these schools, 1730-3. Is not acquainted with other mining schools, 1734. It would be an advantage if those who have passed through the Wigan elementary classes could be further trained, but hopes to be able to give that training in Wigan. Manchester is the centre of a coal mining district, 1735. Some of the large colliery owners apprentice their sons to mining engineers, and during their apprenticeship they attend Wigan school. Apprenticeship is still considered necessary, though a few have gone to Jermyon Street. It is

PEACE, Mr. Maskell William—cont.

the only way of accustoming young men to the almost military discipline of a colliery. Apprentices have no opportunity of acquiring higher education, being engaged all day, 1736-43. For the last two years classes in iron and steel, &c. in connection with the Guilds Institute have been held at Wigan Institution with fair success, 1744. Did not know of the practical examination by the Guilds Institute in mine surveying. That is important, 1745. In addition to the mining schools there are in Wigan two other institutions where technical instruction is given in connection with S. Kensington, 1746.

ANDERSON, Mr. WILLIAM. Pages 169 to 177.

Is a mechanical and civil engineer, member of the Institutes of Civil and of Mechanical Engineers and partner in the firm of Easton and Anderson. Is acquainted with the state and systems of instruction in civil and mechanical engineering, both here and in some of the principal continental countries, 1747-51. Pupils coming to him for training as managers or owners from the great public schools or universities have no scientific knowledge, except perhaps in mathematics. The modern schools, such as Owens College, &c., give really useful education. He has few pupils from them, 1752. The best training would be instruction at a scientific college, from about 16 to 19, and 2 years training at the works, passing through all departments to gain practical knowledge of materials, &c., instead of 5 years at the works, 1753-6. At the college, besides sciences, all of which are wanted by an engineer, the present state of machine construction should be taught. Competent professors could be got to teach it, 1759-60. Such instruction could be given at University or King's College. Prof. Cowper used to deliver at King's College admirable lectures on mechanical construction, illustrated by models, &c., and take his class to factories to see machinery at work. Believes this is still done. There was a fairly good workshop which witness attended, 1761-3. A physical and chemical laboratory are useful, but does not lay much stress on the workshops. It would be a good thing, and save time when students entered the works, if they were accustomed to the use of tools at college, but the work done in these workshops is small in character and of little use, and students are not kept to the prescribed courses, but allowed to do fancy work. Where good use is made of them the workshops are of considerable advantage, 1764-70. The systems pursued at King's and University College workshops are distinct, and both wanted. The latter is more a physical laboratory, which is indispensable, but not a substitute for the more systematic workshop instruction at the former. When he was at King's College the first year was devoted to wood-work, the second to elementary fitting in metals, and the third to the use of machine tools, &c., which is a very good course, 1771-4. In training managers, &c. in Germany, Switzerland, and France, too much time is given to theory and none to practical training. German students, who attend a technical college for a year or two, afterwards pass a time at the works, and then return to college, consider actual work beneath their dignity, and only walk about the workshops taking notes, &c., and occupy themselves in the drawing office. If they worked it would be a good system, 1775-9. If it were introduced here, does not think the young men would return to college. Frequently sends abroad pupils who have nearly completed their term to take charge of machinery and workmen, and it may be years before they come back, 1780-2. For the present generation of foremen little in the way of training can be done, but for the rising generation much might be, and is being done, 1783. Selects his foremen from among the workmen, who enter as boys and acquire experience in the works. The Education Acts have done much to improve workmen morally and intellectually. Does not think the French system of training foremen can answer; management of men cannot be taught in a school. It is essential that foremen should be drawn from the workman class. The new code proposes to give more science instruction in elementary schools, and although, since the boys leave school at 14, that instruction must be rudimentary, it can be continued in night classes, 1784-9. Hopes in time to see a class of young men intending to become foremen who will go through a course of workshop training, longer than that

ANDERSON, Mr. William—*cont.*

required for a manager or owner, after an elementary education more advanced than that of ordinary workmen. A foreman need not be a good workman, but must be familiar with the work. Promotes men who have the knack of organization and superior elementary education. You cannot get at the right sort of men by examination; the same applies to school teachers, 1790-3. Is not acquainted with the schools connected with Mather and Platt's works which apprentices are obliged to attend to receive instruction bearing upon their trade, but thinks such schools would be beneficial and would adopt the system if he could; fears, however, that the men would oppose it. Is not surprised that it pays, nor that it improves the conduct and intelligence of the workmen. If it should become known that the one school is successful it would help employers to overcome any objection on the part of workmen to similar ones, 1794-1802. It would be a good thing if drawing were taught in elementary schools, but the code is getting so stringent in standard subjects that it is difficult to find time to teach it. There is no drawing class at Erith elementary schools, 1803-5. There are classes in connection with S. Kensington. The Department are doing the best they can, but the teachers are very inferior. In isolated places good lectures cannot be got because of the necessarily small attendance, 1806-7. To a suggestion that some of the draughtsmen or junior managers might conduct classes, replies that, however much a man may know, it does not follow that he can teach, 1808. The elementary schoolmasters there are not certificated in science; if they were, that, with access to the works, would meet the difficulty, 1809-10. Prof. Rankine's system of teaching has had a great influence on English engineers, and in making engineering scientific, 1811. Witness's pupils from public schools know only pure mathematics, and cannot apply their knowledge at all; it is useless, 1812. Students from the science colleges are all that can be desired, 1813. Mechanical engineering as an art is improving very much in this country. Continental nations are fast approaching our level, but have not yet reached it. We are more practical, 1814-9. Our locomotives, marine engines, and hydraulic machinery are all much better than theirs. They are not ahead of us in any branch of engineering, but are getting very near us, especially in electrical engineering. In the ventilation of mines by machinery Belgium made more progress for a time than we, but we are now no longer behind them. Foreigners copy everything that comes out here, 1820-30. If artisans could have access to good classes it would be a great advantage, but does not see how to get them in isolated districts. The community should provide them by taxation. Does not much like Government interference except for examination, 1831. An educational test for membership of Institutions of Civil and Mechanical Engineers would promote the education of English engineers, since they all desire to become members. Would not suggest a Government examination; would only require that the candidates should pass through some sort of scientific training; at present many members have hardly any scientific knowledge, and may even have gone through no scientific study. Some exceptions might be made. No such training need be insisted upon before a man is allowed to conduct a mechanical engineering factory, 1832-7.

MOTT, Mr. HENRY H. Pages 178 to 181.

Has general management of the business of H. Scott, Richmond, & Co., wholesale dealers and producers of the best class of textiles and wall papers, for which witness furnishes the designs. Some of their goods are made abroad, but all from his designs. The French send many goods of this class into our market, 1838-52. Has been connected with the trade many years. Has been successful as a designer, but had no special training. Has entire management of Scott & Co.'s business, both as to designing and administration, 1853-5. Designers sometimes take round their designs, and the manufacturers choose such as they think will sell; that is their only criterion, 1856. There are several designers in London, but it is not a very large business, 1857-8. Cretonne, tapestry, and damask designs are purchased in London, but Paris is the chief designing centre for all nations, 1859-61. French decorative designs are light, frivolous, and gay, and therefore popular;

Morr, Mr. Henry H.—*cont.*

ours are, perhaps, over-studied for the general taste, 1862-5. Parisian designers pick up their training as assistants. Does not believe they attend schools of art to any great extent, 1866-7. Knows of no other training for designers in England than that at schools connected with S. Kensington. They do not generally receive even that. They usually start with a capacity for drawing, but no education in figure drawing. They begin to design and gain experience as they go on. Some improve themselves by study, but many do not. Their designs sell as well, if not better, even in expensive fabrics, than those of more artistic merit. Perhaps this is a little less the case than formerly, but not much, 1868-74. Mr. Morris's designs pay, but his is a special case, and no guide as to the commercial success of a high class of designs. Does not think they would pay on a large scale. They have only been copied here and in America, not on the continent. His work is a very small part of the general trade in fabrics, 1875-8. Scott & Co. export to America only. There is not much export trade in high class stuffs to the continent; many cheap cretonnes are sent, mostly copies of French designs, 1879-81. Only designs for Scott & Co., 1882. The public, both here and abroad, do not appreciate artistic merit; those articles sell best generally that have least, 1883-5. The production of a high class of design would not prevent the ordinary trade being carried on, nor have much effect on the amount of business done. The taste for the "Early English" style has given an impetus to our manufacturing trades by keeping out foreign goods, but the French and Americans are now adopting that style. Mr. Morris created his designs upon old types, marking them strongly with his own genius. The "Early English" style is a debased and indirect outcome of his work, 1886-8. A man, to be a successful designer, must have taste, some knowledge of form and of the style of particular periods, and some power of hand. If a man has it in him he will be a designer, training or no training; but if not no teaching will make him one. The best training is that got in business, but a general art education is of value to designers, and the broader the better. They should also be induced to read as much general literature as possible, 1889-94.

CHAPMAN, MR. HENRY, M. Inst. C.E., M. Inst. M.E. Pages 182 to 193.

Is a civil engineer. Has resided 25 years in France, and has experience of the working of both English and French systems of instruction for engineers, 1895. The technical instruction given to sons of masters and managers in the French École Centrale and Écoles des Arts et Métiers is not sufficiently practical to enable them to conduct a factory without practical foremen, 1896-8. That at the École Centrale is of a very high order, but young men from that school think themselves engineers, and are above being taught anything practical, and therefore never become thorough mechanics. Most French mechanics have a low standard of accuracy in workmanship, and sacrifice simplicity and cheapness to theoretical perfection, 1899-1901. The French system, by keeping a man out of the works until he is 22, prevents him changing his profession if unsuited for it, 1902. In England an apprentice who finds himself unsuited to his business is young enough to leave it and learn another. If he remains and feels the want of technical education he generally has opportunities of self-improvement, *e.g.*, Crewe works. His practical knowledge then enables him to learn the theory more quickly, 1903. The objections to the École Centrale apply also to the Écoles des Arts et Métiers, but with less force, the technical instruction there being more elementary. They turn out capital clerks for railway and credit companies, and their students are in demand as such, but do not turn out mechanics or engineers. The pupils gain little practical knowledge, and the workshop education is of very little use to them. Would rather take a lad who has been in a workshop only, than one who has been in a technical school only; the former can be taught theory more rapidly than the latter can be taught practice, 1904-11. French mechanical engineering is inferior to German or English; simplicity, economy, &c. are sacrificed to a desire for theoretical perfection, and their machines are therefore complicated. They fail, too, in accuracy of workmanship. They use the Whitworth system of screws, &c., and make severe specifications, but are deficient in handicraft,

CHAPMAN, Mr. Henry, M. Inst. C.E., M. Inst. M.E.—*cont.*

1912-7. The French are not making rapid progress in engineering, nor do they promise shortly to beat us. French mechanics of 60 or 70 years back were practical men, not technically educated, and their work has not been improved upon since. The technically educated men are inferior to their predecessors who adopted the profession from taste. The introduction here of the French system would be disastrous, 1918-21. The system of technical education in this country, extended as it is being extended, could scarcely be improved upon, 1922. In an ideal system children should be taught elementary mathematics and science in all, even board, schools; those showing industrial taste should be apprenticed, and if the taste developed opportunities should be given of acquiring technical education at night, or, if working half-time, in the day, 1923-4. Would insist on apprentices, &c. attending technical night schools as advantageous to themselves and their masters, 1925-6. Where such schools do not exist it would be to the masters' advantage to establish and support them. Some large works have schools attached to them; would rather apprentice a son of his own to those works than others, 1927-9. Does not think large employers will generally establish schools of their own, but they might liberally support mechanics' institutes. There is danger that lads attending factory schools might get into a groove, 1930. In English engineering works, so far as he knows, draughtsmen would not be allowed to leave their drawing and go into the works. They should have gone through the departments and gained practical knowledge before becoming draughtsmen. Young draughtsmen coming into the works without practical knowledge of machines, and not paid full wages, he would look upon as apprentices, and allow to go into the works to study, 1931-3. The action of trades' unions and rules of trade is disastrous as limiting the number of apprentices a master may teach, 1934. Master workmen do impart what they know to their apprentices, as far as they can, 1935-6. Thinks that workmen, as a rule, would rather their sons earned wages than give time to education, 1937-8. Does not think the workpeople would co-operate in any great technical educational movement. The workmen's power to restrict the number of apprentices is increasing. The system of apprenticeship is not dying out in higher branches of mechanical engineering, but perhaps is in certain manufactures, 1939-44. The teaching of manual labour and the use of tools in primary schools is very valuable, as training the fingers and giving a taste for the work. Every boy should be able to do a little carpentry, or some such work, 1945-7. Such teaching is the best part of the French educational system, and is worth the time spent on it. Recommends its introduction here. It would not supersede workshop training, 1944-50. In mechanical engineering we more than hold our own in comparison with the French, 1951-2. As to a statement that certain engines at Croix and Lisle, made in France, were cheaper and more efficient than could be got from England, replies that English-made machines would have to pay carriage, &c.; although some English makers would not supply what was wanted others would; as to quality, attaches no importance to one person's preference, 1953-5. The free night-school drawing instruction in France is of great value for training engineering draughtsmen. Similar facilities should be largely developed in England, where they hardly exist anywhere, except in mechanics' institutes. That provision is not enough. Masters might see that their employes attend night schools and science classes, 1956-60. Cannot speak as to the relative cost of English and French cotton and wool machinery, but the former is preferred, because, being better designed and made, it can be worked at higher speed. There is no serious competition with us in that class of machinery. The best French-made machines are on English patterns, 1961-4. French works sometimes employ English workmen, 1965. Has no doubt we have bought useful inventions in cotton-spinning machines from French patentees. The French have, from natural aptitude, greater inventive power than we, 1966-8. The only feature of the French system we could profitably adopt is the greater attention paid by them to chemistry and physics in ordinary education. In our secondary schools there is a distinct want of scientific instruction, 1969-72. French mechanics are inferior to English in

CHAPMAN, Mr. Henry, M. Inst. C.E., M. Inst. M.E.—cont.

consequence partly of the system of training them in schools attached to mere amateur workshops instead of in factories, 1973-5. The best training for an English engineer would be, after a general education, including elementary mathematics and science, apprenticeship in a workshop from 16 to 21; sufficient theoretical knowledge, which he would acquire more quickly because of his practical knowledge, being obtained at night classes, &c. At 21 he will have had sufficient training to become a practical engineer if he has any taste for it, 1976-8. For the higher class, those who are to advance the science of engineering, a further and more complete theoretical education would be necessary. They should after 21 study the applied sciences in which they are weak. Men get too old to learn the practical part of their business, not the theoretical, 1979-82. Agrees with the suggestion that they should enter the works on leaving school, and after a time return to college. It is a defect in the French system that at a given age students must have obtained a certain proficiency, 1983. Men are not better fitted to learn theoretical science between 16 and 21 than after that age, but the reverse, 1984-5. The period of apprenticeship of those who were to return to college might vary according to proficiency. Instruction in the use of tools at such a workshop as that at King's College would be advantageous and would shorten apprenticeship, 1986-9. The defect in the French system mentioned above (1983) is a very important one. If a man of 50 can pass the examination he should obtain his diploma, 1990-1. Has been speaking of machine makers, not civil or mining engineers, 1992.

**KENNEDY, PROFESSOR ALEXANDER B. W., M. Inst. C.E., M. Inst. M.E.
Pages 193 to 199.**

Is professor of engineering at University College, 1993. Young men come to him from school before entering works, &c. The course recommended is:—first year, mainly science; second year, elementary technical problems and drawing; third year, mainly in the engineering laboratory, learning nature of materials, accurate measurement, &c. Has a large testing machine and a small steam engine for experiments, and hopes soon to have a larger engine, 1994-8. Some facility of manipulation is incidentally obtained, but it is not formally taught, 1999. Was the first to adopt this system in England; new colleges are now adopting it, 2000-2. After leaving school went to School of Mines; was then articled to manufacturing engineers, &c. for 4½ years; and before going into business worked as draughtsman, 2003. Instruction such as that at University College renders 3 years' apprenticeship sufficient. This is now the usual term, 2004. His course is intended for masters only, and the fees are high. Has not thought carefully on the technical instruction of foremen, &c., or workmen. Does not know an alternative to the system of selecting foremen from the workmen. Does not know the French system, 2005-10. Enthusiastically mechanical lads might take some practical work first, but generally prefers students straight from school; if mechanical work proves distasteful, men can enter branches of engineering not requiring it, 2011-2. A man going through witness's course should at the same time study pure science, 2013. He had better study pure science alone, before being articled, than nothing, but it would be better that he should study its applications as well, 2014-5. 5 years' apprenticeship from 16 with theoretical evening instruction would not be good training. Physical fatigue would often prevent effective evening study, and some relaxation is necessary, 2016. Practical teaching in the works followed by a course of theoretical instruction (including technical applications of science) would be good training, but prefers the reverse order. Does not think 5 years' preliminary training necessary for men of the class he has to do with, 2017. There must be at some time systematic training in theoretical subjects. A young man of 21 leaving his articles is in the best position to get practical work, and hence there would be temptation to give up all further education, but he would be as well qualified to take up theoretical study, and easier to teach than when younger, 2018-20. The S. Kensington examinations in machine construction and drawing are calculated to be very useful to those they are intended for. They tend to raise sufficiently qualified teachers. To pass in the advanced and honours stages

KENNEDY, Professor Alexander B. W., M. Inst. C.E., M. Inst. M.E.—*cont.*
 the teaching must have been good. Is not familiar with the examinations in other subjects, 2021-7. The number of candidates is enormous in the elementary stage, and as large as can be expected in the advanced, 2028-30. His pupils at University College pay about 40*l.* a year in fees. They are mainly sons of professional men; 90 per cent. of them are training for mechanical or civil engineers of the higher class, 2031-4. Lads at middle-class schools, who are to be engineers, should spend more time on science, geometry, and model drawing to scale. They are now taught to draw from the flat, often without ever seeing the objects drawn. At colleges training might be given similar to that at University College, 2035-8. Thinks it most desirable to introduce engineering laboratory instruction into the S. Kensington system. It would be expensive, but could be done on a limited scale in large centres, 2039-40. The apparatus for such a laboratory would cost 1,000*l.*, or on a smaller scale less, 2041. The papers used in the Guilds Institute mechanical engineering examinations are satisfactory. Practical examinations might be introduced if there were practical means of teaching, 2042-5. *Refers to lecture put in (App. A.), and adds that the workshop training which he considers necessary should be carried on in those places where first-class work is done by first-class workmen with all the facilities and difficulties of large manufactories, 2046-51.*

LEGROS, Professor A. Pages 199 to 203.

Is professor at the Slade School of University College, and formerly taught etching at S. Kensington. Understands French and English systems of art teaching, 2052-4. Students in French art schools who do not become artists become industrial designers; they know how to draw. The English system is slow, vicious, feeble, and antiquated. Students will spend a year copying one object, and learn very little. The Slade School is, by high fees, practically closed to workmen's sons, who would profit by it, and of 100 students only 1 shows proper application. Art instruction in England should be gratuitous, as it is in France, where it produces a marked effect upon industries dependent upon art, 2055-60. Knows little of the evening art classes under the Science and Art Department. The drawings at the yearly exhibitions show too high finish, and consequently slow work. Such work develops neither ideas, rapid execution, nor appreciation of form. The system has much improved under Mr. Poynter, 2061-4. At S. Kensington schools there are too many lectures, of very little value as art training, and too many examinations, 2065-6. Instruction in pure art should precede (as in France) training in designing. A man who can draw well can easily apply his knowledge to designing, 2067-8. The training for picture painters and designers should be identical. The best artists of the Renaissance were also industrial designers. Nothing but poverty will stop the tendency to paint pictures instead of designing, 2069-70. To train designers for a particular line their designs should be practically carried out. So long as they work on paper only nothing but pure art can be taught, 2071-2. The English are not inferior to the French in artistic capabilities, and there is no reason why we should not reach as high a level of industrial art as they, if good methods of instruction are adopted. Gratuitous education lies at the root of the question, 2073-5. The reason we buy our designs from Paris is that witness and others like him sometimes make designs for sale. The school of Parisian designers trained as such is not a strong one; they are mostly persons trained as painters, but who have failed, 2076-8. Attaches great importance to the museums, &c. in France as training the artistic feeling of the people. English museums, &c. are comparable with French, but fewer. Many people who have failed in Paris are thought a great deal of in the French provinces, but men are so educated in London as to show a stereotyped form of excellence. In France the best artists take pupils, sometimes gratuitously. That is not so here, 2079-80. English workmen are as capable, artistically, as French. Free adult classes would show it, 2081. Our art classes suffer from want of skilled teachers, 2082. Our national artistic power is slowly increasing, but during the last 30 years there has been an enormous change as regards applied art, 2083-4. French primary school

LEGROS, Professor A.—*cont.*

instruction has little or no effect in the production of art, 2085. To improve English art teaching the instruction, besides being cheap, should be given by artists, 2086-7. In S. Kensington school there are plenty of models and casts, including a good many bad ones which should be got rid of; country schools have not enough, 2088. Provincial museums of industrial art would do much good; they should be general rather than special, 2089-90. Modelling classes should be generally established, 2091. Art training for designers should be general. The designs at Sèvres are furnished by artists. The highest walks of industrial art are always occupied by the true artist, 2092-5.

SOLLY, the Rev. H. Pages 204 to 211.

The Artizans Committee earnestly recommend the establishment of apprenticeship schools on the ground that lads cannot, as a rule, learn the principles of any trade nor their application in workshops, but only rule of thumb; and that often only by treating. They cannot gain the required knowledge at night, being often too tired, nor in the day, as that would involve loss of wages. Much might be done as half-timers; working men recommend the establishment of apprenticeship schools in which the theory and science of special trades should be taught, illustrated by manipulative work—not for sale—mainly making models. Manipulative skill must be acquired in workshops, 2096-2101. Cannot say whether central or local authorities should provide the necessary funds. The latter would not without a good deal of agitation, 2102-5. The schools might be established and supported by the masters, the state, or municipal authorities, or all three. Doubts if the masters would be willing to do so, but instances Mr. Hooper's good work for technical instruction, 2106. Has no specific plan for meeting the cost. Draws attention to apprenticeship endowments. Recommends the Huddersfield scheme to the Commissioners' notice. Workmen will in many cases pay what they can for their children's technical training, but cannot pay enough. Apprenticeship is dying out, except in engineering, 2107-8. Scientific and theoretical instruction cannot be given in a workshop, but might in a technical school; its application should also be taught practically there. Lads have no time in the shop to think how their theoretical knowledge may be applied, 2109-11. Is speaking of the education of artizans. Foremen should be chosen from artizans, 2112. Apprenticeship schools should not supersede workshop apprenticeship; the lads should spend part of their time in the workshop and part in the school. Many workmen doubt the practicability of this plan at present, 2113. The half-time system is the best, and 3 afternoons a week should be spent in the technical schools, or, failing that, lads should be taught in evening classes, 2114. The Science and Art Department classes teach theory well, but do not teach its applications, which is what the youths require, 2115. Parents would become reconciled in time to the loss of wages caused by attendance at afternoon schools, and lads would earn good wages much sooner, 2116. Suggests that afternoon and evening schools should be established in which practical manipulation is carried on together with theoretical instruction; lads often refuse to attend evening classes because they are tired or want recreation. Employers could and should compel apprentices to attend afternoon schools if a provision to that effect were inserted in the indentures. They now contain no adequate provision for teaching. Evening classes meet the wants of a few only, 2117. Believes there are schools at La Villette and Havre on that principle. In England only knows of those connected with the Artizans' Institute, 2118-9. Would apply the principle with any required modifications to all towns and all trades. Large towns with many leading trades should have schools for all those trades, not necessarily in different buildings nor with different teachers, 2120-2. The theoretical teaching given by the Department is excellent, but classes are required in which its application shall be taught by men who have learnt both the theory and practice of their trades; some such men can be found, but their number must be increased, and their training improved by such classes as those connected with the Guilds Institute, or they might be selected from workmen holding S. Kensington certificates, 2123-4.

SOLLY, the Rev. H.—*cont.*

Additional Statement.—Technical evening classes for adults are necessary. They should be near the workmen's homes, and managed by local committees. Employers and workmen on piece should be interested in technical education and the production of good work. Trades' unions should be urged to promote technical education. The competency of foremen should be tested by examination, especially in building and engineering trades. The advice and experience of practical workmen should be utilised in framing and carrying out schemes of technical education. Local classes should be affiliated to the Guilds Institute; the payments on results will much reduce their expenses. Hands in pamphlet, 212*a*.

BENN, MR. JOHN W., and PAUL, MR. HENRY R. Pages 211 to 217.

(*Mr. Benn.*) Is secretary of deputation of artisans now present. Is a cabinet and furniture designer; Mr. Paul is a cabinet-maker, 2125-7. Has worked at the bench, and knows perfectly the conditions under which work is carried on in this country, 2128-9. Since the lapse of the apprenticeship system lads in cabinet-makers' shops pick up the trade; no one teaches them. Recommends classes for teaching construction as applied to wood work, conducted by men of practical knowledge. A complete set of tools, English and foreign, should be provided, and their use and the preparation of working drawings taught. The latter can seldom be learnt in workshops. Cannot say how the expense should be met, 2130-1. Mr. Solly's excellent suggestion of afternoon schools is impracticable; the classes must meet in the evening and on Saturday afternoon. Apprenticeship schools for workmen's sons would be a failure; they could not afford the loss of wages, 2132-7. Furniture designers, &c. have to pick up artistic information at the museums, &c.; there is little teaching to guide them. Recently 18th century designs have been copied, even though most ugly. The designers led the fashion; improved designs would have sold as well or better. The S. Kensington teaching does not train the students in style or its application. Suggests classes for the study of this, 2138-40. Knowledge of drawing need not necessarily precede this study. Recommends teaching of ornament and drawing. Would recommend to the class a list of books on the subject. A list of standard examples in museums, &c. should be prepared, and the class with its teacher should inspect such objects. Prizes, &c. might be given for descriptions, rough sketches, &c. 1 or 2 wood carvers might assist the theoretical teacher. Fashions in cabinet work are setting towards continental renaissance and employers are importing foreign workmen. Believes we shall soon import foreign furniture, &c. for sale, 2141-2. Styles may be taught without very considerable art training, 2143-4. (*Mr. Paul.*) Confirms all Mr. Benn's recommendations. Workmen have to set out working drawings, and should understand style to avoid mistakes. Foreigners learn at their evening schools to set out their work in a practical workmanlike manner. This cannot be learnt in London. A workman who has passed the Second Grade in art would be in a position to attend the suggested classes. As mechanics we equal foreigners. The gold prize at the last Paris Exhibition was won by Messrs. Jackson and Graham with an article designed and executed by foreigners. A man who attends evening classes acquires a knowledge of drawing and style which assists him in his mechanical work, 2145. Is told that in continental schools style is not so much taught as working drawings and drawing from models, *e.g.*, pieces of furniture. Has seen better working drawings in Paris than in London, 2146-7. A society in Paris for "patronage" of children in the cabinet making trade" has established professional examinations for apprentices, and a school has been opened for teaching drawing applied to furniture, decorative drawing, and modelling. Will try to obtain further information, 2148-9. Most lads coming to the trade are capable of attending the suggested classes, and many men would attend them and be willing to pay for the instruction. Does not recommend that it should be gratuitous. The S. Kensington grants would be lost, as the authorities there seem to wish for elaborately finished drawings. It is desirable that S. Kensington should alter its system as to students who have passed Second

BENN, Mr. John W., and PAUL, Mr. Henry R.—cont.

Grade, 2150-7. (*Mr. Benn.*) If the Commission should find any continental school meeting the wants of the cabinet trade, would be glad to make notes of it and put them in evidence, 2158. Apprenticeship education in cabinet making is declining in England. Relies on some fresh educational expedient to maintain the trade, 2159-60. There has recently been a distinct advance, mainly as a matter of design. Our workmanship is excellent, but we were wrong in pattern, 2161. The relative progress in cabinet making between England and other countries is matter of taste and fashion, 2162. In drawing and setting out designs foreign artizans are in advance of English. In designing there is more originality of thought in England; more knowledge of style and more finished art training abroad, 2163-5. Our art schools could not give the special teaching required by cabinet makers without specialist teachers. The majority of the present workmen do not see the need of it; the generation now growing up do, 2166-71. Drawing and modelling should be taught in elementary schools. The drawing taught there now is sufficient and is good preparation for further instruction, 2172-5. Parisian boys learn more drawing than English in evening schools; cannot speak as to day schools, 2176-7. A little modelling should be taught in the suggested evening schools. Neither modelling nor the use of tools could be taught in day schools, 2178-9. It would be a great advantage for children under 13 to learn the use of certain tools, enabling them to learn more quickly trades in which they are used and inspiring mechanical tastes, 2180-4.

HOOPER, Mr. GEORGE N. Pages 217 to 226.

Is a carriage builder, 2185. Is not appointed to represent workmen or employers, but believes his views are shared by intelligent working carriage builders, 2186. His grounds for that belief. Has, with others, sent workmen to international exhibitions to observe and report on carriages, and established St. Mark's Technical School, where drawing, &c., and, latterly, technology, is taught. The teachers were all selected from the students, and have since passed the Guilds Institute honours examination, 2187. Gives examples of questions in coach building technology set at the Guilds Institute examinations. The training given causes men to reason on their work, saves mistakes, and removes prejudice against improvements, &c. It is adapted for foremen rather than artizans; use of tools is not taught, 2188-92. Many trades are prevented from offering suggestions by ignorance of what is being done on the continent. Has visited technical schools abroad, and sent two men there to be trained, who have since been useful here as teachers, 2193. They were at Paris 6 months. Will arrange for them to give evidence as to the coach makers' schools there, of which there are 3. Suggests that selected workmen in other trades might, with advantage, be sent to technical schools abroad. The Guilds Institute would probably provide funds, 2194-2200. If the Commission applied pressure, the Coachmakers' Company might devote more of their funds to this purpose. Recommends grants for small technical schools in the localities where trades are carried on, 2201-3. Hitherto the instruction has been in the evening, but opportunities should be given of attending day classes. The best class of workmen will make the necessary sacrifice for their children. Cannot say whether it would be generally applicable, but it would be worth while for other trades to try schools near the works, giving instruction for 2 hours on 3 afternoons a week. Has not done it at St. Mark's from lack of funds and opportunity. The suggestion is Mr. Thrupp's, 2204-11. Would submit to the inconvenience of some of his apprentices leaving work to attend such classes. Expects them to attend night classes and pays fees, but after the day's work they are not so fresh as is desirable, 2213-5. The patterns of carriages vary at different houses. In America certain waggons are built of uniform size and pattern. It is not necessary, but desirable, that the men constructing parts of carriages should have an intelligent knowledge of the whole, 2216-20. Does not at St. Mark's teach use of tools, but sons of employers might advantageously be taught that and the qualities and conversion of materials, 2221. One of the 3 Parisian schools trains chiefly the sons of coachmakers. It has greatly influenced the coach building trade of the world, 2222. Has sent two workmen there, and a Dublin coach-builder has sent his

HOOPER, Mr. George N.—*cont.*

son. Theoretical and practical instruction are both given there. The school has great influence, and has reduced the export of carriages from England. Its existence is not generally known here, 2223-6. The system does not so much cheapen carriages as improve their quality, 2227-9. It is most desirable that a similar school (except that freehand drawing should be taught) should be established for manufacturers and employers here, 2230-1. Apprentices, workmen, foremen, and employers' sons attend St. Mark's. The instruction develops workmen's intelligence and increases their chance of promotion, 2232-5. The principles of mechanics should be taught. Students would attend classes in mechanics if the teaching were practical, 2236-40. Does not think Government grants should be made to trade schools; the various trades would establish them if they realized their advantages. The more intelligent artisans are more zealous in this matter than employers, 2241-5. Apprenticeship is dying out in the carriage trade, 2246. The trade has suffered greatly from railways, 2247. The general character of carriages made would be much improved and the trade stimulated by good drawing or technical schools, 2248-9. Continental countries have made relatively far greater progress in quality than we, but the cost of their carriages increases. Competition is at our doors, 2249-53. English carriage interiors are inferior to foreign, but are becoming equal to them. Has employed foreign workmen for trimming, 2254. Foreign employers, foremen, and workmen who have passed through the Paris classes are better instructed than English, 2255-7. An ample supply of teachers for the suggested schools might be got in 5 years, but not suddenly. At St. Mark's they were selected from the students, and have since acquired further knowledge, 2258-9. The factory system is not extensively applied to carriage building here but it is in America. A few American carriages come here, 2260-2. There is more machinery used in the provinces than in London, but no great repetition of parts, 2263-4. Little machinery is used in Paris. In Vienna there is more repetition of parts, and much machinery is used, 2265-6. The Institute of British Carriage Manufacturers met for the first time on December 2 last. It accepts the importance of technical education for workpeople. The Paris school where masters are trained is a private speculation, and was started by a workman. He supplies drawings, &c. As public opinion becomes more advanced, manufacturers will establish technical schools, 2267-71. As regards freehand drawing, the Department classes might have exercised greater influence. The required technical instruction should and will be given in schools for all classes, supported by manufacturers and taught by selected foremen and workmen trained in art and science. Calls attention to the mixed committee of St. Mark's school, 2272-4.

MILLIS, MR. CHARLES THOMAS, and HENDERSON, MR. DANIEL.
Pages 226 to 230.

(*Mr. Millis.*) Is a metal-plate worker, 2275. Refers to paper on training of apprentices prepared by him, 2276. Apprentices to tin-plate workers in London are very imperfectly trained. They repeat a number of articles and do not get any instruction in pattern cutting. Nearly all the articles are made of old shapes. Birmingham and Wolverhampton manufacturers constantly introduce new patterns, or foreign competition would be very keen. Believes that foreigners do now compete with us in all markets, 2277-81. The Americans have taken more interest in pattern cutting, and published several trade handbooks, 2282. Metal-plate workers should be taught pattern cutting, and so much of the properties, &c. of metals as would explain the principles of annealing and solders. The Guilds Institute syllabus meets their requirements, 2283. A thorough knowledge of solid geometry should precede instruction in pattern cutting. Freehand drawing would not be a great advantage, 2284-6. (*Mr. Henderson.*) Young engineers have much improved in education and ability, and show great desire for technical education. The engineering trade is not going back. The workmen are more skilful than when apprenticeship prevailed, notwithstanding division of labour. By going from factory to factory they get wider experience and better knowledge of the use of tools, and technical education enables them to take advantage of these opportunities, 2287-90. The science and art classes do good work for the trade, 2291. Government

MILLIS, Mr. Charles Thomas, and HENDERSON, Mr. Daniel—*cont.*

and railway companies might encourage technical education, and fill situations by competition, 2292. The classes at Crewe are much encouraged, stand very high, and are of great use to the workmen, 2293-4. Makes the Nordenfeld gun; finds no difficulty in meeting with skilled artificers for the work, 2295-6. Technical education is well provided for in some parts of London, but not in certain manufacturing districts, 2297. The drawing taught in elementary schools fits lads for the workshop. They are more intelligent than they were. Evening instruction in theory, with workshop instruction in its application, and in practical work would be sufficient. Engineers have improved in character and willingly assist the boys, 2298-302. Workmen greatly desire technical education. Suggests examinations and orders of merit to assist employers in selecting men for promotion. Employers would, however, generally prefer men trained by themselves, 2303-6. (*Mr. Millis.*) The instruction he suggested would improve workmen and assist in training foremen. They cannot get it in workshops, 2307-8. The Department geometry classes do not give it, 2309. It is advisable that every tin-plate worker should understand pattern cutting, 2310-2. He would then put his work together better, 2313-6. (*Mr. Henderson.*) Has worked with continental and American engineer workmen, and found their education inferior to Englishmen. Only knows one institution in New York where they are specially trained, 2319-20.

WRIGHT, MR. WILLIAM. Pages 230 to 234.

Is a modeller at Doultons', and has supplied models for gold and silver work, 2321-2. Students, to learn modelling, should begin young, even in elementary schools; those who begin later get a cramped style, 2323-4. Such training as that at Lambeth Technical School would improve our artistic industries, 2325. More art knowledge and taste is put into French pottery than (with a few exceptions) into English. There is more moulding used in the latter, 2326-8. Learnt practical modelling from M. Protat, whose mode of working was superior to those used in England. Describes it. Was taught terra-cotta work, which is in great demand here, 2329-34. Certain potters should have a knowledge of modelling—moulders to know where to place seams, &c., pressers to aid them in taking off seams and restoring defects in moulding, 2333-9. Was a national scholar at S. Kensington School of Art, 2340-1. The training there and at Lambeth School was the best he could have had, but previous training, by a practical man, in ornament and styles would have been a great assistance, 2342. The teaching in local schools so far as S. Kensington is concerned is admirable, but masters for special schools should have special training adapted to the district industries, 2343-4. Children when very young might be taught the technical part of the district industry, and eligible youths be sent to S. Kensington, &c. for art and science training. In Kindergarten schools rudimentary modelling in cardboard is taught. Has heard that clay also is used, 2345-50. Persons instructed in fine art in relation to pottery should have a knowledge of the materials used, 2351. The design classes at S. Kensington are not quite satisfactory, but improving, 2352-3. Modelling classes both there and at Lambeth show decided progress, 2354. Modelling might be taught in all art schools; it is useful in most industries, 2355-7. Has little knowledge of foreign modellers, and that not flattering to Frenchmen, except M. Protat, 2358-9. Elementary instruction in modelling should be the same for all, advanced differentiated, 2360.

BERRY, MR. GEORGE MATTHEW, CHANNON, MR. JOHN, and STAYNES, MR. HENRY. Pages 234 to 239.

(*Mr. Berry and Mr. Channon.*) Are bricklayers, 2361-2. (*Mr. Berry.*) The taste for art in brickwork has lately grown to a wonderful extent. Suggests establishment of technical schools of bricklaying, especially in London. External aid is required to support teaching. Has taught in 3 classes for working bricklayers. States subjects of instruction, most of which are not taught in science and art classes. Some are trade "knack," which cannot be explained, 2361-9. Does not look so much to Government money as to that held in trust for educational purposes by City guilds. The Artizans' Institute

BERRY, Mr. George Matthew, CHANNON, Mr. John, and STAYNES, Mr. Henry—*cont.*

has received grants from certain companies, but desires something more definite, 2370-4. It is of national importance that bricklayers should be technically educated, and they are much disposed to perfect themselves in originality and ornamentation, 2375-6. (*Mr. Channon.*) The teaching at S. Kensington, both elementary and advanced, is not sufficiently practical for bricklayers; it could only be made so by teachers who are practical workmen understanding the applications of science to bricklaying, 2377-82. If bricklayers conducted classes under S. Kensington they must follow its syllabus. This should be extended in a practical direction. Students should be taught to work arches, &c., 2383. The examinations do not test whether a man has the knowledge necessary for a bricklayer. Has been through the examination. Something far more advanced is required, *e.g.*, moulding arches, &c., 2384-6. Will hand in a paper of suggestions (App. B.), 2387. The teaching required might be given in evening classes, and paid for on results by the Department, 2388-9. (*Mr. Berry.*) Has some experience of Portuguese and French bricklayers; they are not so fast as English. French workmen have better general education, but are not more intelligent, and have no more special training. They might understand working drawings better. The system of working is different, 2390-400. The Department syllabus might be improved, and the classes need some little alteration to better adapt them for bricklayers. Space for modelling and a percentage on the cost of models would be highly satisfactory, 2401-3. (*Mr. Channon.*) Inferior brickwork results from inferior workmen being necessarily employed, and is more costly than better work. The remedy would be technical education of bricklayers, 2404-5. Thinks there are now no bricklayer apprentices in London, but plenty in the provinces bound for 5 to 7 years, 2406-8. The class in St. Martin's Lane which he taught last year numbered 16 or 18; Mr. Berry held it previously. The classes have been held since 1875. At first very few attended, but the average attendance is now 146 in three classes. More would attend but that they frequently have to move to other parts of London. Classes should be established in all parts, 2409-13. (*Mr. Staynes.*) Carpenters and joiners require technical education more than most artisans. They can get theoretical teaching in science and art classes and experience in workshops, but it is difficult to apply the one to the other, and something further is needed, 2414-8. A boy during his last school year should learn elementary solid geometry and natural philosophy—freehand drawing is not much required for carpenters. After entering the workshop he should go through the science and art class training, and apprentices should be taught in technical evening schools the application of science to their trade. The teaching in Cowper Street School supplies the wants of carpenters, and similar schools should be established in different parts of London and the provinces, 2419-26. A supply of models would facilitate teaching, 2427.

UMBACH, Mr. August. Pages 239 to 241.

Is a tailor, 2428. Large sums are sent to the continent to meet the demands of the ladies' trade, which, from lack of training in freehand drawing, geometry, and anatomy, our workmen cannot meet. They fail in putting the garments together, and continental sewing is better, 2429-31. Doubts the statement that ladies' tailoring is confined to England. Supplies a house which spends in Berlin 60,000*l.* or 80,000*l.* for articles they cannot obtain here. Carries on ladies' tailoring with 20 or 30 hands trained by himself, but cannot get the articles put together properly, 2432. As to the number of houses where riding habits can be obtained Paris may be an exception. Certain English houses have started branches there because they get better pay there than here, and perhaps to get the ideas of foreign workmen for use here, 2433-4. There are in Germany a central tailors' school in Dresden and local schools, where cutting and putting together, geometry, anatomy, and freehand drawing are taught. Does not know of such in France, 2435-43. The cutters and German workmen employed here have mostly been trained at Dresden school or its branches, which are evening schools, 2444-5. Workmen's jealousy and prejudice hinder the establishment of similar schools here, 2446. Refers to ladies' tight-fitting garments, which are a revival of the fashion of a century back, when,

UMBACH, Mr. August—*cont.*

although there were no technical schools, tailors were practical and better trained men, 2447-9. The instruction at Dresden was the same before tight-fitting garments came into fashion. Thousands of pounds are paid abroad for garments in this branch which come here ready made, 2450-1. English higher class gentlemen get their clothes from Paris because of the superior make and fit obtained there, 2452-3. Foreign tailoring is better than English. Continental gentlemen vary their clothes with the fashion; English do not; consequently we have made little scientific progress, but have rather retrograded, 2454. A large number of German tailors are employed here because of the superior training they have received in German technical schools. They get higher pay than English because of their more scientific work, 2455-61. The importation of skilled workmen does not reduce wages, 2462. Thinks that, in the opinion of employers and foremen, men's garments are better made abroad than here. Foreign workmen are employed by large firms in preference to English, 2463-4.

MITCHELL, Mr. HENRY. Pages 242 to 255.

Has been connected with the Bradford trade for 40 years, first as manufacturer, then as merchant, 2465-7. Improvements in machinery, &c. during that period, 2468-72. The produce of Bradford and district has increased more than three-fold in 40 years, but has fallen off during the last 8 or 9, owing to decreased exports and changes of fashion. Some countries formerly dependent upon us now supply themselves with the commoner goods, 2473-9. Our exports to the United States have decreased two-thirds in 8 or 9 years, while the high class all-wool goods sent there from France have much increased, 2480. Such goods are made in Bradford, and the production of them is increasing. The silk industry also has been introduced, 2481-2. French wool manufactures have increased more than English since 1862. In America the production of cheaper goods has increased four-fold since the civil war, 2483-5. It is proposed to establish technical schools for textile industries in the United States. There are none now. There are schools for engineering and iron industries, 2486-8. In the Eastern States, where the woollen factories mostly are, operatives are better educated than in Bradford district, in others not so well. The managers, &c. are mostly English, 2489-91. Can trace no connection between education and the rise of the American worsted industry, or the engineering connected with it, since the managers, &c. and machinery are mostly English, 2492-7. The French excel in high class, and particularly all-wool goods, owing to long experience, scientific training of managers, &c., and great care in all branches. Many of their looms and most of their long-wool machinery are English, their spinning machinery mostly French, 2499-2501. Cannot speak as to education of French operatives, 2502. Elementary education in Bradford is very efficient. Gives statistics. The number of half-timers has increased and their instruction improved, 2503-3. There are 2 higher grade schools where the children (many of whom are from lower grade schools) pay 9d. per week, and receive instruction in science and art besides ordinary education, 2509-12. The distinction is social rather than educational. There is also a grammar school, 2513-5. Science and art are taught in the Mechanics' Institute and Church Institute, 2516. Is president of Bradford Technical School, 2517. Was impressed when juror at Philadelphia and Paris exhibitions with the progress made abroad in high-class manufactures, and has since often called attention to the necessity for technical schools here, 2518-20. A temporary technical school has been open at Bradford for about 4 years. Course of instruction, &c., 2521-4. One teacher with 2 or 3 assistants takes all the subjects. There are day and night classes, and the course in either lasts 3 years, 2525-8. Most of the day pupils pursue other occupations. They are mainly sons of merchants, &c. Fees. There are three terms per year. All do not stay 3 years. Fees for evening classes, 2529-33. The results so far have been very satisfactory, 2534. The school is supported mainly by fees, by subscriptions and by an annual grant from the Clothworkers' Company. Local manufacturers do not as yet take a great interest in it, nor largely support it. Some probably think that having succeeded so far we had better keep to the old ways, some fear that technical education will increase competition among ourselves, and others,

MITCHELL, Mr. Henry—*cont.*

that the young men will go abroad, and other countries will get the benefit of the instruction given, 2535-41. Before this school was established some young men, sons of manufacturers, not being able to obtain higher technical instruction here, went to French and German schools with satisfactory results, 2542-6. The school has suffered from unsuitable premises, but a new one is building, to cost about 30,000*l.*, of which 22,000*l.* has already been raised by subscription. The Clothworkers' Company have subscribed 3,000*l.* They assist other specified schools, &c. in the neighbourhood, 2547-51. Means of support of new school, scholarships, &c., 2552-6. Has already furnished particulars of the school buildings, 2557. The new school will be well adapted for its purpose. Before building it got information as to continental schools, 2558-9. In conjunction with the mayor, sent 6 or 8 artisans to the Paris exhibition, who visited some of the French schools and published a report (*hands it in with his own report on the exhibition at Paris in 1878*; some of the Bradford students afterwards visited other French schools, 2,560-1. A permanent impression was left on the minds of the artisans, agreeing with his own, that technical training is necessary for them. The more intelligent artisans are much impressed with this necessity, and would gladly co-operate with the managers of technical schools. This feeling will influence other artisans, and there will be less resistance to novelties, &c. than formerly, 2562-6. The difference between the fees and cost of tuition of artisans in the school will be met by the Clothworkers' grant, S. Kensington grant, and local subscriptions, and it is hoped that the Government will soon help technical education as it now does science and art, 2567-8. In a factory an artisan goes directly to work—in the school he only does enough work to practically apply the theoretical teaching, 2569-70. The instruction given is of little use to the mere worker, but of great value to managers, &c., 2571-2. Describes governing body of the school, 2573-5. Thinks surplus funds of the City guilds better employed in assisting technical than elementary instruction. This view is largely held in Bradford district, 2576-9. The evening classes will be mainly composed of youths employed in factories during the day. Some portion of the new school will be devoted to ordinary education, not under the school board, supplemented by science and art teaching adapted to the trade of the district. The sons of overlookers and higher working men will be able to attend it, and after leaving it, having learnt the rudiments of science, will be able to attend the evening classes and take up more special science bearing upon their daily work. By this means fair technical education may be obtained, 2580-6. It is also proposed to teach in evening classes under the Science and Art Department all the subjects in the prospectus. The intention is to give in the day school a good elementary education; in the evening classes a continuation of the same in the more technical branches of the Bradford trade, and to those who cannot attend the day school a course as similar as possible to that they would have received had they done so, 2587-92. A considerable quantity of all-wool goods have been sent to France to be dyed, but many Bradford dyers now produce as good results as the French, so that this will probably soon be altered, 2593. One class of goods is largely sent to Scotland for dyeing and finishing. Is not aware that Scotch dyers have superior technical education to Bradford dyers, but certain of them have paid special attention to high class all-wool goods. It is very probable that the leading men in Scotch dyeing works are from Bradford. Is not surprised to hear that artisans in French dyeing works have had no technical instruction, 2594-7. Until now there has been no dyeing school in Bradford, but there will be a good one in the new building, the main reason being a desire to give our dyers every educational advantage in competing with the French. It is only in all-wool goods we are inferior. Bradford dyeing is the best in the world for mixed fabrics. The experience gained at Leeds dyeing school has to some extent influenced the determination to have one at Bradford, 2598-603. Dyeing schools have existed for some time in Germany, 2604. German dyeing is in some respects better than Bradford dyeing, 2605-7. There is more need of a technical school in Bradford than in towns such as Leeds where men's cloths are made, though it is convenient to have schools in the latter, 2608-9. It is important to bring the schools near the artisans.

MITCHELL, Mr. Henry—*cont.*

Yorkshire College is of little use to artizans because they cannot afford the expense and time to attend, 2610-1. Technical instruction will awaken dormant talent in the workmen and enlarge the field of selection for foremen, &c., 2612. The designs used for higher class goods in Bradford are generally French ones that have been used in silk fabrics. There are few original designers there. This is not good, 2613-6. The French worsted manufacturers also largely use silk designs, 2617. It would be better if the artists initiating designs could put them into the loom. They cannot do so now to any great extent, 2618-9. Many designs are needlessly difficult to execute because the designer is unacquainted with technical difficulties. One great object of the school is to avoid this, 2620-3. The principles of art will be taught in the new school, 2624. There are several excellent textile designers in Bradford art schools, 2625-8. Has heard no complaint that art teaching in connection with S. Kensington is not sufficiently directed to designing, 2629. Suggests that the cost of building technical schools might be provided in equal parts by Government grant, by municipalities through the school board rate, and by subscription. Free lectures might be given by scientific men. Many towns could not afford to provide these for themselves. Bradford has a free library and a large art gallery supported from the library rate, 2630-7. The museum connected with the technical school should be an industrial and technological one, 2638.

ADAMS, PROFESSOR W. G., M.A., SHELLEY, PROFESSOR C. P. B., and WALKER, MR. DAVID. Pages 256 to 268.

(*Prof. Shelley.*) Is professor of manufacturing art and machinery at King's College, 2639. (*Prof. Adams.*) Is professor of natural philosophy there, 2640. (*Mr. Walker.*) Is workshop superintendent there, 2641. (*Prof. Adams.*) Teaches mechanics, physics, and applied science, 2642-3. Mathematics and chemistry are also taught at the College, and there is a school of art at which a start has been made towards teaching design, 2645-6. There is a full course of pure science, with opportunities for practical work, after which technical work is taken up. Associateships may be gained by those who have passed through the full 3 years' course of pure and applied science, 2647-51. Occasional students are admitted without examination to any class, and are taught and examined in the same way as matriculated students, 2652. Describes provisions for instruction in physics, 2653. Has only one demonstrator; would like a second. Each student receives individual attention, 2654-5. Describes instruction in chemistry. Photography is also taught. (*Prof. Shelley.*) Metallurgy is generally taught to third year students. Describes course in manufacturing art and machinery, 2656-66. (*Prof. Adams.*) Number, &c. of students attending physical and chemical laboratories, 2667-9. (*Prof. Shelley.*) Has on an average 70 to 75 pupils, 2670. (*Mr. Walker.*) The number attending the workshop has varied during the last 6 years from 137 to 169, of whom from 26 to 45 were evening students, 2671-2. (*Prof. Adams.*) His pupils, excluding medical students, have been of the employer class rather than foremen. Has also had about 30 students connected with the Indian telegraph service, 2673-4. (*Prof. Shelley.*) His students are mainly the same men as attend Prof. Adams' course, 2675-6. Sir J. Whitworth some years ago founded 3 exhibitions, since withdrawn, more especially for shop apprentices. The College sacrificed part of the fees, Sir J. Whitworth paid the rest. The exhibitors had a difficulty in supporting themselves, 2677-8. They were concurrent with, but separate from, the Whitworth scholarships. Does not know why they were withdrawn, 2679-82. Describes the workshop instruction, which is conducted entirely by himself, but under supervision of the Department and the Dean. Prof. Shelley and he drew up the syllabus. (*Prof. Shelley.*) A testing machine has recently been given by the Clothworkers' Company, and a meeting of professors will be called to arrange a course for testing strength of materials, 2683-91. (*Mr. Walker.*) Carpentry is Prof. Kerr's subject; he seldom comes into the workshop, but criticises work exhibited each year. (*Prof. Shelley.*) A regular course is laid down. Describes it, 2692-6. The testing machine will stimulate reorganization of the workshop instruction generally, 2697-8. (*Prof. Adams.*) Most of his pupils in engineering become engineers, and many electrical engineers.

ADAMS, Professor W. G., M.A., SHELLEY, Professor C. P. B., and WALKER, Mr. David—*cont.*

Some go to the Universities, 2699. (*Prof. Shelley.*) One former student, the Hon. Mr. Duncan, is a partner at Maudslay's. (*Mr. Walker.*) Mr. Field, of the same firm, and Mr. Anderson were students. (*Prof. Shelley.*) Messrs. Easton and Anderson gave as an annual prize a free apprenticeship for 3 years in their works, the premium for which would have been 500*l.* This was withdrawn on dissolution of their partnership. (*Mr. Walker, Prof. Shelley, and Prof. Adams.*) Mention other late students, 2700-2. (*Prof. Adams.*) The physical laboratory is known as the "Wheatstone Laboratory," 2703. Impresses on his pupils the necessity of studying pure science as preparation for applied science, and encourages them to apply their knowledge practically, 2704-5. (*Prof. Shelley.*) The workshop is a valuable adjunct, but does not remove the necessity for apprenticeship, &c., 2706. A boy to become a good mechanic (whether as workman or employer) should begin practical work at 14 or 15, work for, say, 3 years, perhaps receiving technical evening instruction during that time, and then devote 3 years to scientific instruction. He could afterwards acquire further general education, 2707-13. (*Prof. Adams.*) Does not agree with this. Thinks a course such as that at King's College should be a continuation of school work. The use of tools can be taught in the College. Some engineers prefer that students should pass through this course before entering their works. Has known cases of men receiving high salaries shortly after leaving the College, 2714. (*Prof. Shelley.*) A boy to become a good workman should begin manual work at an early age. 8 months work and 4 months education alternately would, if practicable, be very good, 2715. The use of tools might profitably be taught in elementary schools to boys of a mechanical turn, and might develop the taste in some others, 2716-8. (*Mr. Walker.*) Mr. Weston considers 17 or 18 too young for intending managers to begin mechanical work in the workshop, 2719-20. Suggests that such should learn some science and manipulation at school, then attend scientific and technical classes, e.g., those at King's College, and enter works at 18 or 19, when 3 years experience, partly in the drawing office, would qualify them for responsible posts, 2721-8. (*Prof. Adams.*) Fees for and profit or loss on laboratories, &c. Hands in prospectuses of classes, 2729-31. Has only 40*l.* a year for apparatus, &c.; would like 200*l.* and an additional demonstrator, 2732-5. There are in the chemical department a professor, 2 demonstrators, and thinks another assistant, 2736. (*Prof. Shelley.*) Is sole professor in engineering. More funds are needed for models, &c., but staff is sufficient, 2737-9. (*Prof. Adams.*) There are only 4 endowed professorships. Is paid from students' fees, 2739-40. Hitherto endowed schools have not much injured King's College, but the Normal School, and others as their instruction becomes more complete, draw students from the college by their cheapness, and Cooper's Hill by the prospects of good appointments. Examinations for Indian and Colonial appointments should be open to all, and independent of Cooper's Hill, and engineering colleges should be sufficiently endowed to compete with the latter, 2741-3. Professors should be paid partly by endowment and partly by fees, 2744. (*Prof. Shelley.*) We have not had time to see the effect of the Normal School, &c., 2745. All should attend school up to 14 years old, 2746. Engineer apprentices should attend evening science classes. Foremen are selected workmen. The more scientific education they can get the better. Employers' sons should, from about 15 years of age, attend a practical and scientific course, such as that at King's College, and then be articulated or apprenticed, 2747-51*a*.

LEAKE, Mr. ROBERT, M.P. Pages 268 to 275.

Is head of a firm of engravers for calico-printers, and his evidence applies only to that trade, 2752-3. Describes the various branches and their requirements, 2754. Will say little on designers. Printers usually furnish designs, but special designing grows out of the processes, &c. of engraving. The qualifications required are taste and imagination as applied to form and contrast, 2755-6. The perception must be trained to recognise minute differences of form, &c. and the essential quality of a design, and the hand to use tools, 2757. To train the hand, assuming natural aptitude, elementary

LEAKE, Mr. Robert, M.P.—*cont.*

artistic training is necessary, which must be given early, 2758-60. Lads are apprenticed at 14 or 15, and are instructed by foremen, &c., and soon employed on productive work alternated with "practising." This produces better results than pure instruction, 2761. Many take evening art lessons during their apprenticeship, 2762. Has given them time to attend the art school in Manchester, but has noticed no special superiority in lads attending that school over those taught only in the works. A high art training is not needed, 2763-5. The technical rudiments can be well and effectively taught in the workshop; thinks technical schools for the purpose impracticable, from the difficulty of getting suitable masters, and because pupils could not afford the time and cost, 2766-8. Attaches great weight to elementary art training and advocates extension of drawing in elementary schools. Is not acquainted with the present system of elementary drawing instruction, 2769-72. Recommends numerous cheap or free elementary art schools, which might be founded by private enterprise or municipalities, but the demand for such schools is very limited, 2773-6. We ought to have, in every industrial centre, free museums, &c., to cultivate the taste of workmen and the public. In these matters we are much behind France, 2777. In the mechanical technicalities of his trade the English workman is greatly superior, but the French, from their superior facilities, excel ours in good taste, and therefore render designs better, 2778-80. The trade as a whole is cleverer here than in France, but in special high class designs they excel us. Their calico-designers are immeasurably in advance of ours, 2781. There are obstacles to our attaining equal excellence, (1) because calico largely imitates superior materials of which the French command the market, (2) because of racial peculiarities, climate, and surroundings, 2782. Art schools should aim at developing artistic aptitude, &c. in the mass of workmen rather than at increasing the number of artists. Each school should have connected with it a museum of manufactures, &c., ranging from art luxuries to simple utilities, adapted to the district capacities and demands. This would aid in the selection of trades, 2783-5. They might be supported by benevolent or national aid, or by municipalities under the Free Libraries Act. Most of the objects would cost comparatively little, but would be of enormous value to students. The English are naturally deficient in appreciation of beauty, 2786-8. Youths inspecting these museums would gain knowledge of many trades, and be better able to select one. Information might be given as to apprenticeship, &c. The exhibits should show every process in a given manufacture, 2789. The superior art genius of the French may result from the great pains taken by the State to cultivate it, while we have not taken such pains; but given the same surroundings, &c. we should still be behind, not being such a lively and imaginative race, 2790-5. In the highest forms of art we are not deficient. Our mental power when called out is equal to that of any race; but the genius of our people is directed to mechanics, &c. rather than art, 2796-7. The S. Kensington art teaching does not sufficiently reach the workman. Would make drawing, &c. a more important, but still optional, subject in elementary schools, 2798-9. There is a large and growing demand for art in daily life, and the supply of art workmen would be increased by the schools, &c. he has recommended. Thinks technical schools impracticable and inexpedient in his trade, 2800-1.

GRAFTON, Mr. FREDERICK W., M.P. Pages 275 to 281.

Is chairman of committee of Manchester art school, 2802. Agrees with Mr. Leake as to necessity of primary art education, 2803-5. But, besides the general art school instruction, a certain amount of general technical instruction might profitably be given, 2806. Manchester art school has attempted to open classes for design in calico-printing, &c., but few students offered themselves, 2807. Did not know that S. Kensington had suggested teaching of design. The art school was originally a school of design, but was altered to meet the view that higher pure art teaching would be better to begin with than special technical instruction, 2808-9. Thinks pure art a proper foundation, but more special instruction should be afterwards given, e.g., an intending designer should first be taught drawing, then designing, 2810-2. Recommends technical museums, &c. connected with district

GRAFTON, Mr. Frederick W., M.P.—*cont.*

industries, to be maintained by municipalities. Many would probably give specimens, &c., 2813-5. There is now no sufficient collection illustrating Lancashire trades, and unless such are soon made the materials for them will perish, 2816-7. Such museums should be placed in industrial centres, 2818. English designers have rather deteriorated within the last 20 or 30 years, since Paris has become the designing centre for the world, 2819-21. Something might perhaps be done towards shifting the designing centre from Paris to London, but it would take a long time. The museums, &c. suggested would materially assist the education of designers, improve their social status, and give them an interest in art generally, 2822-3. London designers might profitably devote themselves to superior designs for textile fabrics. Exclusive novelty is a great point with leading manufacturers, and in Paris the same idea is reproduced too frequently. Our designers have now few opportunities of seeing what is going on here. In France an organization supplies collections of textile specimens which show the prevailing taste, and are a means of education for designers, 2824-5. In Paris there are for all trades fully 300 designing establishments employing about 1,600 designers. In London only about 20 or 25 establishments (*puts in papers issued by the Union Centrale des Arts Décoratifs relating to Exhibition*), 2826. Copyright in designs is very important. The Registration Act is most unsatisfactory. Is glad to hear it is dealt with in the new Patent Bill, 2827-30. Believes that English trades suffer as compared with French and German from the want of scientific education. Approves of the establishment of technical schools for training managers, &c. and a general extension of scientific teaching for the masses, 2831-4. The question whether the art faculty is as prominent naturally in Englishmen as in Frenchmen is a difficult one. With the advantages of cultivation the English are not inferior. Foreigners have advantages of climate, but, with improved opportunities for study, English industry and intelligence will counterbalance these. Does not attach great value to the teaching of design in art school classes, except as a preparation tending to shorten the term of apprenticeship, &c. at the works, 2835-6. Has never had much trouble with the trade union. Has not heard any objection to apprentices attending art schools, 2837-8. Manufacturers here would not support technical schools; they must be supported by Government or municipalities, 2839. To enable our manufacturers to retain their proper position in competition with other nations every possible facility for scientific and artistic instruction will be required, 2840.

DONNELLY, COL. JOHN F. D., R.E. Pages 282 to 293.

Is assistant secretary of Education Department, chief of executive at S. Kensington, and Director of the Science Division. All correspondence, &c. at S. Kensington passes through him, 2841-3. Describes aims, &c. of Science and Art Department, 2844. The teaching under the Department is confined to principles, excluding technical details, 2845. If the art teaching is extended further into industrial application than science teaching it is accidental. Experiments have been made in teaching applied art, *e.g.*, wood-cutting, but were given up. No outlet could be found for the students, or they would probably have been continued, 2846-7. The principles of designing are taught and prizes given for designs, 2848. If it could be shown that benefit would follow from encouraging application as opposed to theory it would not be contrary to any rule or the scheme of the Department to do so, subject to parliamentary sanction, 2849-51. The work of the Department has a very great bearing upon industry, 2852. When it has diverged from general science and art to application it has not been very successful. Experiments have, however, been made at S. Kensington Museum that have had a direct effect on industry, and also an indirect effect as a mode of instruction, *e.g.*, terra cotta used in the decorations, 2853-4. There is nothing in the Department rules to prevent any subject being taken up in almost any way if thought advisable. The advisability or otherwise must be decided in each case as it arises. Thus instruction in the principles of agriculture is now assisted, keeping clear of the practice of agriculture as of other industries, 2855-8. Terra cotta working was never taught, but only specimens exhibited

DONNELLY, Col. John F. D., R.E.—*cont.*

and the modelling of that used in the building done by students, 2859-61. As to the objection that the system is not sufficiently technical, thinks the Department go as far as is now advisable in this direction. A scheme for examinations in technology was strongly objected to by employers, &c., but not by workmen. The Department has been, at all events until very lately, in advance of the public demand, 2862-4. Instruction in technology would be very advantageous; who should give it is a wide question, 2865. There is nothing to prevent the Department from considering an application for aid to technical teaching; it is all a question of expediency. In the case of agriculture, when representative agricultural bodies said that aid should be given by the Department it was given. Personally thinks many such subjects would be better taken up by bodies like the City Guilds, 2866-9. Technical teaching is valuable, and private persons or trustees of endowments undertaking it would produce good results, 2870. Workmen value science and art and technical instruction more highly than employers. The latter could, by letting the workmen see that they really valued it and by giving facilities for obtaining it, greatly stimulate technical education, &c. at small cost. For convincing employers of its value we must trust to their seeing broadly that all-industries are based on scientific principles, and that increased intelligence on the part of workmen improves industry, 2871-2. The danger of easier papers being set in some subjects than in others at the Department's examinations is guarded against (1) by criticism in the Department, (2) by the table of percentages of passes calling attention to any inequality. There is no syndicate of examiners, but the examiners in any subject and certain of their assistants usually consult together, 2873-5. Designs sent up are generally submitted to persons conversant with the industry to which they relate, 2876-7. Will put in a return of the number of students in schools which take up a "systematic course" of instruction in science. Is afraid it is not a large proportion, 2878. Extra payment is given when that course is followed; it is not likely to be largely taken up by adult artisans but only in secondary boys' schools, 2879. Would not recommend further inducements to take up advanced stages in science. The teachers are as willing, and it pays as well per pupil, to teach the advanced as the elementary stages, but students will not attend. Doubts if it is more profitable to teach elementary than advanced art. The rates of payment on the latter are much higher than on the former, 2880-1. Cases where teachers make 700l. or 800l. a year from groups of elementary classes who would not make nearly so much by teaching a higher grade in one town are rare, 2882. Science classes are sometimes given up from lack of students, but pupils are not taken from one elementary subject to another for teachers' benefit. More money can be earned by teaching a large elementary than a small advanced class. Does not know of any school or class which stops at the elementary stages. The teachers would have complained if the payment for the advanced stage were insufficient, 2883-6. Would like to see increased numbers in advanced and honours stages, but cannot recommend increased pay to teachers, as they now all teach in those stages. The only way to increase the number of students is to give them an inducement to attend, such as would be given by employers showing a strong interest in such instruction, 2887-8. It might in time be advantageous to increase the qualifications necessary for teachers, but doing so now would lead to the closing of many classes in small towns which could not afford to pay highly qualified teachers, 2889. Does not see how a distinction could be made between teachers for higher and for elementary classes. It would be better at present to abolish certificates and keep the teaching open, 2890-1.

CUNLIFFE-OWEN, SIR PHILIP, K.C.M.G., C.B., C.I.E. Pages 294 to 316.

Is Director of S. Kensington and Bethnal Green Museums, 2892. Has no control over Edinburgh and Dublin Museums, which are administered by the Science Branch, 2893-4. The only art museums in England directly under exclusive Government control are the 2 in London, 2895. Hopes Dublin Museum will eventually copy that at Edinburgh, which is not an art but an industrial museum of a perfect type not existing in any other country.

CUNLIFFE-OWEN, Sir Philip, K.C.M.G., C.B., C.I.E.—*cont.*

Professor Archer has procured from many manufacturers special collections showing the processes of manufacture. Col. Donnelly knows more about these 2 museums than he, 2896-900. The influence of S. Kensington Museum bears more upon art education and manufactures; of Edinburgh Museum upon technique, 2901-2. A central establishment for collecting and circulating specimens similar to those at Edinburgh would be very useful, and if provincial art and industrial museums be established S. Kensington Museum should extend its operations to industries. Worcester Exhibition is a good specimen of the kind of provincial museum required. In the Jermyn Street Museum there are several collections illustrating industrial and even art processes, 2903. The central industrial museum should be central for reference with duplicate collections for circulation, as now at Bethnal Green, but if, from considerations of expense, &c., industrial collections could not be on view in London it would still be desirable to circulate them. S. Kensington Museum has never aimed at developing the industrial side, 2904-9. Describes the growth of the circulation system there. Hands in statistics and a memorandum relating to its technical advantages (App. C.), 2910. Its advantages. Other countries are copying it. Museums with the same advantages of light and warmth as gin palaces, and open in the evening, should be established in all large towns, 2911. The great success of British manufactures at the Paris Exhibition in 1878 is a direct proof of the influence of S. Kensington Museum and its ramifications. The Paris syndicate of cabinet-makers admitted that we had advanced immeasurably more than the French since 1867. Instances also pottery and glass, 2912-3. As to some of the most successful English houses employing foreign designers, answers that we can produce our own designs, and the employment of foreign designers is going out of fashion. Has not found French influence lead to satisfactory results to manufacturers, but the reverse. Art has no nationality, and English manufacturers are to be commended for getting the best possible talent. The introducers of Murano glass manufacture here aimed at first, mainly, at copying older productions. Since they have attempted to originate designs much has been produced which it is to be hoped will not be imitated. It has had no influence on Messrs. Webb, whose productions are very original. The admirable glass made on old models by Messrs. Powell is traceable to S. Kensington influence, 2914-6. His views are shared by the majority of British manufacturers. The influence of S. Kensington may be seen in most drapers' and furniture shops. A workman who does not know how to set out working drawings has either never attended a school of art or has been taught to draw without a purpose, 2917. Received 500 artizan reporters who had spent a week or 10 days in Paris during the Exhibition, and had visited workshops, &c. there. They seemed to think watchfulness necessary lest the French should surpass us. Artizans probably do not think S. Kensington and other museums have had much to do with the progress of our industries, not seeing that by educating the taste of the upper classes the museums have created demand. A partner in a large Parisian cabinet-making firm came here to buy furniture in the English style for sale, after vainly trying to make it in Paris, 2918. The collections sent to the provinces are examined with great attention by manufacturers, who impress upon their workmen the advantage of doing the same. They train the workmen and enable them to understand instructions better, and they also help to train designers, 2919. The museum and its circulating collections educate the taste of manufacturers and consumers and help artizans to meet the improved taste, 2920. Their influence is greater than that of any Continental museum; the objects are brought to the door of the artizan, 2921. S. Kensington Museum is a collection of articles, primarily made for the instruction of students in the school of art, which has become a great museum. The loan system was begun by the Queen lending valuable objects. Her example has been followed throughout the country, and now objects are readily lent to local exhibitions in which S. Kensington takes an important part. The system could not work better in this respect than it does. It often leads to the establishment of permanent museums in fire-proof buildings; e.g., Derby, Leek, and Rugby, 2922-4. The circulation system was established to promote technical study of art in connection with art schools, &c., and

CUNLIFFE-OWEN, Sir Philip, K.C.M.G., C.B., C.I.E.—*cont.*

since 1880 has been largely extended to permanent, corporation, and free library museums. Excluding any small representative collection illustrating the local industries, the objects in country museums should be changeable. Recommends that the S. Kensington votes for purchases should be trebled, or more, to meet the increasing demand for such circulating objects, 2925-6. The sums put down in the estimates for circulation of objects (which are frequently overspent) do not include purchases of objects, glass cases, &c. In purchasing, suitability and usefulness for circulation are kept very much in view. Witness never purchases objects. The amount spent in purchases would not but for the circulation be smaller, 2927-31. The provinces have a direct interest in the purchase vote. Visitors to S. Kensington often complain of the absence of objects which are being circulated. Much has been done in reproducing objects in the museum, and also in other countries. Much benefit may be expected from international exchanges of reproductions, &c., 2933. Applications are now being made by provincial museums, &c. for reproductions, on which an allowance of 50 per cent. is made; this greatly stimulates local liberality and aids the formation of permanent collections. The articles supplied have been mostly electrotypes of metal work, but reproductions of metal work and casts would be supplied, 2934-5. Mentions some of the reproductions already made, 2936. They are executed by Messrs. Elkington from type pieces belonging to the museum, 2937. The grant of 1,500*l.* towards purchase of objects for local museums in 1881-2 has been nearly all absorbed. Hopes this grant will be largely increased to enable grants to be made towards the purchase of other objects, *e.g.*, textile collections, 2938-9. There is an old minute under which textiles, &c. would come. Would not say that original specimens could now be supplied at a reduction of 50 per cent., but the machinery for supplying them is ready, 2940-1. Textile duplicates, &c. in the Bock collection could not be given to provincial museums without serious detriment to the lending power of the Museum, 2942-3. The Museum has no power to make grants in respect of objects purchased abroad by private persons, but technical schools might obtain 50 per cent. grants for models, &c. from the Science Branch, 2944-5. There would be an unlimited demand from the provinces for reproductions at 50 per cent. reduction if the money were forthcoming from Government, 2946. The Free Libraries Act should be extended to enable purchases to be made for local museums. The penny rate is insufficient, 2947-8. All objects, either in S. Kensington Museum or circulated, are labelled. Mentions certain shilling works issued by the Department which have been sold in large numbers, and are very popular with working men. Others are now preparing, 2949. The Art Library is unrivalled. It contains 60,000 volumes of art books and probably 100,000 engravings, &c. of art objects, and will be further developed. It is used by art workmen of all kinds, and many French people come over to study in it. It is to a certain extent open to circulation, 2950-1. In 1873 there were 37 museums created upon the model of S. Kensington, and the number has since largely increased. Mentions some. The Berlin Museum has followed closely the distinctive feature of S. Kensington—the bringing together of art objects and establishment of art schools in the same building. It is admirably arranged. Foreign museums produce immense results with small funds, mainly because their curators are given opportunities of travelling and studying the systems of other museums. Recommends that similar opportunities be given to curators, &c. of English museums, 2952-5. The jurors and others at Paris were of opinion that our success there, from an art point of view, was attributable to schools of art connected with S. Kensington. Many manufacturers would not admit this; but the demand for their productions, and the designers and workmen who produce them, are the result of the S. Kensington system, 2956-7. In 1859 an exhibition was held of objects made from designs by art school students, which created great interest. Another similar one would be very useful, 2958. An international exhibition of a similar character would be very interesting if practicable, but an exhibition of work designed or made during a fixed period by men from our own art schools would be more satisfactory. It would probably show that witness has underrated the influence of the Department, 2959-60. It would be easy to get up an interesting and useful exhibition of the work of foreign technical

CUNLIFFE-OWEN, Sir Philip, K.C.M.G., C.B., C.I.E.—*cont.*

schools, given the funds, but it would be useful at the same time to have the exhibition before suggested, 2961-2. As to space for such an exhibition, it is merely a matter of money. No doubt it could be done, 2963. A given object may in past times have been sent twice to the same place for exhibition, owing to the limited number of objects in circulation, but now the whole of the museum collections, with certain exceptions, are available for circulation, 2964-5. Bulky objects, even furniture, have been sent, 2966. The minute extending aid to corporation museums has been much appreciated, and has stimulated the establishment of permanent museums, 2967. The question of providing suitable persons to lecture on the collections sent to provincial museums, &c. is under consideration, 2968. The museum has many pairs, but few other duplicates. These duplicates are as far as possible available for circulation. It is better that exhibitions should be confined to one branch of art, 2969. The giving of duplicates to local museums would lessen the resources for circulation. Such museums can be better assisted by adding to their permanent collections objects bearing upon local industries, 2970. The Museum is open from 10 till 10 on 3 days a week. The evening attendance is about the same as in a corresponding time in the morning, which is very satisfactory. The arrangement for keeping open for 12 consecutive hours is much appreciated. Greater advantages and conveniences are provided at S. Kensington than at any other museum in the world, 2971-3. The evening visitors are mostly middle class families coming for instruction. Many artisans also come, particularly on Mondays, to improve their technical knowledge. The conduct of the visitors is very satisfactory. Recommended that the Berlin Art Museum should be opened in the evenings, 2974-7. All museums, &c., including the British, should be open at night. The electric light removes all objections, 2978. The Royal Academy sometimes lends certain pictures to local museums, &c., and the British Museum gives them duplicate specimens and advice, 2979-80. The Commissioners of the Exhibition of 1851 purchased objects of art, which are circulated by the Department. Doubts if they can do more for local museums, &c., 2981. In its efforts to make contributions to provincial museums the Department receives great and increasing aid by loans from private individuals. Two very valuable bequests have recently been made. The more space, &c. is provided the more advantage will be gained from private liberality, 2982. The objects exhibited at local exhibitions are returned to the lenders. The Worcester people regret that the collection shown there should have been dispersed. Many objects would have been left had there been an institution to receive them. The Department took no steps to secure articles exhibited there, but only lent a number of objects and inspired the lenders of others with confidence. It helps as far as possible every museum, &c. of science and art, 2983.

HUXLEY, PROFESSOR T. H., LL.D., F.R.S. Pages 317 to 342.

Is Dean of Council of Normal College of Science, and has been an examiner of the Science and Art Department for over 20 years, 2984-6. Has no experience of the working of the science schools, &c. in their bearing on industry, but only of (1) the influence of the system on the diffusion of scientific knowledge; (2) the aid given in acquiring that knowledge to those who could not obtain it otherwise; (3) the examinations; (4) the instruction of teachers and examiners, 2987. His experience on the latter point arises largely from his position as examiner, and from a perception of the necessity for raising the standard of teaching. Compares present facilities, &c. for obtaining scientific education with the state of affairs 25 years ago, 2988-90. Knows a number of cases of young men taught in science classes who have obtained scholarships, &c. Gives one, 2991. Cannot say whether the science classes are generally or only in a few localities efficient enough to enable their students to attain Queen's scholarships. They guide and stimulate young men in their studies. The Normal and other such schools do not require scientific men to start with, but able ones, and these the system brings out, 2992. The results of the system have far surpassed his highest hopes. The universities, &c. have now taken up scientific instruction, or they would be in a very false position. The founding of science classes was the creation of a people's

HUXLEY, Professor T. H., LL.D., F.R.S.—*cont.*

scientific university. No doubt a great deal of the information is loose, and some of the teaching bad, and even dishonest, but the same is more or less true of all teaching organizations, 2993-5. Teachers hold that on an average not 1 in 10 of any class of scholars take a firm grip of what is taught. The complaint that many science teachers teach only to enable their pupils to pass examinations is as often made against the highest as the lowest educational institutions. The system must have benefited industry by increasing the general intelligence and knowledge, and giving scientific education to a large number who, though fitted for it, could not otherwise have obtained it, 2996. Is doubtful whether the State should do more than develop and improve the existing system (1) by encouraging the formation of classes, (2) by direct and distinct encouragement to the establishment of Sunday classes. Such Sunday classes could only be carried out by private effort, 2997-9. The Department might also do more in supplying apparatus and encouraging practical teaching. Anything further that is needed should be done by trustees, &c. of ancient educational endowments for the poor (now generally devoted to middle and high class education), and by employers. The latter might greatly advance technical and scientific education by establishing schools accessible to their workpeople, rewarding scholars who distinguished themselves, 3000. Employers would doubtless do more for science classes if the subjects were more specialised, e.g., metallurgy of tin, &c., but unless previous proficiency in general science were required such a course would lead to neglect of the general science upon which special teaching should be founded, 3001-2. The Department examines students in some subjects, e.g., steam, without requiring previous training in physics, &c. Disapproves of this, but when the system was established it was unavoidable, 3003. A student who had passed in chemistry and physics might be examined in the metallurgy of tin, &c., but such special subjects could be better dealt with by employers, &c. than the State, 3004-5. It is desirable that a more distinct line should be drawn by the Department between pure science and its applications, if the latter could be as well provided for otherwise, 3006. The keystone of the whole Science and Art Department system is in the examinations and examiners. Describes his own system of examining. Believes the same system is followed by other examiners. It is settled by the regulations, and is the result of co-operation between the examiners and the Department, 3007-11. (*Prof. Roscoe* states that the system of examination in chemistry is the same as that described by Prof. Huxley, except that assistant examiners make reports on the general style of the answers, &c., and that the papers of those who nearly but not quite succeed are examined a second time by the principal examiner. In chemistry all students are now required to pass a practical examination.) (*Prof. Huxley*) His practice as to reports is substantially the same as that of Prof. Roscoe, 3012. In setting papers the objects are (1) to test whether there has been reasonable teaching, (2) to give scope to men who have learned more than would be got from ordinary routine teaching. Students who show such knowledge as a decently taught person of ordinary intelligence must possess are always passed, but always rejects those who have been "crammed" or taught by rote. "Cramming" must be put down, 3013-5. The spelling, &c. of the papers has much improved since the passing of the Elementary Education Act, 3016-7. The power of literary expression is little attended to in training colleges for teachers, and therefore the teaching of science is not much facilitated by improved literary capacity in science class students, 3018. Training college students used to take part in the May examinations, taking the same papers as other students, and did fairly well. Then the time of their examination was altered, and somewhat more advanced but still very moderate papers set; the result was a most astounding collapse. This led to an inquiry into the science teaching at the colleges; in some it is very good, in others singularly defective, 3019-20. Visited some London training colleges recently and found the teaching good; knows of nothing to compel its being so, 3021-2. (*Captain Abney*, as an inspector of the Department, states that the inspectors attend certain examinations, &c. at training colleges, but do not inspect the colleges as to science teaching, except to see that the laboratories are in working order, 3023-5.) (*Prof. Huxley*.) Practical examination in science classes is very desirable, but does not see how it could be carried out in

HUXLEY, Professor T. H., LL.D., F.R.S.—*cont.*

some subjects, *e.g.*, physiology, 3026. Inspection of classes while being taught is the only way to ascertain whether teachers are competent and means of practical instruction sufficient. It would require an immense amount of inspection to do this for all the science classes, 3027-8. Honours examinations in his subjects should include practical examination. This could be done if the students were brought to London, 3029-30. Recommends inspection of science classes at uncertain times by men familiar generally with the methods of science, and specially of the science taught in classes under their inspection. This would stop "cramming," 3031-4. Increased efficiency, and the saving of money now paid for valueless teaching would be a set-off for the increased cost of such inspection. The whole hope of the working of the system is in a stern execution of duty by examiners, and efficient inspection, 3035-6. When the system was first started really competent teachers could not be found, and it was soon felt that they must be made somehow. The literary instruction given in training colleges is of no value as preparation for studying science, so it was decided to bring a certain number of teachers to London each year to learn the methods of scientific study. This was an important step towards improving teachers. The present system of certificates is bad. The Department does not certify that a man is able to teach. All teachers should go through a course of instruction such as is given at the Normal School, or, as that is impracticable at present, certificates should be abolished and teaching thrown open, 3037-8. No higher value should be attached to results obtained by teachers trained as suggested, as they would be able to earn larger payments than others, 3039. The proportion of advanced to elementary pupils is about the same as it always was. It depends upon the willingness of pupils to attend. If the reward for advanced teaching were considerably increased teachers would pay pupils to come. Honours should not be granted without evidence of practical knowledge, such as a practical examination in London, 3040-3. Does not know whether pupils trained in the Normal School are allowed to give up teaching and enter industrial employment, but if so the State would still profit by their knowledge, 3044. Whether it would be better for manufacturers to establish schools of their own, encourage schools already existing, or join together in providing schools, depends upon the circumstances of each case. The teaching should be readily accessible, 3045. Such schools should in large towns be near the larger works. Employers might give a greater stimulus to the study of science than all the State can do if they were to show an appreciation of its value, 3046. Artizans who refuse to take advantage of scientific instruction do not understand their own interest. Does not approve the suggestion that artizans after a year or two of work should go back to science classes. They can pick up knowledge while acquiring the more valuable education of practical work, 3047-8. The system pursued in some continental countries of sending selected workmen to technical colleges for, say, two years to qualify them for foremen, &c. is likely to unfit them for the position. Energy, business habits, command of men, &c., essential qualities in foremen, are not to be got from books or laboratory work, while the knowledge required can be obtained by evening instruction, &c. Besides, the men when educated and refined would not be likely to return to their work, 3049-51. As to an extended system of sending students to the Normal School it is a mere question of funds. If the towns will send them the school will receive them, subject only to limits of space available, 3052-3. Has been told by a highly intelligent German merchant that he finds English men of business admirable as such, but beyond that they have no ideas or interests in common with him. English clerks are being largely supplanted by Germans, because of the superior education, &c. of the latter, 3054. For the last 300 years England has had leading men in each branch of science equal or superior to those of any other country, but next to no rank and file. Until within the last 25 years there was no recognized means here of becoming a scientific man. France, 50 years since, took the lead in science because of its large scientific organization, 3055. Between 1840 and 1850 Germany took the lead, and still keeps it. We are surpassed not because we are inferior in mental power—our best men are equal to any—but because in Germany there are better opportunities of learning, and, owing to the multiplication of universities, every able scientific man can earn a living by science.

HUXLEY, Professor T. H., LL.D., F.R.S.—*cont.*

Hopes that we, too, shall have universities in our industrial centres. In England men of ability can earn higher rewards in other pursuits, 3056-9. The German universities stimulate largely the general culture there. Even those in small towns far surpass our middle-class schools, 3060. The scientific training given in them provides a class of men able to carry out new ideas and improvements, and so advance industries. Literary culture will not do this, 3061. Believes that a large proportion of the students examined by the Science and Art Department are artisans, 3062. The examinations for science schools where progressive courses are taken should differ from those for students who only go through one course. There are a few such schools; would be glad if there were more, 3063. It would be better that for evening classes an elementary examination in general science should precede that in special branches; on the other hand, a special subject precludes vagueness, and may be so taught as to be an introduction to general physics, 3064. In teaching chemistry too much attention is often given to formulæ, too little to actual facts. Does not apply this to the S. Kensington system. Is glad to hear that a series of experiments is now recommended in the Department syllabus, 3065-7. To a question whether the science examinations for artisans might not be made a better introduction to technical teaching, replies that the present examinations in his own subjects merely test a fair elementary knowledge, irrespective of how it is to be applied. (*Prof. Roscoe* observes that the same is true of the elementary grade in chemistry), 3068. Does not think the knowledge required should be diminished, 3069. Hands in a statement, from the first annual report, of the history, objects, &c. of the Normal School. (*Printed in his evidence*.) The school fulfils its object. The only change needed is better accommodation for some departments, 3070.

ABNEY, CAPTAIN W. DE W., F.R.S., and ISELIN, MR. J. F., M.A.
Pages 342 to 350.

(*Capt. Abney*.) Is one of the 4 inspectors under the Science and Art Department, 3071. Their duties are primarily administrative. They are not supposed to technically inspect, and although such technical inspection is desirable there are great difficulties in the way. Technical knowledge would be essential. Does technically inspect classes in some subjects, but no one man can be expected to be familiar with all the 24 science subjects, 3072-6. Some technical knowledge, which as it happens the inspectors as a rule have, is necessary to deal with cases of copying, &c. They inspect both science and art classes, 3077-8. 65 Engineer officers were more or less employed as acting inspectors in 1880. Engineer officers are fit persons for acting inspectors, but would not necessarily be qualified for permanent inspectors if a large amount of technical knowledge were required, 3079-81. Describes his method of inspecting a class, 3082. Inspectors should be able to examine classes in the sciences taught and do so as far as possible, 3083-4. There are, perhaps, 2000 or 3000 classes. An idea is got of the way instruction is given in them by inspecting classes at random. Each is inspected at least every other year by an acting inspector—important classes every year, certain well-conducted ones, perhaps, less often, doubtful ones more often, 3085-8. It would be difficult to entrust the inspection in science and art to different inspectors, 3089. Cannot say that less technical inspection is needed in art than in science. The Art Division finds it necessary to hold technical inspections. In consequence the general inspector is looked down upon and loses influence, 3090-2. This might be obviated by always appointing inspectors who had technical knowledge of science or art, and if possible the number might be increased, 3093. The inspectors, who may be purely science men, have, besides reporting on art schools, to examine in black-board drawing, and the grant of certificates to teachers, carrying extra pay, depends upon their reports. So far they have been able to efficiently carry out this examination, 3094-7. (*Mr. Iselin*.) Is Assistant Director of the Science Division, 3098. Does not think technical inspection necessary in all cases—examination tests teaching. If better inspection would improve teaching it would be desirable, 3099-102. Continuance of defective instruction, &c. are guarded against by present system of examinations and inspection. Inspectors who are experts in all

CLXXIV ROYAL COMMISSION ON TECHNICAL INSTRUCTION :

ABNEY, Captain W. de W., F.R.S., and ISELIN, Mr. J. F., M.A.—*cont.*
 the sciences would be difficult to find and expensive to employ, 3103-4. The risk of payment for barely efficient results is small. There might be waste of energy, &c. in some village schools from defects being discovered only by the results of examinations, but not in large centres, 3105-6. (*Capt. Abney.*) There are nearly as many advanced students as is possible; only a certain proportion will go to the advanced stage. There may be cases in which teachers prefer elementary students as paying better. Increased grant for advanced stage would be desirable, if practicable; it should be paid on results. Objections to other modes of payment. In practical chemistry alone the advanced stages are better paid than the elementary, (*Mr. Iselin*) because of the larger expenses attending advanced instruction, 3107-8. (*Capt. Abney.*) It would not now be practicable to pay on general efficiency, tested by examination of each class by inspectors, owing to the difficulty of getting sufficient high class inspectors; otherwise sees no objection, 3109-12. A grant on good teaching apparatus could only be a single not an annual one, and the apparatus might never be used in order to keep it good. (*Mr. Iselin.*) Has known cases where the apparatus provided was never used. (*Capt. Abney.*) The great drawback was want of apparatus, but there is improvement in this, 3113-4. The present system tests whether apparatus has been used. There is a great difference between teachers; those who have attended the Normal School are far superior to others. (*Mr. Iselin.*) Inspectors can see if the apparatus is habitually used or not, 3115-7. (*Capt. Abney.*) The Department is looked to to support science teaching, and local contributions are next to nothing. (*Mr. Iselin.*) Comparatively small. (*Capt. Abney.*) This is an evil. Local contributions should be sufficient to procure better teachers. The fees and grant are often not sufficient to ensure good teachers. (*Mr. Iselin.*) The Department insists that pupils shall pay fees, 3118-20. The local contributions are too small. If the teaching is good the fees might be raised, 3121. A successful teacher makes a fair living. (*Capt. Abney.*) The most successful teachers generally teach more than one class. In large centres the classes support them. It was originally intended that the Department should aid local effort; now the State supplies the greatest support of the teachers. Employers of labour should contribute, 3122. Prizes are only exceptionally given by local subscriptions, 3123. Returns of subscriptions, grants, &c. are given in the reports, 3124. In some cases, but only in good centres, local aid is given to establish a class, and when the teacher has got it, and perhaps others near, established the aid is withdrawn and he gets a good income without it, 3125-6. At Belfast students who have passed the advanced stage in the practical chemistry classes readily obtain employment in dye-works, &c., 3127. It would be desirable, but in some cases difficult, to introduce practical examination. Honours should not be granted without it, 3128. Teachers trained in the Normal School are better than others. They should not be put in a higher grade. It would be better that teaching should be free without any qualification, 3129-30. Will draw up, with Mr. Iselin, a memorandum on the state of the science classes, 3131. (*Mr. Iselin.*) It treats with the managers, &c. of schools to lay down systematic courses of instruction, 3132. 10s. per head, independent of results, is given for students who take a systematic course. Mentions schools founded on this system. Will give no opinion as to expediency of calling attention to it by special circular, 3133-5. (*Capt. Abney.*) The appointment of local resident inspectors in great centres would be a good plan if the Treasury would provide the funds. Good salaries would be required (*Mr. Iselin*) and first-rate men, 3136. (*Capt. Abney.*) 24 such at least would be needed, but 6 would be a material assistance. (*Capt. Abney and Mr. Iselin.*) It would be difficult to get scientific men of sufficient eminence who would be willing to undertake the work for 100l. or 150l. a year, 3137-8.

See also PROFESSOR HUXLEY'S evidence.

ARMSTRONG, MR. THOMAS, and BOWLER, MR. HENRY A. Pages 351 to 373.

(*Mr. Armstrong.*) Is Director for Art of the Science and Art Department, 3142. (*Mr. Bowler.*) Is Assistant Director, 3143. (*Mr. Armstrong.*) The Department aims at giving such knowledge and practice of drawing and

ARMSTRONG, Mr. Thomas, and BOWLER, Mr. Henry A.—*cont.*

modelling as may be applied to the industries of the students and to educate the country, 3144. (*Mr. Bowler.*) Aid is given to elementary day schools and training colleges for their teachers, art classes, schools of art, and the training school for art teachers, and also, by contributing part cost of objects and by circulation, to museums and art schools, 3145-6. The art instruction in elementary schools is limited to elementary freehand drawing from the flat, model drawing, and practical geometry, and is paid for and examined by S. Kensington, the papers being sent there, 3147-51. Safeguards against fraud (*see Art Directory*), 3152-3. Scale of payments, 3154-5. The only age limitation is that children must be under 18 years, 3156-8. This part of the system is doing a great deal of good, 3159-60. More time might usefully be given to drawing, and probably would be if the payments were larger, 3161-4. From 1 to 4 hours per week is devoted to it, beginning at 6 or 7 years old. Suspects that the time specified for it in the time tables is sometimes encroached upon, 3165-7. It is taught in about one-fourth only of the elementary schools, and although the number is increasing the proportion perhaps is not, 3168-72. The instruction is generally given in school hours, 3173-5. Children get an amount of instruction likely to be very useful to them, 3176. Has recently visited France and seen the drawing in Parisian and elementary schools. It is in many cases less exact than in our schools, 3177-83. English children could not do the work done by French children of corresponding age. The English is the better system. The drawing taught here would be more useful to children who will enter manual trades; the French system is better for artistic trades, 3184-7. In French schools one branch of drawing is often taught exclusively, and the children acquire greater facility in it than ours, but the English system covers a larger field. Thinks it more advantageous to do 3 branches (named) to a less extent than 1 to a greater, 3189-95. In French schools showing the best results, thinks that casts take the place of our printed copies, 3196-8. (*Mr. Armstrong.*) Quotes from his report some notes on drawing in certain French schools, 3199. Has visited the model school in Dublin. The work there was of an unsatisfactory kind. At the model school he visited in France saw drawing from casts far better than anything he has seen or heard of in an English elementary school. (*Mr. Bowler.*) The teaching in Dublin model school is not a very good type of our work; it is not inspected by the Department, 3200-1. (*Mr. Armstrong.*) Will put in an estimate of the relative efficiency of the drawing taught in a good Parisian school and the drawing of a London board school, 3202-3. Reads and explains his notes on drawing instruction in certain German schools and Sunday classes, 3204-13. In German elementary schools much more time is actually spent in drawing than in English schools; consequently, when the boys come to art schools they are infinitely better prepared than English boys. (*Mr. Bowler.*) In Germany drawing is taught in all elementary schools, but many English students enter art schools without any previous teaching, which reduces the average proficiency of our art students, while those who have been taught drawing in our elementary schools are still inferior to German boys. (*Mr. Armstrong.*) German schools give better preparation than English because more attention has been given to the subject; (*Mr. Bowler*) more time in the school and more general preparation to the teacher, 3214-20. (*Mr. Armstrong.*) The German teachers are well qualified to give the degree of instruction they ordinarily give, 3221. (*Mr. Bowler.*) In English elementary schools the drawing instruction is usually given by the schoolmaster, whose qualification for the work is lower than German schoolmasters', 3222-3. There are not many schools in which instruction is given by specially trained masters. The London School Board has appointed a special master to teach the teachers, 3224. (*Certain drawings by Berlin children 11 or 12 years old were shown to witness.*) The skill shown in these is above the average of English school children of 11. The aim of this drawing is to give knowledge of form as opposed to appearance, and differs from that of our model drawing, 3225-6. This is a desirable aim for children who will probably follow mechanical occupations, but not more so than the power of observing correctly, which is not included in it, 3227-8. Appearance of an object is affected by the laws of perspective, actual form is not, 3229. One of the drawings shown is intended to give an idea of form, another is drawn in perspective. Many

ARMSTRONG, Mr. Thomas, and BOWLER, Mr. Henry A.—*cont.*

English children of the same age could do the latter as well, 3230-3. They could not draw it so well in the much easier orthographic projection, 3234-5. The object of model drawing in English schools is to cultivate the power of observation and imitation, in German schools to give a knowledge of particular forms, 3236. The former is the more generally valuable, though the latter may be of greater value in mechanical trades if the student is master of the theory on which the drawing is made. Children trained on the English system might rapidly take up such a section as that shown, 3237-9. Drawings in orthographic projection are not done in English elementary schools. The execution of such would assist a mechanic apprentice to give an intelligible representation of an object, but not so much as drawing in perspective. It is better that children should learn to draw first and take up mechanical drawing afterwards, 3240-4. Almost all of the elementary school children examined are presented in the first grade. For results see Annual Report of the Department, 3245-6. Qualification of teachers, 3247. Cannot speak as to relative quality of school drawing done under art masters, &c., 3248. Sees nothing to prevent modelling being taught in English elementary schools. No payment for it is authorised. Does not recommend it, as drawing from the flat is more exact training. This is the general opinion, 3249-53. (*Mr. Armstrong.*) If more time were given modelling might be taught with advantage in primary schools in certain districts, but not with the present allowance of time for drawing, 3254-6. Reads notes on the modelling in a Parisian technical school, 3257. A little drawing instruction must precede modelling, 3258-9. Unless 5 hours a week can be given to drawing and modelling it is better that young children should devote the whole time to drawing, 3260-4. They would find modelling more interesting, 3265. Cannot say how far the instruction given in English and Continental primary schools is appreciated by directors of art schools. (*Mr. Bowler.*) Cannot say how far it influences the average in English evening schools. (*Mr. Armstrong.*) The skill of hand gained far outweighs any vices. (*Mr. Bowler.*) Quotes a report by Mr. Matthew Arnold as to its effect in promoting neatness and finish, 3266-8. French elementary school drawing is less exact than English owing to the system of drawing from casts and the use of charcoal and the stump, which leads rather to looseness and freedom, 3269-70. Study of drawing up to passing second grade should be from the flat, but geometry and model drawing are taken up before reaching that grade. Children leaving school at 13 might never pass second grade, 3271-5. In our schools the 3 kinds of drawing are carried on side by side, and a child may earn payments on all at one examination, 3276. Is aware that certain school conductors have decided in favour of flat casts for primary instruction, 3277. The flat cast system would assist decorative painters more than the outline. Technical instruction is one of the objects of the Department but not the only one, 3278-80. The French system of elementary art teaching is less likely to lead to sound results in industrial work requiring precision than the English or German, but may be better as preparation for artistic work, 3281-4. Drawing is taught in all French and German primary schools, but only in a quarter of the English, 3285-7. Has formed no opinion as to the influence of primary art education upon art designing in France and Germany, 3288-9. More than half the children in English schools where it is taught learn drawing. Gives statistics, and describes the models used, 3290-8. In English schools the model drawing is mainly from squares, cubes, &c., in France from casts of low relief, heads, &c. (*Mr. Armstrong.*) Casts of leaves and casts in geometrical form slightly raised, 3299. (*Mr. Bowler.*) Does not know of any modelling in English elementary schools, nor to what extent it is taught in France, 3300-1. The English system of teaching drawing in elementary schools is superior for industrial purposes to the French, as it gives an exact comparison between parts, which the French does not, 3302-3. Drawing is very popular with children here; cannot say as to French children, 3304-6. The small number of English schools teaching drawing may be accounted for (1) by the teachers not having a drawing qualification, (2) by other subjects being more remunerative or more popular with the children. In England, as in Germany, drawing might be made a necessary qualification for a schoolmaster, 3307-8. Drawing is virtually a specific subject now, and a child may, perhaps, earn as much for it as for a specific subject, 3309-10. Drawing models as they

ARMSTRONG, Mr. Thomas, and BOWLER, Mr. Henry A.—*cont.*

appear is more valuable than orthographic projection; 108,250 exercises in model drawing were used at one annual examination, 3311-3. Model drawing and orthographic projection may be taught together, and the objection to the latter would then vanish, 3314-8. A child who earns 1s. for a "fair" exercise may be presented again in the same grade, but not one who earns 1s. 6d. for a "good" exercise, so that it may be to the teacher's interest to keep his pupils in the lower grade, but does not believe it is done, 3319-21. In English training colleges the instruction is second grade. The teachers are masters of art schools or masters holding full D. certificates. They may have no higher qualification than that which would enable them to teach a class in an elementary school, 3322-5. The instruction is unsatisfactory, as a large proportion of the students leave the colleges without taking a second grade drawing certificate, and it is desirable that every elementary teacher should be qualified to teach drawing. Teachers in the colleges should hold higher certificates than the full D., 3326-32. Does not think it desirable that technical art instruction should be given in training colleges, the office of elementary teachers being to prepare their pupils for technical art instruction, not to give it. (*Mr. Armstrong.*) Concur, 3333-5. In schools where the time for drawing is very short it would be best devoted to drawing with instruments; it would train children's hands, teach them to draw correctly, and be a preparation for mechanical drawing, 3336-9. Thinks the best elementary school drawing teaching in Paris superior to any he knows of in England or Germany, and more likely to be useful to artisans, 3340. (*Mr. Bowler.*) Under certain conditions it might pay masters better to teach a specific subject than drawing, 3341. Thought the machine drawing at Nuremberg exhibition very sound and useful. Describes course at the realschule there, 3342-5. The work done there is very valuable. Similar work is largely done in the Department evening classes, 3346-7. The mechanical drawing in art classes is similar to that in science classes, 3348-50. The work in some of these classes is as good as that at Nuremberg school and the drawings are more highly finished, 3351-4. The works seen there showed a knowledge of the form and construction of the object and a knowledge of the principles of working; some were copies, but many probably not, 3355-8. In our science schools few flat copies are used; the principles of projection are applied first to simple objects then to more difficult ones. The work is generally sent up to the examiners in books which show the method pursued, and less value is given to copied work, 3359-62. Endeavours to ascertain that the drawings sent are not mere copies. With single drawings the examiners may be misled but not with a series. In cases of doubt writes to the school. The copying of a series of drawings is guarded against, though not effectively, by inspection, 3363-9. Saw the works of the Industrie Schule at Nuremberg and inspected the work of that school in the exhibition. Mechanical drawing is there carried further, 3370-1. (*Mr. Armstrong.*) The art teaching in the best evening schools in Paris is the best he has ever seen and of great value in training workmen. Was told that French workmen get through their work in less time than London workmen, owing to the ease with which they obtain the drawing instruction they require. Thinks workmen here could not so readily obtain it, 3372-7. English teaching is perhaps a little hampered by formalities. French teachers have greater license and can put a man direct to the work most useful to him. (*Mr. Bowler.*) In French schools persons can get free instruction in exactly what they want and then leave, while the S. Kensington system aims at giving a good art education, 3378-80. Saw students making individual drawings for themselves. An English student stated that at Limoges he was admitted to a municipal drawing school, paid no fees, was taught drawing from both flat and round, and was not compelled to attend examinations. That facility is an advantage of the French system, 3381. The French system does not improve the general taste. English schools have made more progress since 1855 than French, and the taste of our students is better than of theirs. (*Mr. Armstrong.*) The tone of the country is raised by our system, but would also like to see greater facilities given to workmen. Does not see how to combine the two, 3382-4. It would be desirable that artisans should be given art instruction more directly bearing

CLXXVIII ROYAL COMMISSION ON TECHNICAL INSTRUCTION :

ARMSTRONG, Mr. Thomas, and BOWLER, Mr. Henry A.—*cont.*

upon their industries, 3385. Schools only give skill in drawing designs; museums, &c. educate the designer. Good designs should be disseminated, 3386-7. Has tried to impress on school committees the desirability of establishing museums, under the same roof as the schools if possible, and accessible to the students, for fostering design, 3388. Inquired into the teaching of design in France and saw the work of designers there, also the work at certain schools, which showed more designing power than that at Nuremberg exhibition, 3389. The designer should have a knowledge of his material and the processes of manufacture. This is not always the case in Paris. (*Mr. Bowler.*) With us specific designing is preceded by study of the principles of design. After these are acquired the pupils are encouraged by high prizes and high payments to their masters to proceed to design, 3390-2. The eminent artists who judge the designs sent up, especially in textiles, are competent to judge of their suitability for execution in particular materials, 3393-6. (*Mr. Armstrong.*) They could tell whether a pattern were suitable for execution in brass, wrought iron, &c., 3397. An exhibition of drawings of similar character and quality to those exhibited at Nuremberg could be got up from English schools, but does not think it advisable. Would not wish our students to spend so much time on mere copies from books, &c., 3398-400. Reads and explains his notes on the Bavarian exhibits at Nuremberg, 3401-3. Our best training school students would very soon be able to produce work as good as or better than a stand of models shown there, but such work could not be produced in art schools throughout the country, as no encouragement has been given to it. It is desirable that the energies of Birmingham students should be directed to such work. Reads and explains notes on ladies' school at Munich, 3404-7. Some of the work exhibited has been long done. By going back 10 years an equal variety of art work might perhaps be got from some English schools, 3408. A drawing by a decorator attending the Munich Fortbildung Schule on Sundays was mainly copied from books. (*Mr. Bowler.*) Noticed in one school paintings cut from a work of which he saw copies in the exhibition, 3409. (*Mr. Armstrong.*) Nuremberg school exhibits are of the same character as those of Munich, 3410-1. (*Mr. Bowler.*) There can hardly be so close a connection between these Bavarian highest art schools and the more elementary ones as exists between S. Kensington school and our provincial schools. (*Mr. Armstrong.*) Reads note on Munich Kunstgewerbe Schule, 3412. There is a connection between the elementary teaching in Bavaria and the Fortbildung Schulen. The latter are attended by apprentices and artisans in the evening. The work exhibited from those schools was superior to that of English night art classes, 3413-5. (*Mr. Bowler.*) Their work has a more direct bearing upon industry than that of our art classes but not than that of many of our schools of art, 3416. The day classes in our schools of art are visited more by amateurs, but their night class students are mainly of the same social grade as those of art night classes, 3417-9. The exhibits of modelling from Fortbildung schools evening classes were more general than in our schools. We do much more colouring than the French or Germans, which has a valuable industrial bearing. The study of colours in France is unsatisfactory. Saw some very disagreeable coloured work in French and German schools, 3420-2. (*Mr. Armstrong.*) A boy commencing elementary art training should draw from the flat for a short time, then from objects or from slightly raised ornaments such as are used in France and Bavaria. The objects should as far as possible be beautiful. In our elementary schools no casts are used. (*Mr. Bowler.*) The drawing is principally from the flat and continued too long, 3423-4. (*Mr. Armstrong.*) Does not agree with Mr. Bowler as to French colour teaching and its results. The use of colour is not taught scientifically in our schools, 3425-6. Would like to see an open competition of designs, &c. applicable to industrial objects. Will further consider the subject, 3427-9.

SHARPE, Rev. T. W., M.A. Pages 380 to 390.

Is inspector of training colleges for schoolmasters, 3430. 90 per cent. of the students at these colleges have been pupil teachers—usually those who stood highest in Queen's scholarships examinations, 3431-5. On entry they

SHARPE, Rev. T. W., M.A.—*cont.*

are generally very backward. Can only account for this by neglect on the part of their teachers, 3436. As pupil teachers, they should not work above 7 hours a day, which gives only 2 for private study, &c.; many, however, have studied 8 to 10 hours a day, 3437-9. Physically they are averagely developed, but mentally very undeveloped, 3440. The masters are tempted to grasp at money results to the exclusion of other duties, 3441. The examination is calculated to bring out the relative capacity of competitors, 3442. The reduction in the number of hours pupil teachers are employed teaching will increase the time for learning, and so raise the attainments of training college students. The teaching hours are sufficient for learning to teach, 3443-4. Further reduction is desirable, but, in the interests of rural schools, impracticable. If school boards, &c. can do it they have the power, and it would be a great gain to future teachers, 3445-8. General mental cultivation of pupil teachers will render them more receptive of science teaching, &c. In mathematics many of them are incapable, on entering the colleges, of any abstract reasoning. Many of the country masters who have pupil teachers were not taught algebra or Euclid at the colleges, and are ignorant of both mathematics and science. Pupil teachers in towns can attend science classes, but not in country places, 3449-51. In the larger colleges students are classified, but in the smaller they are generally taken as one class, and men of higher capacity suffer. Not many such, however, enter the smaller colleges, 3452-4. The college authorities prefer students who have been pupil teachers. They are superior to others all through their career both in general capacity and the art of teaching. The means of comparison, however, are small, 3455-8. Recent regulations may attract many women, but probably few men. The Education Department syllabus for training colleges now enables students to matriculate, except in Greek, at London University; and if they continue their studies to pass on to B.A., 3459-64. Has been asked by college authorities to recommend, in cases of special merit, a grant for a third year's residence to gain the knowledge necessary for B.A.; otherwise it might be gained at evening classes after leaving college, 3465-8. The syllabus for the colleges is divided into 2 parts, obligatory and optional. Describes them, and the regulations as to number of optional subjects allowed. Will put in questions in history and geography (App. D.), 3469-76. Prescribed science subjects, 3477. Within the last 3 or 4 years colleges have paid their teachers by salary. Previously lecturers took the grants and were tempted to cram subjects that paid best; they now choose those they can teach best. Payment on results is in many ways detrimental. Pupil teachers are taught a number of sciences that their masters may get the grants, and the London and other school boards give a special grant for every science certificate held by a teacher, whether he teaches the science or no. Consequently more essential subjects are neglected, 3478-81. Science subjects are the only ones for which special payments are made to training colleges; suggests their withdrawal. The new code modifies the system of payment by results. If the science subjects were placed under Whitehall, S. Kensington might still examine in them, 3482-90. The committees receive the S. Kensington payments on results, which are deducted from the Whitehall grant, 3491-3. A *criâ voce* examination in science subjects at the colleges would be a great advantage, and might be conducted by the S. Kensington examiners, 3494-9. Is sole inspector of training colleges and all subjects taught there. Is no judge of apparatus for teaching chemistry, &c.; the colleges have taken the fullest advice on these matters. It would be most desirable that competent persons from S. Kensington should inspect the apparatus, character of teaching, &c., 3500-6. In most colleges about 3 hours per week are given to lectures and 1 to private study in each science. Insufficient time is given to both sciences and languages. Hands in time table (App. E.), 3507-12. No special qualification or training is insisted on for college science teachers. They are generally well qualified to teach. The results are variable in different subjects. Some are considered easier to pass in than others. There is also great variation as to colleges, 3513-9. Will put in a table of marks obtained, &c. (App. F.). Quotes and explains tabulated results of 1881 examination, 3520-1. Many of the lecturers attend the vacation courses of lectures for teachers. Nearly every student who passes second

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class in a science could give a fair grounding in it. Approves of the system of travelling special teachers, the schoolmasters keeping up pupils' knowledge in the intervals between the special teachers' visits, 3522-6. The instruction given in general teaching is calculated to fit pupils for teaching science. They have not time for experimental work. In almost every case some specific subject is taught in the college practising school, enabling the students to cultivate science teaching, 3527-30. Teachers passing out of the colleges are fairly qualified to teach all subjects required in elementary schools. Those who do not show aptitude are generally sent away after 1 year, the colleges losing all grant upon them. Describes his test for teaching, 3531-5. Recommends a third year's course in special cases, and more definite inspection as to qualifications of science teachers, 3536-7. The school boards of some large towns have established or are about to establish training colleges. Knows of no reason except insufficient accommodation at present colleges. The present syllabus is suitable for ordinary elementary teachers; for special science teachers a science college might be beneficial. The present colleges supply the demand for male but not for female teachers. Some of them will be closed if new ones are established by school boards, 3538-47. The students in Scotch colleges, which are partly day colleges, lose much of the home feeling and stricter moral discipline of English students; does not know their cost, 3548-50. Girls are admitted to training colleges on the same terms as men, but there is greater competition, 3551-2. Two new colleges are to be founded at once, as the supply of female teachers is insufficient, 3553. Girls are taught 1 science, selected from the same list as the men's, and 1 language, 3554-6.
See also Mr. OAKELEY's evidence.

OAKELEY, Mr. H. E. Pages 391 to 392.

Students on leaving training colleges differ much according to the colleges from which they come. Trained masters are far better than untrained, 3557-8. In the metropolitan and some other colleges the teaching is better than in most provincial colleges, and they command a better selection of pupils, 3559-60. Inferior colleges might be induced to get special lecturers, 3561. (*Mr. Sharpe.*) The grant depends upon the inspector being satisfied with the premises, management, and staff, so that Government has absolute control. Conditions of grant, 3562-7.

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In the early days of the S. Kensington system there was an elaborate system of examinations, *vidæ voce* and others, for science teachers; it did not prevent bad teaching. It is better to make teaching as far as possible a free trade matter. The certificates are often considered as certifying ability to teach, 3569-71. Does not think the number of bad papers would be much increased. The only way to improve science teaching is to increase facilities for instruction of teachers, 3572. Payment by results cannot be dispensed with in training colleges. Science teachers for those colleges might, if desired, be examined at the Normal School. We must look to college committees to check the tendency to teach subjects which pay best, 3573-5. The Department tries to make all subjects equally difficult. Mathematical teaching is so bad and so limited here that subjects requiring mathematical training are unavoidably difficult. Refers to instructions to examiners. There are 2 examiners in all subjects in which the papers are numerous, and they are asked to consult their assistants as to the questions, 3576-7. Mr. Curzon's evidence (504-20) gives a very exaggerated idea of the amount of unsystematic teaching. Classes are sometimes started and then dropped from lack of local support, &c., and even in these cases some good is done, but as a rule the same subject is continued from year to year. The Department does all it can to encourage systematic teaching by giving extra payment for it. Such restrictions as that proposed by Mr. Curzon lead to much irritation and administrative complication, do no good, and are always rebelled against. Mr. Curzon and the body he represents could enforce systematic instruction, 3578-80. The rule suggested by Mr. Reynolds (570, *et seq.*) that a man should not be allowed to teach 2 or

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more subjects unless they were allied could not, if imposed, be maintained. It rarely, if ever, happens that one man teaches such very different subjects as physiology and steam, but does not see why he should not, if qualified, 3581-5. To the allegation that some teachers qualify themselves just sufficiently to get certificates in a number of subjects, and that payment on results of their teaching leads to a detrimental system of cram and results not worth their cost to the State, replies that a more elaborate certificate examination did not and would not in the future check that. If a teacher could confine himself to 1 subject he would no doubt know and teach it better, but it would be a mistake to impose restrictions on the number of subjects a man may teach. In any given place there will either be only 1 teacher of a subject, in which case it is better he should teach than no one, or more than 1, when the students will go to the best. All avoidable restrictions are mischievous. Efficient teaching will be best arrived at by payment strictly on results, 3586-90. No higher rate of payment on results should be made to teachers with higher qualifications. A better teacher will earn more by producing better results, 2591. There should if possible be a practical examination for the honours stage, but there are many difficulties, 2592-3. History and effects of Whitworth scholarships, 3594. To give men technical instruction we must generally remove them from the routine of their trades, and it is very difficult for them to get employment again. The system of technical education for engineer students, &c. in Royal dockyards is excellent, but difficult to carry out in private works, 3595. Sir J. Whitworth's endowment has been of great service to the country. Similar scholarships might with advantage be founded in branches of applied science other than engineering, 3596-7. It is as easy to pass students in the advanced stage as the elementary, but the total payments for the former, owing to the smaller number of students, are less than for the latter. It is desirable to increase the number of students in the advanced stage, but increased payments to teachers would not do this, and would introduce the principle of paying for subjects inversely to the number of pupils. All teachers of the elementary stage teach the advanced stage also, 3598-600.

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There is little or no room for science instruction in elementary schools. Considerable pressure is already experienced. More time, &c. should be given to drawing, which should be taught on the French system, and carpentry, &c. might be taught after school hours. A deputation sent to Paris by Manchester school board reported in favour of both. In higher grade schools (those containing fifth, sixth, and seventh standard boys drafted from other schools) as now organised no special instruction in the principles and processes of the pupils' future work can be given. Too much is already attempted in them. Each such school might be divided into a "high school" giving an ordinary education, including languages, and a "technical" or science school where elementary mathematics would be the principal feature, a laboratory or workshop would be provided, and scientific treatment of local manufactures taught, 3601-3. Boys from the high school would become clerks, &c., or enter universities. Those from the technical school, who would follow technical pursuits, would gain by having their attention concentrated upon things useful to them, 3604-6. The expense would be no greater than now. The Education Department should give a grant for practical as well as theoretical work, and the district inspectors should conduct all examinations. They now examine in specific subjects, but certain science subjects are also taken up by the Science and Art Department. The present system should be maintained as to art, 3607-11. Competent examiners could easily be got. Examination and inspection should be combined both in science and art, 3612-4. A great portion of the science instruction in elementary schools is mere cram, particularly in physiology and physical geography. Both of these are under inspection by the Education Department inspectors, and not paid for on results. In mathematics and mechanics the teaching has been fairly successful, 2615-9. Manchester school board is fully alive to the advantages of laboratories, &c., 3620. His district includes Manchester and its suburbs, but has

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 had other experience. There are 2 or 3 independent boards in the suburbs, 3621-3. The fairest comparison that can be made between different districts is the number presented in the upper standards. Manchester stands first in all the country. Gives statistics, 3624-5. Standard reached in general subjects is a guide to capacity for science instruction. Children below the fifth standard derive no benefit from specific subjects, but object-lessons, &c. may be commenced even in infant schools, as preparation for a specific subject, and the quality of the instruction tested by a class examination, 3626-8. Attaches great importance to an improvement in the teaching of drawing in elementary schools. Drawing educates the eye, &c. The results are now very poor. Our children draw too long from the flat, 3629-31. Geometrical drawing has considerable value, 3632. Is glad the experiment of teaching carpentry in schools as a prize for the better boys is to be tried in Manchester, but is not sure of the results; it may degenerate into something like a game, 3633-4. There is a tendency among elementary school boys to scorn manual work, and enter the over-stocked market as clerks. Teaching the use of tools in schools would help to correct this, 3635-6. Would like to see physiology and domestic economy struck out of the list of science subjects for elementary schools. The latter eminently requires practice. It is not obligatory, so there would be no hardship in insisting that, if taught at all, it should be taught practically and proper apparatus, &c. provided. It would then be very valuable, but there are great difficulties, *e.g.*, material for cooking, 3637-43. Will read and perhaps comment upon a report on Peter Street school handed to him, 3644-5. Advantages of inspection in the science examinations of elementary schools. Sees no great difficulty in introducing it. The examinations might advantageously be conducted by Her Majesty's inspectors. There would in his district be no difficulty in obtaining inspectors competent for the work. The payments would depend on the results of the inspection and written examination, which would be very advantageous, 3646-51. Knows no school organised as he has suggested (*see* 3603), 3652-4. Peter Street school, Manchester, is one of the best higher grade elementary schools. Very good instruction in science is given there, but they attempt too much. Mentions the subjects taught. If the school were divided, chemistry, and, perhaps, experimental mechanics would go to the technical department, and technology of the cotton industry would be added to the subjects taught in that division, 3655-8. Knows of no school so organised. It is his own idea, 3659. The high per-centage in upper standards in Manchester schools is due chiefly to the school board, and to an excellent organising master who has great personal influence with the pupil-teachers, with the result that the teachers are superior to those of other districts, 3660. The system of grading the schools has not been at work long enough to test its results. It leads to economy of teaching, and keeps boys in the higher standards longer at school, 3661. A peculiar system of marking registers is used, and prizes are given for regularity. There are meetings, speech days, &c., which are looked forward to by parents, and do much good, 3662. The open school system enables young pupil teachers to do work which could not be entrusted to them in classrooms. The Manchester board have in their new central school taken to large class-rooms. Has known both systems work well, 3663-4. All the junior schools in Manchester are taught by mistresses, 3665. Female pupil teachers entering training colleges are better prepared than males, 3666. In many subjects females would be as well qualified for taking higher standards as males, 3667. There are more good board schools in proportion to the population attending them than denominational, but some of the latter are among the best, 3668. Recitation, &c. is done extremely well in some Manchester schools. If carried too far it would have a bad influence, 3669.

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Is a senior inspector of elementary schools, but has for many years been engaged on other duties. Is member of London University Senate, and was one of the examiners, 3671. Will speak first of science instruction in Lambeth, and comment upon Messrs. Sharpe and Oakeley's evidence as he goes on, 3672-5. Statistics of science and art teaching in Lambeth, 3676. Knowledge

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of the facts and laws of nature should enter into every scheme of education, however low, 3677. Such instruction should begin by object-lessons in the infant school and continue through the whole school course. Would not begin definite science instruction before reaching 12 years of age, and the fifth standard. Under the old code the mistake was made of commencing it in the fourth standard, often without any preparation. Under the new code elementary science may be taken as a class-subject. Advantages of this, 3678. Prefers the class system of examination for all elementary school subjects. Hopes it will discourage the taking of science subjects in the fifth standard without previous preparation, 3679. The inspectors examine in all class and specific subjects. Drawing is the only subject under the Science and Art Department. Quotes and comments on parts of the administrative instructions. Museums are being formed in many schools by the teachers and scholars, 3680-2. A few of the scholars at elementary schools attend evening science classes connected with the Science and Art Department, 3683-4. The staff of inspectors, with their assistants, are competent to examine in all class and special subjects. A system of special inspectors for special subjects would be very mischievous, 3685. An inspector who was unable to examine in any subject might, by applying to the senior inspector, get assistance from another member of the staff, 3686. The examination in specific subjects is now seldom oral, because the grant is paid at per head for those who pass, 3687. If oral examination were initiated, the slightly increased difficulty might be got over by better organization of inspecting staff, &c. Such men as the present inspectors ought to and could easily acquire the necessary knowledge, 3688-9. In his own district as inspector could within a year, with his two assistants, orally examine in all subjects except perhaps one, and in his larger district as senior inspector could arrange for all subjects, 3688-91. No great change would be needed in the qualifications of inspectors on appointment. Ordinary intelligent university men could and ought to acquire the necessary knowledge during the year's training to which they will be subjected, 3692. As to Professor Huxley's evidence of the opposition between literary and science training, few men now leave the universities without knowledge of some branch of applied science. Those intending to become inspectors would probably give more attention to this than others. Inspectors would select assistants acquainted with those subjects in which they themselves were deficient. A knowledge of the methods of teaching applied science should be required of every inspector, 3693-6. Drawing instruction can best be judged by its result as shown on paper, but even of this, inspectors acquainted with the schools, &c. could judge better than examiners who only saw the papers. Bad methods would be more quickly corrected by personal inspection than by rejection of papers sent up to S. Kensington, which would be a great advantage, 3697-9. On this subject agrees with Mr. Oakeley, 3700. No one's education is complete without some knowledge of the facts and methods of science. The machinery for teaching science (1) as a part of general education, (2) for those who will use it in industry, &c., should be considered separately, 3701. The code provides for the former, and provision might with advantage be made for the latter by establishing trade or science classes in connection with schools, 3702. There ought to be in every large town a good science school (not the ordinary higher grade school) where picked boys could acquire such knowledge. Additional science facilities for those who intend to become skilled artisans are very valuable, but boys who leave school at 12 or 13 are too young for such specialised instruction, and even those who leave at 14, had better study the code subjects *pari passu*, than devote the last year to some one subject, 3703-5. Objections to the Manchester system of drafting fourth or fifth standard boys to higher grade schools. They would not apply to the same extent to a higher school in the same building as the lower, nor to schools for a specific subject like science. The scheme of elementary instruction prescribed should be completed at 14. Those who can stay till 15 ought from the first to have a wider education, 3706-7. The science teaching in schools is defective from imperfect qualification of teachers, but this defect could be better remedied by good itinerant lecturers, assisted in the intervals between their visits by the head-masters, than by the establishment of separate schools. This is the Liverpool system, and unfortunately neither it nor the

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Manchester system has yet been adopted by the London Board, 370^a-9. Some such plan would give greater thoroughness to the higher science teaching of schools, and would improve the methods of the masters and make the course of instruction continuous from the first, 3710-2. Payment by results is the only equitable method as between Government and the schools, but teachers should be paid partly by salary, not more than a fourth of their income depending on results. Where the teacher's entire income depends upon results he is tempted to adopt unsound methods of teaching, 3713-4. The London Board pays its teachers by fixed salary and a bonus on the grant earned. The salary does not seriously fluctuate if the number of scholars keeps about the same. Their system of paying 5*l.* additional to every teacher holding 3 advanced science certificates is objectionable, 3715-6. Believes that the teachers of evening science classes in his district usually depend for their remuneration on the Government grant. This, though perhaps necessary, deteriorates the character of their teaching, which is entirely devoted to passing scholars, 3717-8. The science instruction in elementary schools is valuable, but would be more so if the teaching were better and the examination conducted in a better manner. The results have been specially unsatisfactory in the fourth standard. Is glad that rudimentary science will be more generally taught to the younger children and no grants made for a particular science before the fifth standard, 3719-20. The results of the drawing instruction are very valuable, but might be improved. Is sorry so few take up perspective and model drawing, 3721-2. The first step towards improving science teaching would be taken if something of elementary science and scientific methods could be introduced into pupil teachers' training. Does not see how this can be done, as they already have so many subjects to learn and have to teach 5 hours per day, 3723-5. Any further reduction of the teaching time would be economically a serious matter for managers. The reduction to 5 hours has provoked considerable remonstrance, and a reduction to 3 would involve paying for twice the present teaching power, 3726. Every attempt to improve elementary school teaching has provoked remonstrances, and generally from managers of voluntary schools. Pupil teachers, besides exact knowledge, have to acquire experience in teaching, and any reduction of teaching so as to give more time to the former must be at the expense of the latter. They are as often deficient in one as in the other, 3727-9. The 2 years' training college course, which ordinarily follows pupil teachership, gives ample time to make up any loss in teaching facility caused by curtailment of the teaching hours during apprenticeship. Some branch of science systematically pursued should form part of the college course. This is being gradually introduced, and will greatly improve the teaching in our schools. Our schoolmasters are good teachers of that which they know, but most of them have not studied science in the colleges. Students in training colleges are allowed to attend science classes, and probably have science teachers, &c. in the colleges, 3730-3. A pupil teacher who has taught for only 4 hours might make up the deficiency by teaching in the college practising school, but the whole system was framed rather with a view to teaching than to training teachers, and great inconvenience would result from withdrawing him from school work for another hour. He might be more valuable as a teacher if he received better instruction, but who is to give it during the time set free? 3734-5. Arrangements for combined instruction of pupil teachers in special subjects ought to be made in large towns, but could not be insisted upon in the country, 3736-7. Simple elementary science might be taught to the youngest children. The Kindergarten system is very valuable, but the lessons lack system. They should be planned with a view to science teaching in the fifth or sixth standard. Hitherto object-lessons have been given in infant schools, but dropped when the standards commenced. The new code contemplates their continuance through the earlier standards, 3738-40. Infant school teachers have hitherto treated the Kindergarten system in too mechanical a manner. There is reason to hope that more attention will now be given to it, and that it will be valuable as preparation for the training of elder scholars in technical subjects. In lower standards the facts of science should be taught, its language avoided, 3741-4. Has no experience of elementary school instruction in the use of

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tools. It is not, like drawing, an essential part of an ordinary general education, but the beginning of technical education for artisans. Although it is well worth knowing it might do more harm than good to teach it in the limited time available for elementary instruction. It is neither on the same footing as drill in respect of physical training, nor as drawing, 3745-8. The numbers attending night schools have recently fallen off, and will further diminish, because those who formerly attended them have received instruction in day schools. They would disappear altogether, but that two class or specific subjects are allowed to be taken in addition to reading, writing, and arithmetic, and special grants may be made for all five. They will occupy a position between elementary schools and science classes. They do not overlap the latter, since the pupils must come up in standard subjects, 3749-50. Boys and girls on leaving school often drop all study for a time, and go backward. The new code, therefore, allows them to be examined once in a standard in which they have already passed. Hopes night schools will lead up to the science and art colleges, 3751-3. Scholars cannot be presented in extra subjects without being presented in a standard. Standards will not disappear from night classes. While pupils may leave school at the fourth or fifth, they may profitably go on to the sixth or seventh in night schools, and so on to the science classes. Hopes night schools will, to some extent, serve the same purpose as the Fortbildung schools of Germany, 3754-7. In Lambeth district, besides elementary schools, science is taught in day classes in certain middle schools, &c. as part of the regular teaching, 3758-9. Apprenticeship funds have long ceased to fulfil their object. Under the Endowed Schools Act they may under certain conditions be treated as educational endowments. As an Assistant Commissioner under that Act found great local opposition (*e.g.* at Hull) to their application to secondary education, but willingness to apply them to the industrial training of artisans. Describes foundation, &c., endowment, and prescribed course of instruction of Canon Moseley's Trade School at Bristol, 3760-2. It was originally founded as a technical school, and endowed with funds intended for the use of scholars of the class attending elementary schools. No other scheme which he has dealt with provided a technical school. The Commission has power to give educational endowments a special scientific character; believes they have sometimes done so, *e.g.*, Keighley Trade School, 3763-5. The London School Board has scholarships, which are attracting great attention, for sending its best boys to middle class schools, and several boys have been admitted to open exhibitions at Dulwich College, &c. The tendency to this will increase as good secondary schools become more numerous, 3766. The scholarships at the Board's disposal have been principally used for sending boys to higher secondary schools giving a chance of going to the university. Parents would probably prefer these to middle class schools, 3767. Holders of school board scholarships should be allowed to choose between schools giving a scientific and technical and a literary education respectively. At present the only channel of advancement for them lies through the best secondary schools, but as scientific schools increase, and as technical schools are founded, they are as likely to select the one as the other. Such boys suffer nothing in higher class schools from their inferior social position, 3768-71. They should be selected at about 12 years old, 3772. This is substantially the London School Board course, and the boys so selected are as likely to do well in the higher schools as those who enter them earlier, 3773. Does not agree with Mr. Oakeley that such boys should be drafted to schools having two sides—(1) technical, (2) commercial. Would rather they should go to a good secondary school. If they decide on a technical or commercial career, they had better stay in the primary school until 13, as the class subjects in the sixth and seventh standards would be valuable to them, and then receive special instruction in a good technical school, linked to an elementary school. The course of education for which a boy is best qualified can be determined at 12 years of age, 3774-5. Two great things to be desired are—(1) fuller recognition of the need of science in general education; (2) a much greater number of technical and scientific schools. Seeing the increased interest and desire to improve among primary school children feels sure that the number who will avail themselves of technical instruction if they can get it will increase every year, and that the disposition of parents to make sacrifices

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that their children may obtain better instruction is increasing, and will increase more rapidly, 3776-7.

RICHARDSON, Mr. H. D. Pages 434 to 441.

Is a shoemaker, and editor of the "Boot and Shoe Trades Journal," 3778-9. Has considered the subject of technical instruction in regard to his trade, and believes his views are shared by those members of the trade who have considered the subject, but not by the majority, 3780-6. There is no technical teaching in the boot trade. Since the introduction of machinery and division of labour workmen learn one process only, not the trade as a whole, and apprenticeship has practically died out, as no longer applicable to the circumstances. Some system of instruction is required to take its place, 3787-93. The introduction of machinery, &c. has been of very great advantage both to the country and to the workmen; explains how, 3794-8. Schools are required where instruction should be given in the anatomy of the foot, designing, pattern-cutting, grading patterns, qualities, &c. of leather, and systematic explanation of construction and finishing and machinery employed. Perhaps one-half of the boys taught on the present haphazard system do not really know how the work should be done, 3799-800. The patterns referred to are patterns of the pieces; if they are wrongly cut the perfect article cannot be properly formed from them, 3801-2. One set of patterns would be used for a large number of articles, and their production is the business of persons of whom proportionally few are employed, holding a higher position than the workmen executing the work, 3803-6. Although a knowledge of the anatomy of the foot and designing would be principally of value to designers, its general diffusion would widen the field of selection for superior officers, and be an advantage to the trade. Among the younger men there is a desire to learn the trade as a whole. Believes his paper sells because of the sheets of designs issued with it, and is read for their sake by intelligent artisans, who want to rise, as well as by designers. Does not suppose all the artisans would avail themselves of technical instruction if it were provided, 3807-11. Thinks we are in advance of foreign countries both as to design and manufacture of boots, &c., but there is danger that they will soon pass us. They are paying great attention to the subject. Does not know how to awaken interest in it among English manufacturers. They feel the want of technical education, having to try and to discharge many men in order to get the ones they require. Only certain portions of the shoes are made by machinery, 3812-9. Is not prepared to say how the instruction should be given, but only to point out a want which, in his opinion and that of many operatives and some masters, exists. For cutting out instruction is needed in the texture, &c. of skins. The foremen, as a rule, look sharply after their men, but they have not time to teach the young men, and a certain discretion is necessarily left to the workmen; the skins vary in texture, &c., and a large number pass through the cutter's hands in a short time, 3820-6. Will consider how practically to carry out technical instruction, and communicate his views on this matter to the Commission. If classes were established a large number of men would pay fees. Teachers are the difficulty. Mr. Hannibal is a man of great experience. Will bring him forward if desired, 3827-8. Apprenticeship has nearly or quite died out in the shoe trade. Boys who enter the factories are paid for their work almost directly, and get no teaching. Boys who put on the bottoms are mostly brought into the trade by the large number of men who work at home, 3829-33. Owing to division of labour a workman is kept entirely to one operation. It is advisable that he should be acquainted with others that he may take them up if required, or if unable to get employment in his own branch, 3834-6. A workman employed in a factory has little opportunity of becoming acquainted with other branches than his own. Technical instruction would obviate this. The theory of making hand-sewn boots should be thoroughly explained, 3837-9. Those workmen who actually work machines must understand them pretty well, 3840. In any teaching for apprentices instruction should be given in the principles and construction of the machines employed. All the processes should be explained by means of lectures, &c. free to all. It should be given in the evening, and pupils should know something of the trade before going to

RICHARDSON, Mr. H. D.—cont.

the technical school. It should embrace both theory and practice. Believes machine makers would be glad to send their machines to technical schools without expense, 3841-4. Previous instruction in drawing in elementary schools would be almost as valuable to those learning the trade as writing, both as preparation for designing and as making them more intelligent, and therefore better workmen, 3845-50.

SHIPTON, Mr. GEORGE. Pages 441 to 445.

Is secretary of the Amalgamated Society of House Decorators and Painters, the London Trades Council, and the Trades Guild of Learning. Is a house decorator, and served an apprenticeship to that trade, 3851-3. The Trades Guild of Learning is a society for organizing lectures, mainly historical, on handicrafts, &c., 3854-5. His experience enables him to give evidence as to the wants of artisans, 3856. Will speak of technical instruction (1) generally, (2) with special reference to house decorators, 3857. Traces the break down of the apprenticeship system and the present scarcity of highly skilled workmen to (1) the contract system; (2) division of labour; (3) insufficient inducements to workmen to teach apprentices. The demand for technical instruction results from that scarcity, for which employers are responsible. As now given it will do little or nothing to supply skilled workmen. What is learnt in the classes is not allowed to be used in the workshops. The art school instruction is useless to operative workmen. Submits a scheme of technical instruction for artisans, including trade schools, under skilled workmen, and compulsory instruction of boys by employers. Suggests also that spaces be set apart in museums for specimens of work, to which the names and addresses of the workmen should be attached; prizes might be given for original and good productions, 3858.

HOPPS, Mr. JAMES. Pages 445 to 457.

Has charge of the workshops at Cooper's Hill College, in which some instruction in machine construction and metal working is given to the students. Little instruction is given in wood working. The students are trained as civil engineers for employment in India or elsewhere. Believes they are not pledged to take appointments in India, 3859-65. Describes his own training, which was exceptional, 3866-70. Has been at Cooper's Hill 12 years. The workshop instruction there is almost entirely his own sketching. It is optional, and is not allowed to interfere with theoretical studies, 3871-3. Advantages of technical instruction to civil engineers, 3874-5. In training a master mechanic practical technical instruction is almost necessary. He should attend a school workshop for about 2 hours daily from 15 to 17 or 18 years of age, but so as not to interfere with his theoretical studies. He may be presumed by this age to know trigonometry, geometry, and elementary statics, dynamics, physics, and chemistry fairly well (not a large assumption), and should then be articled to a commercial firm for 4 or 5 years, 2 or 3 of which would be spent in passing from shop to shop and actually working, the remainder in the drawing office, 3876-81. To train a foreman mechanic without his being first a journeyman would adopt a modification of the system at Châlons-sur-Marne, where 6 hours theoretical and 7 hours practical work are done each day. The director would prefer 7 hours theoretical and 6 hours practical work. The course lasts 3 years. Students on leaving cannot always obtain employment as foremen. To train foremen here on that system 2 years factory work must be added, and doubts whether they would then obtain employment as such. Foremen here work to prepared plans, and are principally valued for the power of producing cheaply and quickly; on the continent they often have to design, 3882-4. The best course here would be to increase the theoretical instruction of workmen and select the brightest of them as foremen. Employers see the necessity of foremen knowing what good work is and insisting upon its production. The qualities required are firmness, energy, great mechanical ability, and some theoretical knowledge, 3885-8. To instruct the workmen would commence at the elementary schools. Time is now often lost there in teaching useless subjects. Boys enter factories at 13 or 14 with no knowledge of what is done there or the materials used, and without strength for the heavy work to which they are often put. They are set to mere drudgery, get

HOPPS, Mr. James—*cont.*

practically no teaching, and become idle, 3889-90. In large towns boys should remain at school till 16, the last 2 years being devoted to instruction bearing upon their future trades. Workshops should be attached to the elementary schools, where practical training should be given. It would assist boys in choosing their trades, 3891. Mentions a few of the advantages he would expect from this system, 3892. Would not expect opposition to the sale of articles produced in such workshops. There might be difficulty in persuading the public to buy them, 3893. There would be some difficulty to parents from loss of boys' wages till 16. States how it has been met in certain Parisian schools, 3894. Would give as much practical instruction, if possible, as at the Villette school, but does not recommend apprenticeship schools on that model, 3895-6. Good mechanics cannot be produced in school workshops; gives reasons. To produce a good mechanic 4 or 5 years apprenticeship is necessary, and his work should be as varied as possible, 3897. The Villette school, to vary the work of its apprentices, has produced work, &c. for outside people, but without much success, 3898-9. Workmen produced at such schools would not satisfy English requirements, and the schools would be more expensive than those he has suggested, except in large towns, where central schools with workshops might be established, 3900-1. The number of superior schools would be limited by the number of parents able to keep their boys at school till 16, 3902-4. Would not give technical instruction to boys under 14, even though they are to leave school at that age, 3905-8. Boys during apprenticeship should be compelled to attend evening schools, 3909. States objections to the present system of apprenticeship, 3910-1. Recommends that boys should not enter on apprenticeship till they are 16. They should be kept at schools with attached workshops until that age, an extension of the Parisian system of rewards being adopted to meet the difficulty of loss of wages. The instruction during the last 2 years should have direct bearing upon the future trades of the scholars. Workshops should be attached to all public elementary schools to teach principles underlying trades. The teaching between 14 and 16 should include geometry, machine drawing, and elementary physical science. In factories the masters should be compelled to provide theoretical instruction, 3912-9. In the engineering trade many young men are not apprenticed at all. Would revive apprenticeship, but with the modifications he has suggested, and do away to a great extent with the present arrangements as to juvenile labour, 3920-1. The subdivision of labour as between factories and consequent difficulty of defining trades would be met by stating in the indenture what the master was to teach his apprentice, 3922-3. Does not see how to prevent youths being engaged as labourers in lighter industries, but in such trades as mechanical engineering it should be prevented, 3924. Masters should be compelled to give their apprentices some theoretical instruction, 3925. Technological schools should be established in all industrial centres. Science and Art Department classes teach mainly theory; these schools should teach the application of theory to practice. Mentions some subjects to be taught, which would vary in different localities, 3926-8. The cost should be met by municipalities, and failing them from public funds; would not refuse assistance from the City Guilds, 3929-31. Circulation of objects from S. Kensington should be promoted and free industrial museums established in all industrial centres, 3932-3. Is strongly in favour of opening museums, &c. on Sunday, 3934. The present (February 1883) patent laws are prohibitory for working men. Would cheapen patents. Inventors should be called on to prove novelty and compelled to grant manufacturing licences. The cost of prosecuting infringements should be borne by the State, 3935-9.

Evidence taken at Birmingham.

DRY, Mr. HENRY. Pages 458 to 460.

Is a general brassfounder, employed by Messrs. T. Pemberton and Sons to examine work, and a trustee of the National Society of Amalgamated Brassfounders. 3940-2. Knows generally the views of artizans in his trade.

Day, Mr. Henry—cont.

Many have been delighted with the assistance received from the Art Gallery, and would be glad of any metal work from S. Kensington, 3943. The art school classes have been attended by some artisans with advantage, but not by so many as there ought to have been. Some have no disposition, others no time to attend, 3944-5. Their existence is generally known, but workmen do not take much interest in the matter, 3945-6. The only way to awaken the interest of the men is for a few in each factory to explain to them the benefits to be derived. Suggests also occasional free art and science lectures. The art school managers have done all they could, 3947-8. Manufacturers have not done much to send men to the art school, but have subscribed to it. Would like them to subscribe more, 3949. The fees charged are beyond the means of many artisans, but not of all, 3950. Only a few students from his trade attend the classes, mostly boys or young men, 3951. Cannot give instances where the instruction has led to advancement, but it makes the students more skilful and better judges of work, 3952-4. Some men attend the classes at the Midland Institute; cannot say which classes, but probably scientific ones mostly, 3955-Ga. The branch classes in board schools are very valuable to foremen and workmen. Suggests classes for working men only. A few persons are needed to press the subject upon the men's attention, 3957-9. Many who would not attend the Midland Institute would attend classes nearer their homes. Would like to see the plan of classes in board schools extended, 3960-1. Those interested in the matter might show more zeal in circulating handbills, &c., 3962-4.

BARNES, Mr. T. C., and HADDLETON, Mr. A. Pages 460 to 470.

(*Mr. Barnes.*) Is general secretary of the Glassmakers' Association of the United Kingdom and a practical glassworker employed in Messrs. Osler's factory, 3965-7. It is important that young men in his trade should have technical instruction both in science and art, 3968-70. Is well acquainted with what is being done both in Birmingham Art School and in science classes. Has assisted the teachers of some of the Midland Institute branch schools, where boys are taught outline drawing, chemistry, &c. at a nominal fee, 3971-5. Lectures to induce young men to attend classes are given at the Midland Institute, not at branch schools. All is done that can be to make the classes and their objects known. Suggests compulsory attendance for his trade. The exceptional conditions of that trade would justify exceptional measures, 3976-85. Employers and parents of lads in the trade should be compelled to see that they attend science and art classes. Knows no trade requiring so much technical knowledge. Has had exceptional opportunities for seeing the different workings of foreign houses and the skill of their workmen. Our workmen are inferior in knowledge of design and ornament, but superior in the use of hand tools, 3986-7. Workmen do not design the articles they make, but if properly taught they can understand instructions better and produce better work. Designers have only recently been introduced into the flint glass trade. Scholars from S. Kensington have raised the trade enormously during the last 10 years. One reason why artisans should be better instructed is that foremen are drawn from that class, 3988-90. The best designers for glass are those who understand the material; many do not, and draw impracticable designs. Has had art instruction and found it useful. It is the duty of Government to give every facility for art instruction and to open all museums at times when the working classes can visit them, 3991. Apprentices should be compelled by law to attend science and art classes while learning their trade in the glass factory. Probably the board schools will improve the class of boys, and may give them an inclination for more learning. The trade is difficult to deal with from its exceptional hours of labour, 3992-7. Doubts if his association, though powerful, could enforce such instruction. The men are ignorant, and that obstacle must be overcome to get money for a vote on art education. No doubt if the manufacturers offered a prize the trade would do so too, 3998-4001. The fancy glass and table work trade, to which the association is confined, is not rich enough to pay teachers for young workmen. Gives statistics of membership, &c., 4002. The masters have difficulty in finding skilled workmen. They might make

BARNES, Mr. T. C., and HADDLETON, Mr. A.—*cont.*

it a condition of the indentures that apprentices should attend science and art classes, which would remedy the evil, 4003-7. Has known of no case where this has been done. One master paid a drawing master and provided all materials, but the apprentices would not attend; hence the need of compulsion, 4008. Sees no early remedy except a law or an agreement amongst the members of the trade. If the Commission called attention to the desirability of such an agreement it would probably have weight with both masters and workmen, 4009-11. In his trade the artisans require a thorough knowledge of outline drawing, ornamentation, and design, 4012. This is sufficiently attended to in Birmingham Art School. Approves of the course of instruction there. Does not know of anything more that could be done. Glassworkers, however, should learn more model drawing and modelling, 4013-7. Knows of no improvement in the science classes that would add to their value for his trade, and has never heard it said that the instruction was not suitable, 4018-9. Would like to see more and better drawing done, especially from models, in elementary schools, 4020-3. Does not know how far science teaching in such schools is intended to go, but so far it is just what is required, 4024. Young boys show a great liking for science teaching; they like it better than grammar, 4025-6. They can begin that instruction at an early age. Children's tastes vary. All his own sons have attended the Midland Institute. His eldest has won several prizes and now earns 4*l.* a week as a jeweller. He both designs and makes his work, 4027-9. In the glass trade workmen and designers are different men. Many of the latter are students from S. Kensington, 4030. Continental glassworkers have a thorough education, comprising both technical and scientific instruction, and possess great aptitude in consequence. They have invented and adopted various hand tools which increase and improve the work done, 4031-8. Only knows one of the classes in which they were instructed—the Working Men's College at Vienna. Found the men there very clever, and the managers thoroughly competent technically, and good chemists. The glass cutters and engravers have been instructed in design and the foremen and managers have received sound technical instruction in science and art bearing on their trade, which gives them a great advantage in production. Saw in France a glass worker trained simply as an artist form a scroll as no English workman could, 4039-43. In the Vienna school glass workers learn model drawing and become competent draughtsmen and practical chemists. That instruction has much to do with the competition we feel. Wages also have something to do with it. States wages of French and German glass workers. Every glass there goes through from 5 to 8 hands, 4044-6. There is little difference between French and English artisans, but greater difference in the lower German states. The glass there is inferior, 4047. Bohemia sends the largest quantity of glass in competition with ours. Saw some works there, 4048. Found classes there connected with elementary schools where special training for glass work was given. Often found whole families working at the trade, the daughters taking home vase work, 4049-52. Glass artists there, men, women, and children, had educational advantages our workmen do not possess—if they did no nation could excel us. Most of the articles produced there are of inferior quality, being blown in moulds, 4053-5. Continental design is much superior to ours. Had we their excellence of design with our excellence of workmanship we should be better placed, 4056-7. To provide a market for their inferior and our first-class goods public taste for art must be educated. It has greatly improved within the last 20 years. Glass has improved more in the last 10 than in any previous 50, owing to art institutions, 4058-60. Suggests that some cases of glass from S. Kensington should be sent to Birmingham. Very little glass on circulation has come there or to Stourbridge, the seat of the art glass trade; does not know why. The authorities have applied on many occasions for cases of Venetian glass, &c., but not his society. A prize was offered for Venetian glass. Paid his own expenses to London to see the collections at S. Kensington and won the prize. Many others might derive benefit from seeing such collections if they had opportunities, 4061-5. Would like to see a free circulation of objects from S. Kensington and also permanent collections. The trade requires it,

BARNES, Mr. T. C., and HADDLETON, Mr. A.—*cont.*

4066. When Birmingham Art Museum enters its new buildings there should be specimens of the best work of all the district trades, and the museum should be available for the artisans, &c. of the neighbourhood, 4067-8. The fare from Stourbridge is 10d. to 1s. and the time occupied short, 4069-70. Men in his trade have plenty of time to visit museums, and most trades have Saturday afternoon. In Birmingham there is no objection to the museum opening on Sunday. During the last 5 or 6 years many have visited the Art Gallery, and their conduct, &c. has been good. Special arrangements are made as to attendants, 4071-4. The Birmingham workmen are favourable to Sunday opening of the museum. Has not heard or known of any demoralizing effect from it, but the reverse. Workmen derive advantage from their Sunday visits, 4075-7. There are Sunday morning classes for elementary instruction, and does not see why there should not be similar ones for drawing, &c. They would be beneficial, 4078-80. Visited the glass works at Louvain. Does not know of any schools for glass work there, 4081-2. In the works at Baccarat each workman was instructed in the technicalities of his branch of the trade, 4083-4. (*Mr. Haddleton.*) The education should be compulsory. Boys in the trade have no time during the first 4 days, and few schools are open on Friday or Saturday. Pressure should be brought to bear on employers, 4085. Is a glass blower, 4086. (*Mr. Barnes.*) The consumption of fancy and table glass in England has not declined; the number of artisans has. Machinery has been adopted, but not to a greater extent than on the Continent. Some of the machines used there are kept secret, and therefore not used here, e.g., a machine for cutting off soda tumblers, &c. His association would be glad of any machinery that would help them to meet foreign competition, 4087-94. Both masters and men object to abolition of the restriction on apprenticeship; 5 apprentices are allowed to 10 chairs. Boys do not enter the trade as apprentices, but are bound at 16 or 17, and only until they are 21. Does not object to boys and men who have not been apprenticed doing any kind of work, 4095-8.

WILLMS, Mr. A. A. Pages 470 to 475.

Is chief artist at Messrs. Elkington & Co.'s, and has been so for 26 years, 4099-100. Was trained in France and employed there in general designing. Was really a sculptor and learnt modelling. At 18 earned money as a designer. Was trained mostly for silversmiths' and brass work designing, 4101-4. Received his artistic education in the ateliers of certain Parisian artists, and assisted in decoration of Louvre, &c. till 1848, then worked in London for 3 years for Messrs. Morell, silversmiths, 4105-7. While in Paris attended the art classes. The only very prominent one was the École Lequien. Everyone could attend it. It was very cheap, but not free. It has since been taken over by the city and made free, 4108-12. During the 3 years spent in England attended no school, 4113. Returned to France and started a studio, in which he prepared designs for Parisian manufacturers. Employed many students from art schools, but principally young men from other studios. Some were finished artists, others apprentices, who were taught working in plaster, with special reference to finish, drawing, and modelling, being similar instruction to that now given in Parisian art schools. They were at once employed on useful work, 4114-21. The students in ateliers get on more quickly than those in any art school, 4122. Chose his apprentices amongst those having some knowledge of and showing ability in drawing, 4123-4. A designer should have a good theoretical and practical art training, 4125-6. Is acquainted with the present system in Parisian art schools. A friend of his is head of the school of drawing and designing established by jewellers, &c. The students trained there apply their knowledge to designing work, for which the silversmiths' guild offers prizes. The goldsmiths' and jewellers' apprentices have a school to themselves in the workmen's quarter, where they are taught general designing only, the instruction being similar to that in the art schools, 4127-34. The instruction in Birmingham art school is much the same as that at the Paris municipal and jewellers' schools. Mr. Jackson, assistant master there, was with witness 18 years, and is a very competent master; the methods he pursues under the Department are calculated to produce good designers,

WILLMS, Mr. A. A.—*cont.*

4135-7. He is able to do anything required, and derives advantage from contact with practical designers, 4135-9. A good designer should have good art knowledge and facility and understand the nature of the trade he designs for, 4140. Has recently visited the school of M. Fossey and the Jewellers' school. As to rapidity of execution there, as compared with the Birmingham school, thinks rapidity depends on the nature of the men, 4141-5. The high degree of finish formerly required in S. Kensington competitions was a waste of time, but that now required is necessary, 4145-6. Has seen many men in his trade become better workmen and good designers from attending the Birmingham art school. There are more designers there now than formerly, 4147-8. The instruction in painting there has diminished the instruction in designing, which is undesirable and opposed to the object of S. Kensington, since it produces artists instead of designers, 4149-51. It is intended to have in Paris a school for chasing and metal work. It would be a good thing for students to be taught chasing at the school of art before coming to Messrs. Elkingtons' works. It might be done if they were sufficiently advanced and had a good master, but men so trained will never be so clever as those trained in the shop. Messrs. Elkington have expert workmen, trained by practice, who entered as apprentices and became chasers, casters, &c. according to individual abilities. They formerly employed about 30 Frenchmen, 4152-5. Young men can be trained in the workshop more quickly than in the school, but it would be a good thing to give them while at school an idea of their future work, e.g. chasing, engraving, and other branches of metal work. Fitting requires great care and skill, 4156-8. Messrs. Elkington take some apprentices, but find it better to employ men, 4159. English boys have as much artistic aptitude as French, and with equal education would make as good designers, 4160-1. Does not know of any French designers now employed in Birmingham. 30 years ago they were employed at several specified works, 4162-3. There are more art workmen employed in Birmingham than formerly. They are now all English, generally trained at the School of Art, 4164-6. The improvement in design and art workmanship here is mainly due to the schools of art, 4167. In silversmiths' and brass work the French adhere more strictly to pure styles than we; there is more fancy work in England. English furniture is more advanced than French. In brass and iron work, such as Hardman's, the English, who generally take earlier 13th century period, rival the French, who take Gothic, 4168-9. Messrs. Elkington prefer to take workmen already trained. They come from various places. Some of the chasers come from London, but most of the best have been trained by the firm by contact with the Frenchmen. Those from other works were trained at Birmingham by attending the School of Art, &c. Even some enamellers went there, 4170-3. Chasers now generally learn their trade under other workmen. Messrs. Elkington pay for teaching their chasers, 4174-5. Was away from England from 1852 to 1857. On his return found that considerable progress had been made, due to the collections at Marlborough House and the commencement of art schools, and also to the importation of French designers and the enterprise of certain firms. Quotes from Mr. Redgrave's report on the 1855 Exhibition, 4176-81.

WOODWARD, Mr. C. J., B.Sc. Pages 475 to 481.

Is lecturer on chemistry and physics at the Birmingham and Midland Institute. Was appointed in 1863, and had previously been assistant to Mr. M. Williams there, 4182-4. Had an ordinary school training, and received scientific instruction at the Midland Institute and other places mentioned, 4185-6. Mr. Williams remained at the Institute about 6 years after witness joined it as assistant. The science classes there commenced in autumn of 1854, 4187-8. Foundation, progress, &c. of those classes, instruction given, &c. Students and past students are given facilities for original investigations. The branch classes are professedly elementary, 4189-95. The present plan of having elementary classes throughout the town while more advanced students come up to the Central Institute seems the most economical one, and, while the only accommodation is that given by board schools, the best; but as the town progresses it might be well to have another institution similar to the central one in another part, 4196-7. The instruction has raised the intellectual status of the town and has had a direct practical application to manufactures. Gives

WOODWARD, Mr. C. J., B.Sc.—*cont.*

instances, 4198. About one-third of the students are artisans studying with a view to apply the science to their trades, one-third teachers, and one-third amateurs studying without any special object, 4199. The subscriptions amount to about 1,400*l.* per annum, and the Department pays on results about 600*l.*, 4200. Payment on results tends to confine the teaching to the subjects in the syllabus. Suggests payments on adaptation to local wants as shown by amount of subscriptions, 4201. The scheme of the City and Guilds Institute, which he knows generally, will stimulate the technical instruction not stimulated by the Science and Art Department scheme if suitable teachers can be got; they must be practical men with knowledge of science, 4202-3. Technical instruction is the application of pure science to industry. The practical part is best learned in the workshop, therefore 2 teachers taking respectively the practical and the scientific parts are unnecessary, 4204. Might be able to sketch a course of instruction in theory for those receiving practical instruction in workshops which would enable them to pass the Guilds Institute examinations and would be of advantage to them, but regards practical men as the proper teachers of technical subjects, 4205-6. The instruction given in Prof. Birnbaum's technical laboratory at Carlsruhe is practically the same as that in the Midland Institute laboratory. So far as his experience goes, nothing approaching trade instruction is given in continental technical schools, 4207-8. Is acquainted with the Mason College, 4209. If the Institute has elementary evening classes throughout the town the students should come up to the Central Institute for higher teaching. It might be desirable, as the town gets larger, to have institutions similar to the central one in other parts of it. Does not see how the Mason College could be utilised in connection with the Institute for higher evening instruction of artisans, 4210-2. Believes there would be great difficulty in obtaining technological teachers to give special instruction in chemistry applied to various trades. Has himself specially taught some students, but the Institute has had no classes specially, except one in blowpipe work. Chemists attached to industrial works would be very valuable teachers in their own subjects and would be willing to teach, but does not know how far employers would like them to do so; fears trade jealousy would interfere, although the chemical manufacturers have formed a society and throw open to members in its journal the information they possess, 4213-9. Has not himself followed applied chemistry in any special works. If practical teachers could be got, classes in technical branches of chemistry might be established in connection with the Institute. Does not know that any efforts have been made to obtain such teachers. Thinks there would be a difficulty, 4220-2. If such teachers could be obtained it would be an advantage that students, after 1 or 2 years preliminary teaching, should have the opportunity of studying chemistry as applied to their own industries. Many of them now do so. The same is true of other branches of science, 4223-4. Has about 15 students in an honours class where the instruction is specialised to suit the requirements of students. Does not know what special examinations they would go in for. 1 or 2, engaged in ironworks, who have attended his practical class have gone in for the Guilds Institute examinations, and 2 of his students have been specially successful in electro-metallurgy, 4225-7.

CUCCO, SIGNOR GIOVANNI. Pages 481 to 490.

Is a civil engineer, and native of Biella, Italy. Is here on his own account, but with the moral support of the Italian Government, 4228-30. Was trained in the Royal Polytechnic for Civil Engineers in Turin, 4231-2. First came here 5 years ago, and has lived here $4\frac{1}{2}$ years, for the purpose of studying our industrial resources and institutions, with a view to future usefulness to his country and himself, 4233-5. Spent his time mostly in active employment as a workman in workshops and in contact with the working classes. Mentions his various employments, 4236-42. Up to the present time English mechanics' shops are superior in organization and production to continental. The high price of labour here and other causes have led to a greater use of skill- and labour-saving machinery than in other countries. This has established the engineering reputation of England, but our workmen have grown reluctant to do any operation by hand; the young engineers scarcely learn to handle

Cucco, Signor Giovanni—*cont.*

tools, and their skill has deteriorated. Hence the need for their practical and technical education, 4243-8. A British engineer of the old school, trained before machine tools were so much used or jobs so minutely subdivided, is the best workman in the world, but the same cannot be said of the new men who have had no opportunity of performing the work by hand, 4249-51. The work turned out is as good or better, but it is machine work, 4252. The young foreigner is a better workman than the young Englishman, because, (1) owing to the want of machine tools in continental shops, he performs more delicate work by hand; (2) he possesses better technical education. He is superior in handling formulæ, sketching, and technical trade knowledge, 4252-3. The French workman's knowledge would be very solid if he had the same opportunities of seeing variety of work and the magnitude and organization of English workshops, and if he had more practical chiefs, 4254. Has had no opportunity of comparing different French shops, 4255-6. There are in France large shops with machine tools, &c., but so few as not to influence the general education of the workman class, 4257. English machine designers are second to none in ingenuity and invention, but are often deficient in theoretical and scientific knowledge; hence they use too much material and produce work that is too massive, 4258. English locomotives are more practical, more simple and light, than French; the latter are too complicated and massive, 4259-62. The inferiority of French locomotives is attributable to the fact that the technical staff of the companies are students from polytechnics, where an excellent theoretical, but a very poor practical, education is given. Their contact with workmen makes the latter more theoretical. If things stay as they are here for 10 years, and go on as they have for the last 10 years in France, there will be great disparity. English locomotives will be superior to any others for some time to come, 4263-5. Has had no opportunity of directly comparing English spinning machinery with that at Mulhouse, &c., 4266. There is no better mule in the world than the Manchester mule. In France they have done very little. Switzerland and Germany are advanced in this kind of machinery, but England more so, 4267-9. There is no such machinery in the Turin Polytechnic or the Italian professional schools except in the Biella school, which has a mule from Plati's. In Italian mills they are of a very old type, 4270-3. The use of machinery deteriorates workmen, leading to a diminution of labour and capacity, but not the machinery made. The remedy depends on the perseverance and *amour propre* of the men, 4274-6. The best way of producing skill and knowledge would be by rotation of work in the shops, instead of keeping men at one thing, or, failing that, by daily theoretical teaching and practice in professional schools, for which English workmen have plenty of time, and attendance at which should be compulsory. Masters might well unite to compel attendance. The necessity for learning is as great here as in Italy. It is more important to have tools in professional schools in Italy in the commencement than here, but it is a necessity for any such school, 4277-84. If practical instruction could not be procured here, would begin with theoretical. The teachers in most of the schools are too theoretical; they should be practical men and give practical teaching. Practical men with theoretical knowledge would cost more, but would do much more work, and therefore be cheaper, 4285-6. English foremen are superior to French in practical manual work. In large companies' works the foremen generally become such by seniority, and are deficient in theoretical knowledge. In the private workshops in the North found more skill, but the foremen do not rise to the level he would like them to attain. They should be skilful both in theory and practice, 4287-8. At Oldham School of Science noticed a large attendance, especially in the drawing classes, but the lectures on cotton manufacture were very poorly attended, probably because the work in cotton mills requires little skill, and the men do not understand the need of instruction. The mechanics are the most intelligent class, 4289-91. Lessons on cotton are given in the Oldham night classes. The audience is composed of sons of masters, &c., but few operatives attend. In the mill the operatives learn the practical part only, in the class they would learn the theory, &c. This instruction would give them opportunities of improving their condition, improve their general intelligence, and induce a

Cucco, Signor Giovanni—cont.

desire for other knowledge, 4292-7. Partly agrees with the view that artisans' intelligence can be better cultivated by literary than by technical instruction. Would commence with literary and then pass on to technical, 4298. Found among the Oldham workmen more good influence from the classes than anywhere else, 4299. In this respect the position of English mechanics now is superior to that of the past generation; what is needed is technical instruction. The classes produce intelligent workmen. Foremen should, perhaps, go on to the Whitworth Scholarship level, 4300-1. Men with this degree of instruction generally become teachers because of the higher salaries to be so obtained; if foremen were better paid they would become foremen; they need not be engaged at manual work. If, from a desire for more intellectual work, they become teachers, it is a blessing, as there is need for good teachers. There will be no deficiency of teachers or foremen when the spirit of competition is thoroughly aroused, 4302-4. In a good technical college for managers, &c. the teaching should be subdivided into stages corresponding to the branches of industry taught, each under a specialist. Over all should be an able director, who should teach the connection between the branches. In many respects Zurich Polytechnic may be taken as a model, 4305-6. Degree of mathematics necessary for a civil engineer, 4307. The system at the *École Professionnelle* at Biella is good. Attaches great importance to the use of the kinematic models there. Number of students, 4308-10. The school is due to the initiative of Signor Sella, a manufacturer well acquainted with the needs of industry as to practical teaching, and has had much influence on the industry of Biella, 4311-4. The school is chiefly attended by workmen; few go on to the superior institutes at Turin or Milan. The fee is 20*l.* per school year of 9 months, including board, 4315-6. Believes the chemical instruction there is well organised, 4317. The dyeing school exerts a good influence upon the industry there. The instruction given is of immense value, because students have the means of making experiments which would not be allowed in the works. They get their training in one-tenth of the time it would occupy in the works. A preliminary knowledge of chemistry is required. Here men sometimes take the management of dye-houses without having mastered the rudiments of chemistry, 4318-21.

WHITE, Mr. WILLIAM (Mayor of Birmingham). Pages 490 to 491.

Has taken great interest in Sunday instruction of those whose education has been neglected, 4322. Objects, instruction, attendance, &c. at the school, 4323-9. General sketch of the movement, 4330.

SMITH, Mr. WALTER. Pages 492 to 513.

Is Art Director of the Technical College at Bradford; from 1871 to 1882 was Director of Art Education of Massachusetts, and previously art master at Leeds, &c., 4331-3. Since his return has taken a tour through England, visiting art schools, 4334. Can give information as to art education in Massachusetts and elsewhere in the United States and in Canada, and compare it with art instruction here both before 1871 and now, 4335. Became student of the School of Design about 1848. The 1851 exhibition called attention to the need of art education in England, and so led to the establishment of S. Kensington Museum, the system of public art education, and the training class for art masters, which has since become the National Training School. Was one of the first six students selected for the training class. Has since closely watched the development of art teaching here. The art education of the United States is mainly the result of his work. In 1870 an application was made to Mr. Cole for someone to organise a system of art study in Boston and the State of Massachusetts, and witness was selected. Went there, and found no art education existent. Some drawing books were used, having no bearing on education, but having copies and paper to draw on bound up side by side, which he considers a valuable feature. The drawing instruction was given by special teachers, few and incompetent. The Science and Art Department found the same thing here, and its great work has been to put the teaching into the hands of regular teachers, i.e., schoolmasters, &c. Saw that the first thing to

SMITH, Mr. Walter—*cont.*

be done was to get drawing taught by the regular teachers in the public schools to all children as part of the school course. This involved teaching the regular teachers and providing employment for the special teachers in special schools. Began by giving lessons to the teachers in freehand, model, and object drawing, and as they became trained and were certificated to teach was able by their co-operation to spread the work firstly over Massachusetts, and finally over the United States and Canada. Went upon the plan introduced here, which he now thinks a wrong one. Witness prepared lessons and designs, which he gave to the special teachers of drawing, and with their help to the whole of the 1,200 teachers in Boston, who gave them to the children, 4336-8. This instruction was given to both male and female teachers. In the United States sex is not recognised in education; nine-tenths of the teachers there are ladies. After this preliminary work had been done by the teachers for a year, took up geometrical and perspective drawing, and (being the first time that it had been taught as a subject of study in public schools) design, elementary and applied, 4339. Kindergarten designing is wisely a mere amusement, and does not bear directly upon manufactures. About the end of 1873 or beginning of 1874 began the teaching of design to every child, involving the belief, questioned by many, that every child had the power to design. Found that everyone could learn to draw and to design, using the word design in its proper sense of arranging not originating things. Freehand and model drawing, geometry, perspective, and design having been taught to the teachers they carried them out in the public schools, and the special teachers were at once withdrawn from the lower grades of schools. Began on the basis of what was done in England, but introduced several new features. Elementary designing was taught in lower grade schools, applied design in high schools. Also introduced drawing from dictation and memory drawing. The work has been going on in Boston since 1873, and from thence has spread until there are now from 6,000,000 to 8,000,000 children being taught to draw from designs he has made, 4340-1. Hands in plan of drawing instruction in Boston public schools for 1878-9. Time devoted to teaching drawing in the various schools. There is now not one special master teaching drawing in the Boston public day schools, 4342-3. Free evening drawing classes were established in 1870, but little has been done in many of them owing to the difficulty of getting teachers, 4344. The Normal Art School of Massachusetts was established in 1873. The evening classes have taken up industrial art education tolerably, but not very well. Puts in scheme of study Subjects taught. Persons who are past the learning age are difficult to teach, which accounts for the relative want of success in the evening classes. Modelling is not taught in night schools, it having been accidentally omitted from the Act establishing them, although it is made an important subject in the Normal School. The Normal School is an important agency. It has sent teachers to all parts of the Union, to Canada, and many of the British Colonies, 4345. No modelling is taught in the day schools, 4346. Is not satisfied with the success attained in the evening schools of Massachusetts. In other states it gets worse as the distance from Boston increases, 4347-8. Drawing and design have been taught in the elementary schools of Massachusetts and other States for 9 or 10 years. Gives instances of the effects of this instruction in encouraging and improving art and other manufactures, and educating public taste, 4349-52. The improvement in public taste may be partly owing to the importation of good examples, but not wholly, since had the taste remained unaltered good examples would neither have been appreciated nor bought. Persons who can make designs will never buy anything worse than they can make themselves, and this encourages the good and kills the bad, 4353-4. Industrial designing in the United States is in its infancy, and cannot be compared with designing in this country; only 12 years ago America applied to England for help in her art education; to-day she has nothing to learn from, but something to teach, England, 4355. Would suggest several improvements in English schools. In England we began by trying to teach pupils to draw the outline, the last thing the eye sees. We began utterly wrong, and have gone on wrongly, and consequently few learn to draw very well. In his experiments has reversed the process, and finds that every person when taught rationally learns to draw, paint, and design well.

SMITH, Mr. Walter—*cont.*

Considers the system at Boston Normal School and Conservatory School better and infinitely more successful than anything he has seen in England, 4356-7. The tremendous advance in English taste and industrial design during the last 12 years is owing more to the revival of Gothic architecture than to the schools of art, 4358-9. Cannot see how greater encouragement can be given, on the old lines, to industrial designing here. We must believe that everyone has the faculty of design. What has been done in the United States is the result of that faith. All children there are taught from the age of 5, or earlier. The mass of the people are more intelligent and appreciative, and geniuses are never missed. From 1½ to 2 hours instruction per week of school life is sufficient to produce good general results and to train geniuses. We have left the teaching of design until people were too old to learn it, and have worked at random with no thorough organization, 4360-1. The system he has described teaches pupils to draw well and think well. Good drawing is but the result and expression of right thinking; the mere manipulation comes of necessity with time. No student should be allowed to make finished drawings, 4362-4. Under the system of teaching all children from 5 years old, the geniuses cannot escape. Some pupils who are proficient in nothing else are great geniuses in drawing, but usually pupils proficient in other subjects are proficient in that also, 4365-7. Drawing, and especially dictation drawing, and design, by developing intelligence, &c., is itself valuable education, and of great collateral advantage in other subjects, 4368. The difficulty of teaching drawing to teachers of from 20 to 60, who have not been taught when young, is very great, and their capacity for learning varies greatly, 4369. No good results can be got in elementary schools here from the teaching of special teachers. Instruction by the ordinary teachers is the best and only way, because they alone can adapt their general teaching to individual pupils, 4370. The unsatisfactory results of our present primary school drawing instruction are partly due to want of efficient direction from head-quarters. Our teaching is antiquated; we have made no use of the experience of others; our subjects and methods are almost the same as they were 50 years ago. There is no organisation of instruction from seed to flower, 4371-4. As to materials, &c. used by children in the States, his method has been to practise in every medium, irrespective of surface or vehicle. Gives details. One-third of each class invariably draws upon a colossal scale on the black-board with chalk. Advantages of this, 4375-6. The teachers execute the examples used by them before doing the work in presence of the class, 4377. It is much to be regretted that modelling has not been taught in Massachusetts; it is a most important part of art instruction, and should be taught from the first to the last day of school life. Art lessons should be varied—sometimes fact, sometimes appearance. Course at the Conservatory School, 4378-81a. In training very young children modelling in sand and clay should begin with school life. It is very interesting to the children. When drawing, modelling, and design are properly taught, and finish is ignored, the study of form and colour becomes delightful, very much develops the pupil's intelligence, and no one finds difficulty in learning, 4382-3. Modelling should be taught in primary schools. It need not take up much time, but it should be begun at the beginning of school life and continued to the end. Modelling deals with facts, drawing, &c. with appearances, 4384. The American evening art schools are free, 4385. Produces and explains some exercises, &c., calling special attention to the superior work of students taught by regular teachers as compared with that produced under special teachers, 4386-8. To train an elementary teacher to give such instruction takes, say, a year at 3 lessons of 2 hours each per week. Puts in schemes prepared for teaching in Philadelphia and Canada, 4389-90. That scheme is applicable to England. If the master is well taught he can learn to do the work in a year; if not, or if taught from flat copies, it would take 100 years, 4391. Queen's scholars in training schools should not attend art schools for drawing instruction. All necessary instruction should be given in the training schools by regular teachers, 4392-3. Does not consider it paradoxical that regular teachers should produce better results than specialists. Gives an explanation. In the more advanced classes has abolished flat copies, and begins with colours and light and shade from objects. Describes and illustrates the course pursued. Tells the students they may make the things as badly as they

SMITH, Mr. Walter—*cont.*

like; all he wants to know is whether they see colour and light and shade, 4394-5. They sometimes draw a rough outline in charcoal, but not always; they simply dab a bit of colour on here and there. Each student, besides the morning's work, draws 160 sketches in the year (*some produced*), 4396. In the Boston Normal Schools the teachers are trained in all branches of drawing simultaneously; intelligent teachers here who have taken second grade certificate ought to be well able with 3 lessons per week of 2 hours each on the system of teaching he has described to take the recently established art class teacher's certificate after one year's instruction, 4397-4400.

WATERLOW, ALDERMAN SIR SYDNEY H., BART., M.P., WATNEY, MR. JOHN, F.S.A., ROBERTS, MR. OWEN, M.A., F.S.A., and SAWYER, MR. W. PHILLIPS. Pages 514 to 540.

(*Sir S. Waterlow.*) Is a vice-president and the treasurer of City Guilds Institute, 4401. (*Mr. Watney.*) Is clerk of Mercers' Company and one of the hon. secretaries of that institute, 4402-3. (*Mr. Roberts.*) Is clerk of Clothworkers' Company and one of the hon. secretaries of that institute, 4404-5. (*Mr. Sawyer.*) Is clerk of Drapers' Company and one of the hon. secretaries of that institute, 4406-7. (*Sir S. Waterlow.*) Origin and organization of the institute. Objections urged. Foundation and general objects, &c. of the institute, 4408-11. (*Mr. Watney.*) It is managed by the governors, council, and executive committee. Constitution, &c. of these bodies, 4412-6. The executive committee manages the ordinary business by 4 sub-committees. Division of the work, 4417-18. There are also a treasurer, 3 hon. secretaries, and a director and secretary, now Mr. Magnus, 4419. The Central Institution has for object the instruction of (1) engineers and architects, (2) employers and managers, (3) technical teachers, and is intended to do for other industries what the School of Mines does for mining. Opportunities will be given for original research bearing on industry. Students entering it will be required to know something of pure science. Gratuitous instruction, &c. will probably be given to registered teachers during part of the year. The pupils will be (1) matriculated students taking a complete course of instruction, and either paying tolerably high fees or entering by scholarships from other colleges, (2) persons engaged in industrial pursuits who desire to attend special courses, (3) persons training as technical teachers, mostly educated gratuitously and supported by scholarships. Need for, and probable success of the institute, 4420. Before any steps were taken for its establishment eminent scientific teachers and others were consulted, who upon the whole agreed that there should be one Central Technical High School. The detail of the teaching is not yet settled. Has given his own views only, 4421-3. (*Mr. Roberts.*) Sir W. Armstrong, Prof. Huxley, and Capt. Galton all expressed an opinion that such a high school is necessary, Prof. Huxley more strongly than the others. Capt. Galton prepared a scheme. While the instruction in the Normal School has no direct application to industry, students in the Central Institution, having passed a stringent matriculation examination in pure science, would receive instruction in science with special reference to industry, 4424-8. The pure science knowledge of teachers coming to the Central Institution will be stringently tested, 4429-30. At Cambridge the laboratory teaching has lately become more practical, and technological chemistry is taught at Owens College, but there is room for a Central Institution in London. Chemical instruction could there be advantageously sub-divided in many ways, 4431-3. London is a great manufacturing city, and would itself be a large field from which to draw students. (*Sir S. Waterlow.*) Before the scheme was settled efforts were made to learn what was being done abroad. No institution was found whose system quite met our wants. The methods of the *École Centrale* at Paris are not adapted to the habits, &c. of our people, 4434-8. The teaching staff will depend upon the funds available, 4439-40. Under the lease an endowment of 5,000*l.* a year must be provided, and a scheme of education satisfactory to the lessors carried on. Thinks an endowment of nearly 15,000*l.* a year will be required, and hopes it will be obtained. The companies' contributions are now during will and pleasure. Greater permanency will be required to secure high class professors, 4441. Evening instruction is largely given at Finsbury College, and will probably be

WATERLOW, Alderman Sir Sydney H., Bart., M.P., WATNEY, Mr. John, F.S.A., ROBERTS, Mr. Owen, M.A., F.S.A., and SAWYER, Mr. W. Phillips—*cont.*

given at the new Institution, and also courses of lectures similar to those given at the Conservatoire des Arts et Métiers at Paris, 4442-4. Hopes the building will be completed next year. Reads statement as to accommodation, &c., 4445-6. No residence is provided for the director; it is very desirable that one should be provided, 4447-9. Before apportioning the space other similar institutions were visited. The Central Institution is 4 times the size of Finsbury College. The building will cost 80,000*l.*, and fittings probably more than 20,000*l.*, 4450-5. It is proposed to provide for some branches implements, &c. corresponding to those provided at Leeds and Bradford for textile fabrics, and for branches, not intended to be fully taught, models of machinery, 4456-9. A technical library and technological museum will be added, 4460. It would be desirable that power should be given by the new Patent Bill to transfer the models of inventions provided for in that Bill to the Institution, 4461-3. The Central Institution was placed at S. Kensington that the students might be near the Museum, Normal School, &c. (*Mr. Roberts.*) Those who initiated the Institution had before them the scheme of the Technological Institute at Massachusetts, (*Sir S. Waterlow*) and another American institution, but no one visited America to study the schools, 4464. It is proposed to have a more advanced and higher branch of art teaching than that at Lambeth (described), 4465-6. In universities, &c. the teaching of chemistry is mainly theoretical. In the Central Institution students will be taught its application to particular manufactures, and will be afforded facilities for experiments, &c. on a practical scale, 4467. In the latter students will be taught subjects connected with their occupations, *e.g.*, a chemist would learn something of practical mechanics and something of physics. At Finsbury College a student may, under certain conditions, take a particular department or the whole of the classes (quotes *Mr. Wood*). Something must be done to replace the old form of apprenticeship. Owing to division of labour, &c. lads now only learn one branch of a trade or manufacture. Hopes the courses in the lower and higher schools will enable manufacturers to better understand a manufacture as a whole, 4468-9. Besides the general professors it is proposed (given the funds) to appoint, experimentally, assistants who have been practically engaged in the industries they teach. (*Mr. Roberts.*) The institute would perform a great service by making the experiment, 4470. (*Mr. Sawyer.*) Tells aims, &c. of Finsbury Technical College by quoting programme. Will put in explanatory address by Director, 4471. The present building has been opened recently, but somewhat similar work was previously carried on in the Corporation Middle Class Schools for 3 years, 4472. Numbers and trades, &c. of students, 4473. From the number of applicants for admission the college would appear to meet a want. In some departments, especially electrical engineering, it is too small, 4474-7. The staff hope soon to have a special building for applied art instruction, 4478-9. The building cost about 24,000*l.* The cost of maintaining the college is 6,000*l.* a year, and probably will be 8,000*l.*, 4480-1. Salaries, &c. of professors, 4482. 400*l.* ground rent is paid, 4483-4. Each student taking a complete course pays a fee of 5*l.*, making 500*l.* for the day students. The fees for evening students amount to 200*l.* Half of those fees go to the professors, the remainder in aid of the 6,000*l.* for maintenance, 4485-90. The fees do not vary with the social position of students. They would not be able generally to pay high fees, 4491. There are some scholarships given by the Guilds Institute, and the Holl Scholarship. The Corporation Middle Class School gives none, 4492-3. 134 evening students are apprentices admitted at half fees; many of the others are journeymen, 4494-5. The Institute makes grants to provincial technical schools, &c. under certain conditions. Reads list of present grants. 1,500*l.* is set apart for that purpose this year. It will be necessary to very much increase these grants, 4496-501. It also conducts technological examinations, 4502. (*Mr. Roberts.*) Sketches their foundation and progress. Will hand in paper showing numbers examined this year, 4503. They have been successful in their objects, 4504. Qualifications required for teachers, 4505-7. Some manufacturers object to technical education of their employes and these examinations on the ground that they would make trade secrets generally known. This prejudice is diminishing, 4508. Written

WATERLOW, Alderman Sir Sidney H., Bart., M.P., WATNEY, Mr John, F.S.A., ROBERTS, Mr. Owen, M.A., F.S.A., and SAWYER, Mr. W. Phillips—*cont.*

examinations cannot test technical knowledge in some trades; it is proposed to supplement them by local practical examinations. In some trades practical examinations are hardly possible; all that can be done is to have them where possible. Great care would be required in the selection of subjects. The outlay required would be greater as the subjects were more numerous, 4509-12. Students' occupations are registered. No fee is required for examinations, nor do students necessarily pay fees for instruction. In the latter respect the plan differs from that of the Science and Art Department, 4513-7. Endeavours are made to improve the system in accordance with suggestions in trade journals and elsewhere, 4518. Hopes it will be much extended as elementary science instruction improves among workmen. The preliminary science test required for the full technological certificate makes it difficult for the old generation of workmen to come into the examinations. Teachers may receive payments on results though students do not pass in science. Would be glad to make the science qualification more stringent as science education advances, 4519-22. 4,000*l.* or 5,000*l.* might be sufficient for the next 4 or 5 years to meet the cost of the examinations, 4523. Does not expect that during the next 5 years the system will extend to anything like the present scale of the Department science examinations, 4524. The Government have laid down a rule that they will not teach nor be accessory to teaching trades; the examinations in agriculture, &c. are departures from that rule. Had not the Institute stepped in the rule would have broken down. Questions whether it would be desirable for Government to take up the work of the Institute. Does not think public opinion of manufacturers is favourable to Government teaching of applied science, 4525-7. Local contributions to the expense of the examinations are not required. The institute pays to the secretaries of local committees 3*s.* 6*d.* for each candidate who passes, besides the payment to teachers, 4528-30. As far as possible there are two examiners in each subject, either actually engaged in the industry, or scientific men with some practical experience in it. In many cases they are London men. They set the papers, subject to control of the Director, 4531-4. Mentions certain examiners. The practical nature of the examinations depends upon the examiners being practically acquainted with the particular trades, 4535-40. Great difficulty is found in obtaining competent examiners in some trades, 4541. (*Sir S. Waterlow.*) The present contributions to the general building fund amount to 44,500*l.*, mainly from 4 companies. Part of this has been expended on Finsbury College, for which the Drapers' Company's contribution was mainly given, 4542-4. The cost of the Central Institution will be nearly covered by the balance of the last 4 years. As the outgoings are increasing the balances will rapidly decrease. Describes the growth of contributions. Last year collected 23,575*l.* That sum will have to be largely augmented as the work progresses, 4545-6. None of the companies guarantee their contributions; it would be a great support to the treasurer if they would do so for a number of years, 4547. Received last year 23,575*l.*, and expended about 11,000*l.*, both on general account. The balance was carried to the building fund. Gives items of expenditure. The administration, with certain exceptions, is gratuitous, 4548-52. Gives an estimate of probable expenditure of the institute for the next few years, amounting to over 40,000*l.* a year, towards which there are contributions of about 24,000*l.*, not insured for any time, 4553-5. The Corporation might probably increase their contributions if the companies considerably increased theirs. Some of the companies might increase their contributions from their gross income of more than 500,000*l.*, or, with the consent of the Charity Commissioners, which would probably be given, apply part of their trust incomes to this purpose. It is much to be hoped that they will increase their contributions, as otherwise the fees must be undesirably high, and no funds will be available for scholarships, 4556-60. Besides fees, 15,000*l.* a year at least will be required from the Guilds to carry on the Central Institution with efficiency, 4561. Hopes that Government and Parliament may see the necessity of technical education, and may make a grant, or otherwise help the institute, 4562.

Evidence taken at Sheffield.

JOWITT, MR. ALBERT A. Pages 541 to 544.

Is the Master Cutler and acquainted with the hardware trades, &c. of Sheffield, 7655-6. Foremen are selected from the workmen. Technical education is necessary for workmen in all branches of the Sheffield trades, *e.g.*, file cutting. A knowledge of metallurgy especially is essential, 7657-62. This opinion is held by the more prominent and probably the younger manufacturers, but some of the elder fear over-education of workmen, 7663. Manufacturers of large articles, armour plates, &c., are of opinion that all their men, even labourers, should have technical knowledge to lessen danger, 7664-7. Several employers have already interested themselves in technical education. It is necessary for all workmen, especially foremen, 7668-9. The system of protection in the United States enables them to undersell us in our colonies. Explains this, 7670-3. There is a general feeling in the United States that technical instruction is desirable, 7674-5. Labour-saving machinery is largely used there. Its introduction there depends less upon the good-will of the workmen than here, 7676-7. Its introduction into the Sheffield trades has been impeded by the opposition of the artisans. It is less opposed now, as they see it is a necessity, 7678-83. The superior elementary education of workmen under the Act of 1870 is already lessening the opposition to machinery, and will further lessen it, 7684-8. The finest steels in the world are made at Sheffield, but it is done by rule of thumb. Further knowledge would produce more certain results. Some establishments have laboratories, but they are not used to the extent they should be in crucible steel departments, 7689-90.

JONES, PROFESSOR J. VIRIAMU. Pages 544 to 552.

Is Principal of Firth College, 7691. Puts in prospectus of the college showing—(1) its objects, (a) university teaching, (b) technical instruction adapted to district industries, (c) popular lectures; (2) abstract of Principal's reports for 2 sessions, stating numbers attending day and evening classes and popular lectures, commenting on the work done, &c. in various classes, and recommending that efforts be made to establish the college on a larger and wider basis, 7692-3. The special technical classes are open to all without previous examination. There was an examination in coal mining at the end of the session, but not in metallurgy. The coal mining course of 10 lectures was not sufficiently long to enable the students, many of whom were working colliers, to pass as certificated managers, 7694-7. The metallurgical students were to a great extent artisans, and many employers came. Many who attended the lectures on iron and steel left when other metals were considered, 7698-9. The evening classes are not connected with S. Kensington, as it is preferred to keep the lectures free, and there are already science and art classes in the town, 7700-3. The students at the Mechanics' Institute are older than those at the Central School, but the latter is largely damaging the former. Thinks evening science and art classes in Sheffield should be in connection with Firth College, not S. Kensington, as is the case at Nottingham, 7704. The teaching at Firth College gives freer scope for originality than that in neighbouring science and art classes, but begins at the beginning. It would earn grant. A suggestion to increase the income of the college by that means has been under consideration, 7705-7. It is good to have lectures not exclusively adapted to preparation for examinations; the other work is being done in other institutions. The students are examined, 7708-10. The objection that the teacher is hampered applies also to the London University examinations, but is outweighed by other considerations. The Victoria University charter was applied for on account of this objection, 7711. Does not attack the Department examinations, but thinks it right to have these lectures in addition to science and art classes, 7712. Desires a large development of technical education (described) in connection with the college. The Guilds Institute has consented to found a chair of engineering, 7713. Students of metallurgy taking a technical course

ccii ROYAL COMMISSION ON TECHNICAL INSTRUCTION :

JONES, Professor J. Viriamu—*cont.*

should receive a large amount of scientific education, beginning with pure science. Working men should commence with the metallurgy of the metals they work with and go on to pure science. If the Department examinations were made of such a nature that knowledge of 1 group of metals would enable a student to pass, some inducement should be given to learn pure science afterwards, e.g., the Guilds Institute certificates of honour. The course of obtaining a general knowledge of all metals in the elementary stage and sub-dividing them in the advanced would be more natural for young students, but not for existing artizans, 7714-6.

See also Moss, Mr. J. F.

HUNTER, MR. MICHAEL, junr. (Mayor of Sheffield). Pages 552 to 553.

Machinery is less applied to small things in Sheffield than in other countries. Technical education is needed to enable our workmen to compete with others, 7717.

See also MITCHELL-WITHERS, Mr. J. B.

STEPHENSON, MR. HENRY, J.P. (Vice-President of Firth College.) Pages 553 to 554.

Dr. Sorby, the president, could answer better than he. Agrees with Mr. Hunter, but until the recent advance in elementary education technical instruction could not have been given. The laboratory and workshops established by the school board are of immense importance. Firth College should now take up the work of technical education. A technical college should be founded, perhaps as a separate department of Firth College. The grant from the Guilds Institute for a school of mechanical engineering should be a nucleus for a larger and more complete scheme. Believes that local public bodies and individuals would support it. The Principal of Firth College has prepared a scheme which has been thoroughly endorsed by the few to whom it has been communicated, 7718-19 a.

COLE, MR. SKELTON (ex-Chairman of Sheffield School Board). Page 554.

Workmen are often baffled by the difficulties of their trades. Technical education is very much needed to enable them to compete with workmen in other countries. This opinion is held by many in Sheffield, 7720.

MITCHELL-WITHERS, MR. J. B. (President of Sheffield School of Art). Pages 554 to 556.

Classes and progress in the School of Art, 7720 a. The school is only fairly supported by the manufacturers. Some send their apprentices, but not to the extent that is desirable, 7721-3. (*Mr. Cook.*) Occupations, &c. of students at evening classes, 7724. (*Mr. Mitchell-Withers.*) Lads who come at the beginning of their apprenticeship and work carefully are likely to earn higher wages than if they simply worked in the shops. Those who come at an advanced age, having never been grounded in the principles of art, cannot understand it. Many men who have apprentices to teach prevent them coming to the school, 7725. Large manufacturers in Sheffield purchase a great many of their designs, principally English, but some employ designers, mostly from the school. Most of the best men from the school have gone to other towns from lack of encouragement. (*The Mayor.*) This arises from the nature of the Sheffield trades, 7726-8.

SMITH, MR. WILLIAM. Page 556.

The grant from the Guilds Institute is conditional on the provision of a laboratory and appliances. There is no question that this is desirable. No definite scheme has been submitted to the town trustees, of whom he is one, but has no doubt they would contribute to the utmost extent their funds would allow, 7729-30.

HOBSON, MR. JOHN. Pages 556 to 557.

The art school work is mainly drawing, and fine art is of little use in most Sheffield trades. Technical education has only recently been taken up. Thinks the manufacturers do not desire the proposed technical institute at Sheffield to be a separate institution from Firth College, 7731.

LEADER, ALDERMAN. Page 557.

The town trustees will assist the proposed technical school when a definite scheme is decided on, but its success will depend on the manufacturers and workmen whose prosperity depends upon it, 7732-3.

HORTON, MR. J. A. Page 557.

The chandelier trade in Sheffield is a great art trade, and there are artists there equal to any in the world. Believes that if technical education were started it would go on, and Sheffield would become equal to Birmingham. Would subscribe, 7734.

DONCASTER, MR. CHARLES (Chairman of the Sheffield School Board). Page 558.

Hopes there will be an adequate technical department connected with Firth College. The workshop instruction given under the Board at the Central School is cramped by want of funds. Recommends that the Department should examine in and give grant for it. Believes it would then be extended, especially in evening schools. The boys are glad to come to it, and the parents and working classes generally are strongly in favour of technical education, including mechanical drawing and chemistry, 7735-7.

WILSON, MR. HENRY J., J.P. (Vice-Chairman of the School Board). Pages 558 to 559.

The working classes are strongly in favour of technical instruction in Board schools. The school rate is 8d. Impresses on the boys and others, with increasing effect, the importance of trying to be good workmen rather than clerks, 7738-40.

MOSS, MR. JOHN. F. (Clerk to the School Board). Pages 559 to 565.

The workshop instruction at the Central School is not applied to any particular trade, but aims rather at the application of theoretical knowledge to any trades the boys may take up. Hands in a letter to Dr. Roscoe, stating that the continental systems of technical instruction would not be suitable to our artisans. Such instruction could best be given here in higher grade elementary schools. Children should be admitted only when they have passed well in the 5th, or, in the less populous centres, the 4th standard. This would not prejudice the ordinary elementary schools. Gives reasons. The instruction should inculcate principles rather than deal with the actual work of any trade. Besides the work provided for in the new code and by the Science and Art Department it should include the use of tools, &c., and should be adapted to district industries. Quotes a scheme drawn up for the higher department of the Central School at Sheffield, and gives statistics. Describes the workshop instruction. The boys receive it eagerly and with advantage. Recommends that Government should aid the work, and also that evening schools should be established giving similar instruction. This would not trench very far on the province of the higher technical colleges he hopes to see established. Gives an instance of the welcome such a provision would receive. Gives particulars of the work of the Central Higher School up to date, 7741-2. Would teach the use of tools, &c. concurrently with book and paper instruction. The school furnishes evidence of the success with which science can be taught to the very young. Gives particulars. There are evening classes connected with the school. The students find the instruction of great value to them and desire its extension. Some of them would like a workshop to be added. Superior workmen in workshops do not impart much information to apprentices,

Moss, Mr. J. F. (Clerk to the School Board)—*cont.*

who would therefore derive great advantage from such a class, 7743. (*Prof. Jones.*) The proposed mechanical engineering evening classes at Firth College might be made available for working men; the day classes would be more for employers, &c., 7744. (*Mr. Moss.*) Such classes would be of immense value to working men, and the instruction suitable to them if instruction is given in the laboratory, 7745-6.

EADON, Mr. ROBERT THOMAS. Page 566.

Technical education is important in all trades. Owing to division of labour lads learn only part of a trade; a technical school would remedy this evil. Believes that if a clear scheme were laid down the funds to establish a school would be forthcoming, 7747.

WALKER, Mr. GEORGE BLAKE (Lecturer on coal mining at Firth College and manager of a large colliery). Pages 566 to 567.

Technical education of those engaged in coal mines is very important. Believes they would highly appreciate it. Suggests classes at Sheffield and Barnsley. Miners could attend them without interfering with their daily work. Believes employers would encourage such classes. Would teach not only coal mining but the sciences leading up to it. Is aware of the existence of continental mining schools. The difficulty here is the distance many of the miners live from any available centre, 7748-52.

BARNESLEY, Mr. GEORGE (Manufacturer, and senior warden of Cutlers Company). Page 567.

A technical school in Sheffield is very necessary. From the large number of trades there it would be almost impossible to have a large school which should embrace them all. Suggests that a commencement be made in a small way and afterwards developed. Believes many manufacturers would contribute liberally, 7753-5.

GILMORE, Rev. J. Pages 567 to 568.

The want of a technical school is felt in Sheffield. How far the people will support it will depend upon its character, 7756-7.

COOK, Mr. J. T. Pages 568 to 572.

Is head master of Sheffield School of Art. The school is taught in accordance with the Art Directory, special attention being paid to the district industries and the individual requirements of pupils. Gives list of technical classes, and number of students attending them. The metal casting class may fall through unless supported by the Guilds Institute or some other body. All the technical classes, except china painting, are evening ones. About 80 per cent. of the pupils go through a complete course of instruction. They are taught by practical men. Report on the school for year ending June 30th, 1882, showing number of students, results of examinations, &c., 7758-9.

See also MITCHELL-WITHERS, Mr. J. B.

Evidence taken in Paris.

COOKE, PROFESSOR JOSIAH P., of Harvard College, Cambridge, U.S.A. Pages 573 to 584.

Distributed all over the United States are a great number of technical colleges founded, with certain exceptions, by the separate States, and to a large extent by individual benefactions. The large amount of benefaction for technical education is a great peculiarity of the American system. The funds

COOK, Professor Josiah P., of Harvard College, Cambridge, U.S.A.—*cont.*

for the establishment and maintenance of the colleges, including those founded by the States, are largely derived from this source, aided by State grants, 7760-3. Many agricultural colleges were founded by means of grants of land from the United States. Believes they have exerted little direct influence on agriculture, they and some other technical schools having become to a great extent cheap secondary schools, giving general education with a scientific bearing. This is owing to a feeling that their character would be raised by giving (1) a professional, (2) a general higher education, as opposed to technical education for artisans or practical agriculturists. In this they have to a considerable extent succeeded, but questions if they were in all cases needed in that direction. The multiplication of colleges is to some extent an evil, as scattering endowments which, if concentrated, would produce better results. Gives instances, 7764-71. The Institute of Technology at Boston is a very high class technological school, giving principally general and professional education. There is also some purely technical instruction, for which a machine shop has recently been added. Several of the students of metallurgy have obtained good positions in connection with mining, 7772-3. The students are principally of the middle class, who can and do pay tolerably high fees. They do practical work in the laboratories, some of it very good. The institution is not self-supporting, 7774-6. The college at Worcester is the best example in the country of a technical school. The students do good practical work, principally in iron and wood, which is sold. Even here a certain amount of professional teaching is given in the higher classes. There will always be a difficulty in conducting a purely technical school in the United States from the fact that the children of mechanics seek education with the hope of raising themselves to a higher social position, 7777-8. Some iron and wood work is done at the Institute of Technology at Boston. Does not know whether it is of commercial value, 7779. Some of the students from Worcester school become engineers, and some go into machine shops and rise rapidly to good positions. They do not continue workmen all their lives. Technical schools should aim at training intelligent skilled workmen. Opportunities might be given by scholarships, &c., not too easily obtained, for talented young men to secure a professional education, but technical and professional schools should be kept entirely distinct. Knows of no school in the United States which trains men to be and remain simple workmen, 7780-2. Manual labour has not been introduced into American primary or secondary schools. The introduction of technical education into high schools has been discussed, but objects to it, and to the free high class education given in them, as unjust to the taxpayer and in some instances detrimental to its recipients. Means, however, should be provided for assisting those, fit for but unable to afford higher education, to obtain it, 7783-5. At the Lowell Institute in Boston there is an excellent evening drawing school, where freehand drawing from models is taught, but not geometry. By a connection with the Technological Institute practical evening instruction is given in chemistry, &c., of which the night pupils largely avail themselves. The laboratories are good. (*Note.*—The laboratory instruction is only given in the daytime), 7786-93. Similar evening instruction is given in some New England cities, and perhaps in other places, 7794-5. Lowell is one of the great centres of textile industry in Massachusetts, Lawrence and Fall River being about the same size. There are no special technical schools in any of these towns. The foremen and managers are trained in the mills by apprenticeship, 7796-9. The apprenticeship system is not a desirable one. Good technical schools, if limited to their proper work, would produce better trained and educated workmen in less time, and the great body of artisans being then educated in them, those alone would become foremen, &c. who have the requisite ability, 7800-1. Such schools might in the United States be endowed in time from private sources, and moderate fees should be charged, which artisans there could afford to pay, 7802-4. A system of normal schools might be introduced for training technical school teachers, 7805. Attempts have been made at Harvard University to advance science teaching, but difficulty has been found from the exclusively literary training of the students, which is no preparation for studying science, but

COOKE, Professor Josiah P., of Harvard College, Cambridge, U.S.A.—*cont.*
rather the reverse. To meet this difficulty vacation courses of science have been established to train teachers. Something similar must be done to provide teachers for technical schools; they do not at present exist, 7806. The teachers trained at these courses go into secondary schools. The effect is as yet imperceptible, 7807. The facts of science should alone be taught to the young, commencing at 8 or 10 years of age, 7808-9. In secondary schools preference is shown for botany as a beginning of science teaching; approves of this, if taught by observation solely, and also of mineralogy as an introduction to geology. They must be taught by object teaching, 7810-1. There is great difference in the primary school instruction in different States, New England schools being on an average in advance of any, 7812. Artizans trained in good elementary schools are more worthy men, but doubts if they are better artizans than those from inferior schools, 7813.

An account of the agricultural schools of America follows, extracted from the Boston "Daily Advertiser" of March 23, 1883.

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APPENDICES.

Appendix A.

APPENDIX A.

EXTRACTS FROM ADDRESS, handed in by
Professor ALEX. B. W. KENNEDY. (*See Evidence*, page 198.)

EXTRACTED from Introductory Lecture on the PLACE of COLLEGES in ENGINEERING TRAINING, delivered to the Faculties of Arts and Law and of Science at University College, October 5, 1875, by Professor Alexander B. W. Kennedy, C.E.

I suppose I need hardly commence here by arguing the necessity or benefit to the engineer of something more than the training, merely of practical experience of his work, something in the nature of theoretical training, which alone can enable him to understand the facts of his experience, or to connect them or draw inferences from them in a complete or satisfactory way. It is unfortunately true, however, that some people still deny this, and many others, while admitting its truth, admit it only as a form of words, and practically reduce the value of their admission to nothing by the limitations they put upon it in each particular case, as well as by the sneer or smile with which they commonly receive the mention of "theory." It will be some assistance to our attempts to find out what education is required, or is the best, if we go back a little and look at what is really, whether expressed or only understood, the foundation of this position of badly disguised hostility to theoretical training. This I take to be the fact that of the older engineers, admittedly great in their profession, scarcely any had opportunities for obtaining such training, while in spite of this deficiency they did splendid work. In some notable cases the knowledge that was not acquired while they were young was obtained in manhood. But there are certainly many distinguished engineers, whose names are almost household words to us, who neither in youth nor in manhood ever mastered, or even knew, the principles underlying the work which they so successfully carried out.

That this fact should be seriously used as an argument for a conservative adherence to the system of training under which such men are not educated is as incomprehensible as it is true. In no other subject or profession does a man say, "because I was imperfectly trained and yet I have succeeded, therefore I will train my son imperfectly," and yet in engineering it is said by some, and is practically acted upon by a far greater number. Such people do not hesitate to refer to Smeaton, Brindley, Telford, and others as models, men who, without technical or scientific training, did great work, and whose names every one receives with respect; or in another field to Arkwright or Hargreaves, whose mechanical genius has given to the country so much of its present wealth and prosperity; or again to Stephenson and Fairbairn, who started as engine boys, and again, without technical education of any kind, made their positions by talent, pluck, and unlimited capacity for work. One would have thought the inference sufficiently obvious, if these men did so much under such disadvantageous circumstances, how much more might they not have done if they had possessed all the advantages which are within our reach just now. But no, the idea seems to be, these men served seven years' apprenticeship (or whatever it may be), therefore that is the best thing for every one to do who wishes to follow in their steps.

I think that if we look at the matter from the outside, without consideration of what means are existing or non-existing for imparting the training, or what amount of training men may or may not have hitherto received, we may pretty safely put down the lines which the education must take somewhat thus—not attempting any very rigid classification: first, a general scientific groundwork, a knowledge of the principles of the sciences upon which engineering is based, commencing of course with mathematics in all its various branches, and including physics (in the most general sense of the word), chemistry, and metallurgy, and geology. Then, secondly, a knowledge of the way in which these sciences are applied, or apply themselves, to engineering work, the bearing of the laws of thermodynamics upon the theory of the steam engine, of the laws of mechanics upon the forms of structures, and so on. The theory of machines would here come in, the theory of what we clumsily call the "strength of materials," and in general the principles of the design and construction of structures and machines. This part of the training, especially, should establish the identity of "theory" and "practice," so often spoken of as if they were antithetical, but between which no contradiction can exist, except the superficial inconsistencies arising from the imperfection of the one or the incorrectness of the other. Then lastly, before the training can be considered complete, not only the knowledge of these applications of the pure sciences, but also some experience in the applications themselves must be obtained. That is, the student must have practice in the design of actual machines and in the constructive and other processes of which he has already studied the principles. Only after this has been, in some way, added to the other and more theoretical part of his education can the preliminary training, of which I have spoken, be considered complete.

First as to the general scientific training. If it be once granted that such training is advisable there can hardly be any question that the College is the place in which it can best be obtained. Of course I use the word "College" in its most general sense, intending to include under it those science schools of a high order which are colleges in everything but the name. In general the alternative to the acquisition of this scientific training at college systematically is obtaining it by home study, after work hours, while the student is spending the day in the works or the office.

The evening classes for technical subjects which are now, fortunately, so common, are very valuable in their own place, but do not meet the case under consideration. While they are most useful in supplementing imperfect education and may often greatly help home study, they cannot form any substitute for a regular course of college training, both for the reasons I have already given, and because the time of instruction in them is necessarily so limited as to render impossible much beyond elementary teaching.

A knowledge of mathematics, for instance, is essential, is indeed the very first essential for the student of engineering. Almost all that he afterwards learns will somehow or other be connected with it. But a mere knowledge of mathematical processes, mere facility in working equations not only is insufficient, but in some cases may be positively harmful to him. The questions upon which he will in his profession be called upon to employ his mathematical knowledge are never abstract ones, are most often questions in which there is great complexity arising from the conditions under which actual design or construction has to be carried on. It occurs very frequently indeed that they are not questions involving any very profound mathematical knowledge, but to the extent to which they do require that knowledge, they require it to be thorough and accurate. The solutions to such questions, obtained by an inappropriate application to them of mathematical processes or expressions, have often proved far less trustworthy than the purely empirical solutions of the so-called "practical" man, who is thus confirmed in his contempt for theory and theorists in general, and for mathematicians in particular.

Appendix A. In reference to the study of mathematics as an essential part of an engineer's training, I have no hesitation in saying that a man's knowledge of mathematics ends exactly where his ability to apply that knowledge to his work problems ends; anything beyond this is useless so far as his profession goes, and is even, as I have pointed out, liable to have in certain cases disastrous consequences.

* * * * *

The question now is, can this knowledge of how to apply scientific principles to engineering work be acquired in an office, or by private study, or will it, too, be best obtained in college education?

* * * * *

There is perhaps more plausibility in the notion that this part of the training might be given in an engineer's office, and I would by no means say that this was impossible in itself. It certainly is impossible, however, in any engineer's office as it is at present constituted; for even if the head of the office himself possesses the requisite knowledge, it does not follow that he has the faculty of imparting it to others, and in any case his time is far too much occupied to allow him to do more than give a little help now and then, or a few words of suggestion, to the pupils under his care. He is generally a busy man, with more work on his hands than he knows well how to get through, and even were he anxious and able to give instruction to his subordinates, his more immediate duties would render it impossible that he should do so. We find ourselves reduced then to the alternative that this knowledge of the application of science to professional work must either be obtained systematically at college or "picked up" piecemeal, and with no sort of completeness during apprenticeship and in after years.

A considerable portion of it may be given, I believe, most usefully in the form of lectures and ordinary class instruction. The principles of design for instance could be treated in detail in this way: the functions of all the more important members of machines or structures and the methods of determining their forms and arrangements could be explained, and the way in which their dimensions are calculated. The mathematical or mechanical assumptions made in the calculations could be made clear, their influence upon the result, the consequences of such conditions not being fulfilled, the extent to which the results obtained could be considered accurate, and so forth. In the same way much could be taught as to the art of construction, and the nature and characteristics of the materials with which the engineer has to work.

* * * * *

I should not omit to mention here the study of Drawing which should be carried on really throughout the whole course of training. It is impossible for an engineer to be too ready or too accurate in the use of his pencil. In the earlier part of his college course geometrical drawing will aid him wonderfully with his mathematical studies, while later on it becomes the language in which he expresses his mechanical ideas. At the same time graphical, that is, geometrical, methods of computation are all important to him in the solution both of statical and kinetical problems. These graphical methods afford to him, in an immense number of cases, easily obtained solutions which possess a degree of accuracy even in excess of his requirements.

* * * * *

I may be here met with the very reasonable objection, if made from knowledge and not from ignorance, that men cannot be taught the nature of the materials with which they have to deal without handling them, that they cannot gain any familiarity with either the theory or the design of the steam engine without seeing it at work, and so on for all the other subjects I have mentioned. This I most freely admit, but not so the deduction by which it is frequently followed, that therefore the workshop and the office, not the college, are the places for the studies about which I am speaking. I shall come very shortly to the mention of what appears to me to be the true function of the office and workshop in training the student. Both are essential to him, but neither I think at this stage, nor exactly for this purpose.

Let us take the special cases which I mentioned, they will illustrate my meaning as well as any others. Familiarity with the theory and design of the steam engine cannot be obtained without handling the machine itself. I grant at once that it is scarcely possible to imagine a man, however many lectures he had attended, or however many books he had read, designing a satisfactory engine without ever having seen one. But "handling" is a vague expression which may mean half a dozen things or nothing. It is not difficult to sketch out the sort of "handling" which would be of the most real use to the student. It would presuppose in the first place what is known as an "experimental" boiler and engine, i.e., machines specially arranged for being experimented upon. With these the students would carry on systematic courses of experiments, measuring in the former, for instance, the quantity of water evaporated per unit of weight of various fuels, under various conditions as to the extent and arrangement of the grate, with various arrangements for admission of air and different pressures of steam; finding also the quantity of air consumed, the constitution and temperature of the escaping gases, and so on. In the engine would be measured the quantity of steam condensed during admission into the cylinder, the quantity liquefied during expansion, the quantity liquefied in the jacket, and the relative economy of steam jacketing with different ratios of expansion, the losses by radiation, the proportion between the useful and the total indicated horse-power, and so on. I conceive that some such course of work as this is the sort of "handling" of the machines spoken of which would be of the most importance to the young engineer. It would indeed be of such great importance to him that I think it must be considered to form an essential part of any really complete system of training. Then as to the "handling" of the materials themselves, the iron and steel and so forth, with a view to the thorough grasping of the nature and characteristics of each. This would surely require that the students should themselves make, or at least take part in, systematic experiments upon the strength and elasticity of the materials in question, used in various forms and subjected to various stresses. This certainly seems the most natural way in which the required familiarity with the physical properties of the materials can be obtained, indeed the only way in which it can be obtained thoroughly.

We are now in a position to look at the question of where this portion of the training should take place. I think we must conclude that it cannot be given in the factory. One or two manufacturers have certainly gone so far as to spend much money and time upon the construction of experiments with such machines as I have described. Such action on their part deserves the most hearty recognition. One is glad, too, to feel sure that even financially they will be greatly the gainers by this judicious expenditure of time and money. But even in these exceptional cases, only a part of the apparatus required is provided, and even this cannot be used systematically for educational purposes, but only for such courses of experiments as its owners find necessary for their own information. I see no reason, on the other hand, why any separate institution should be formed for the purpose of giving this kind of instruction, and conclude simply that it, too, should form a part of the regular college training of an engineer.

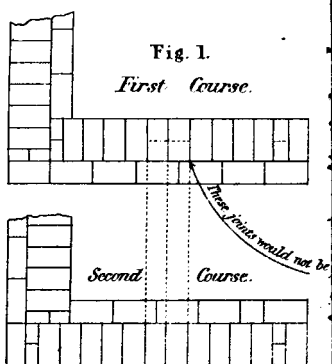
What is really required appears to me to be a kind of engineering laboratory, if I may use the expression, attached to the college, and supplied with the requisite machinery and apparatus. It would be essentially a laboratory for the carrying on of experiments in engineering and mechanical physics; and I do not think it would be possible—if possible, certainly not wise—to make a distinct separation between it and the ordinary physical laboratory, for although there are many series of experiments which would be peculiar to each, there are still many which must necessarily be common to both.

At the same time such a laboratory attached to a college would not only be of value for the sake of teaching, but also to fully as great an

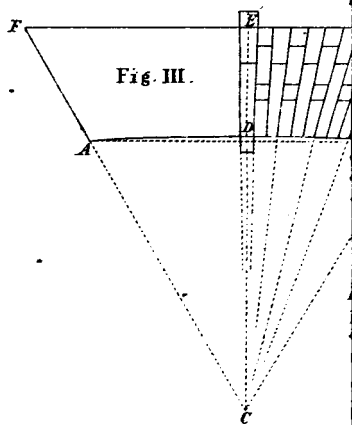
Appendix A. extent for the sake of original research and experiment. There is ample room for this; attempts further to develop scientific engineering are continually hampered by the want of more extensive or more accurate experiments. We have in far too many matters nothing to rely upon but the imperfect or imperfectly reported results of antiquated experiments, while our most trustworthy experiments have in very many cases not been undertaken as part of a scientific investigation but for some much more limited object, and are thus frequently insufficient for the formation of general conclusions. Thus, in almost every direction it would be possible to carry out courses of experiments with the accuracy and completeness of scientific investigation which should give results of almost incalculable value to the practical constructive engineer. And I may add that while such experiments seem to me to be daily becoming more necessary, I see very little hope of their ever being carried out—in this country that is to say—unless our colleges and science schools take the matter up in some such way as I have indicated. The expense is here, as in many other cases, the principal difficulty, for the cost of the necessary apparatus, although by no means enormous, would be considerable, while the fees must be kept moderate if the laboratory is to be really useful. Although, however, it might not “pay,” in the commercial sense of the word, directly, yet the increased efficiency of the engineers whom it would take part in training would, even as a matter of £ s. d., return to the country an enormous profit upon the few thousand pounds laid out. I can only hope that it may not be long before the importance of this kind of training is recognised in a sufficiently practical way to allow it to be set in operation.

But at the same time it does not appear to me that this can ever take the place of work at design in an engineer's office. In the one case a few hours a week, in the midst of other engrossing work, are spent upon designs for which the data are furnished by the Professor. These are chosen from an educational point of view, to familiarise the student with certain problems or certain constructions, they are worked at under the eye and with the help of a teacher. The student's errors are pointed out and to a certain extent rectified, but nothing results either from the errors or excellences of the design, except in regard to what they have been the means of teaching the student. In the office the conditions are entirely different. There the whole time of the pupil or apprentice is spent upon his work, while the design at which he works is for something which has actually to be constructed. The design is no longer made to instruct the designer (another reason for his being instructed beforehand in the principles of design), but for its own sake. Mistakes, therefore, or defects are not tolerated, but corrected to the satisfaction of the chief of the office before the drawing is allowed to pass. The design in fact is made under a sense of responsibility which cannot exist where its actual construction has not to be looked forward to. At the same time the conditions which govern the nature of the design are the complex ones of actual practice, and are not simplified as they must be for educational purposes. The same things apply even more strongly to experience in construction; but here I may say that I think the real object of an apprentice entering a workshop is sometimes misunderstood. It is not that he may learn to be a good workman, although of course it will be so far to his advantage if he does become a good workman, but that he may see how tools are handled, what can and what cannot be done with them, what is difficult and expensive, what is easy and costs little. He requires to see, too, how the different members of a machine are put together, the translation into material reality of the mental building up of a design with which he is already more or less familiar. It seems almost self-evident that the place most suitable for gaining this experience will be a place in which there are numerous good mechanics at work, and where full-sized machinery of various kinds is in process of construction, in other words, in the works of an engineer. I do not think either of these conditions can be attained in the workshop of a college or technical school. Such a work-

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shop can only do imperfectly what will have afterwards to be properly done in the factory, while the work in it will occupy time which might be more usefully employed in the legitimate work of the college in such a manner as I have endeavoured to point out. Hand-work falls within the function of college instruction only so far as it occurs in the experiments or investigations or model constructions of the laboratory of engineering physics which I have endeavoured to describe.

Appendix A.

APPENDIX B.

Appendix B.

STATEMENT prepared by Mr. JOHN CHANNON.

(See Evidence, page 236.)

In compliance with your request I send a statement explaining, from my point of view, where the science syllabus in building construction, or what is taught in connection with it, fails to give, or shew that application of science, which is absolutely necessary to enable bricklayers and brickcutters to become skilled and efficient workmen.

Firstly. In my accompanying diagrams I have shewn what is taught in a science class, and compared this teaching with what we, as practical men, should teach in connection with the same problem, I think it will be easily seen that brick-bond, as recommended by the Science and Art Department, is decidedly very faulty; that being so in simple bond, points strongly to the fact, that the more difficult the work the greater will be the mistakes. But we do not complain so much of what is misleading as we do that what is most necessary is entirely omitted.

Yet when we come to consider that many others, such as carpenters and masons, study under this syllabus, some of whom will no doubt hold prominent positions as general foremen, clerks of works, &c., it seems to me of the utmost importance that they should be able to obtain the best possible instruction in each particular branch of the building trade.

Now, I venture to state that although I have taken certificates in the advanced stage in building construction, I learnt nothing that was practically of use to me (*s.s.*), nothing that would make me a better workman in any sense. But in this remark I confine myself strictly to the brickwork part of the syllabus.

Secondly. It seems to me we require a syllabus treating largely of the application of science to our material; then a general syllabus of the various building trades combined would be suitable for those desirous of obtaining higher positions. At present we are being taught the construction of roofs and the various breaking weights, &c. before we have mastered that part of the subject by which we gain a livelihood.

Thirdly. I do not intend to convey the idea that it is practical knowledge only that I advocate. I contend that our theoretical knowledge cannot be too great, provided we first have sufficient practical instruction to be able to apply theory.

But how difficult to find anyone thoroughly well up in both, therefore practical men, who have a sufficient knowledge of theory to enable them to attempt and work out the suggestions of thoroughly theoretical men, must I believe eventually become the best masters of any mechanical work.

In support of my statement that brick-bonding, as taught under the Science and Art Department, is faulty, I beg to draw your attention to a portfolio of drawings, published by Mr. W. Busbridge (a prominent science teacher); the drawings in question are approved and recommended by the Science and Art Department and by their professional examiners.

Plate XIII. in the afore-named portfolio shews two consecutive courses of brickwork (old English bond) in a 13 $\frac{1}{4}$ " or 1 $\frac{1}{4}$ brick wall.

Appendix B.

Figure I. attached to these remarks shews the principle adopted or recommended by the Science Department. It will be easily seen that a wall built on the principle shewn in Figure I. would only be bonded on the face, and internally would contain a succession of vertical joints which would not be bonded in any single instance.

Figure II. shews perfect bond.

Then again, if we refer to the same portfolio, Plate XIII., we also find a $2\frac{1}{2}$ brick wall on the same principle. The error in this case is more serious, the internal joint being longer.

Also Plate XIII. and Plate XIV., brick piers (in Flemish bond), the principles here adopted are against all rules of brick-bond, strength, or beauty.

I also find in Collins' Elementary Science Series, in the "Practical Guide to Bricklaying," by Scott Burn, mistakes almost similar to those before mentioned.

Again, in a portfolio of Science Examination Series, Answers to Questions set at the Government Examination, Elementary Stage, by Mr. T. Kerksaw (Queen's medalist, &c.) Elementary, 1872 (Subject III.), that the answer to question shews plans of two consecutive courses of brickwork in a three-brick wall; this is entirely wrong; and in the same paper, question V., shewing elevation of a segmental arch, bond again wrong, besides a large waste in material.

Figure III. in my diagrams shews elevation of a camber arch and the manner in which the joints are obtained, as taught in a science class. This question was set in the elementary examination (May 1874), and the answers I have seen are the same as I have shewn in Figure III. I will endeavour to describe how a student would be taught to do this problem.

Figure III. Let the line AB represent the opening. Bisect the line AB with the line CE, then with A as a centre describe an arc cutting the line CE in the point C; this will be the centre to which all joints must radiate. This centre is used because (practically) it would be impossible to find and use the centre of so large a circle, the arch only having a camber of $\frac{1}{4}$ " to every foot in width of the opening, which is given to prevent its having a sagging appearance; the object being to obtain a line which appears level. The distance from D to E being equal to the height of arch, draw a line FG parallel to the dotted line AB meeting AC and BC extended; the lines AF and BG are called the skewbacks. Divide the line FG into a number of equal parts, each part not to exceed the size the bricks will make when cut, and take care the centre brick comes directly in the centre of the opening, then draw lines to point C; these will represent the various courses of brickwork; fill in the bond, and be careful to have a stretcher for the soffit key-brick.

This is the full detail of what would be taught in a science class.

Now I shall endeavour to shew that, besides omissions, a great portion of this instruction is practically wrong.

If the line FG is divided, as described in Figure III., each course of brickwork would be different in size, which would be as ridiculous as to have a brick wall with each course of different thickness. Besides, in cutting the arch you would require as many templates as there are courses, and it would never be fit to look at. Again, the student has nothing to shew him how to obtain the lengths of each course (practically) with the bevels of each brick, and no information as to the application of these bevels to the material.

Figure IV. The method of obtaining the outline of the arch is the same as in Figure III., unless the skewback has to be set to a given angle.

But mark the method of obtaining the courses of brickwork. This arch is only an approximately correct curve, therefore we must obtain an approximate template. This is done by marking half the thickness of a brick on each side of the point E; from points obtained draw lines to C; cut these lines at points sufficiently distant from E and D to allow for the longest course BG; this being done you have the dimensions of an approximate template, but it has yet to be seen if it will answer the required purpose.

Figure V. shews template.

Place the template on the drawing (Fig. IV.), covering the dimensions of the template; then mark perpendicularly on template that portion of the line AB covered by the template itself; this is called the traversing mark, and must not be made a permanent mark (mark shewn by dotted line in Fig. V.); then place two straight edges, *pq*, *rs*, on each side of the template, taking care to have the traversing mark directly over AB; then remove *pq*, take away the template, placing *pq* tightly against *rs*, remove *rs*, placing the template again against *pq*, keeping the traversing mark on line AB, continue this until the point B is reached, or the same result could be more easily obtained by traversing with two equal templates; should the template come directly on line BC well and good, if not it must be reduced, or made larger, as the case may be; this can be done by shifting the traversing mark up or down (and it will be advisable to meet any emergency to make the template quite 6 inches longer than the longest course).

Then by again traversing the template over the drawing you can mark on the courses of brickwork. It will be noticed that by squaring lines from corresponding points in each course, the distance will be the same (i.e.) squared from the bed of the bricks, which would be the case in any brick arch cut in accordance with the rules of geometry. The result obtained in Fig. III. would be quite the opposite.

Although my drawing may not be correct, it will be easily seen that the principle must be accurate.

Now we have a template that will exactly fill the given arch, but as yet we have made no allowance for the joints; this is obtained by placing the template on one course with the straight edges on each side of it (traversing mark as before), then shift the template up, keeping it tightly pressed against one straight edge; then the distance between the other straight edge and template must be the joint (which, for setting in putty, should be less than one-sixteenth of an inch); the traversing mark will no longer be required; place a line perpendicular with AB. Now the template is in its new position, and this is called the cutting mark, to which each course in the arch must be cut.

The next thing is to obtain the bevells and lengths of each course, and to transfer them to the template.

The best way is to take the camberslip, which, in practice, is used to draw the arch (this is a piece of wood cut to the same sweep as the line AB); place this over the line with a block of wood under each end, so as to allow the template to move freely between the camberslip and setting out board; then shift the template to each course (keeping cutting mark on the line), and mark on template the soffit of each brick, also the lengths of each course, numbering the marks commencing from the skewbacks; these bevells can then be placed on another piece of wood for convenience. The bevells and lengths of each course should be shewn on template, Fig. V.

Fig. VI. shews moulds equal to the perpendicular heights of the stretchers, headers, and closers. But it will be seen that although each brick is the same size taken on the square of soffit, shewn by dotted lines *e*, *f*, *g*, yet, being in different positions, each brick contains more or less material, and if the key stretcher is 9 inches long, the others will be longer than an ordinary brick; then, unless we have specially made bricks, we must adopt the general but very objectionable practice of employing what is known as a block joint. This should never be allowed in good work.

All these things could be explained and executed in practice in less time than it takes to write the description, which shows how valuable is the workshop with moulds and models, &c. Besides this the student should learn the process of applying these lines and templates to the material with the least possible waste.

The following questions are specimens of what I consider should be required of a bricklayer in the advanced stage:—

(1.) Give a good explanation of the method you would adopt in cutting bricks for a circular building (plain work); also explain what is necessary

Appendix B. ——— to cut a gauged circular cornice in moulded brickwork. Give thorough explanation of moulds and bevells required; also their application.

(Plan and sections of cornice to accompany question.)

(2.) Supposing you had a window opening in a circular building, with camber arch over, how would you obtain bevells, moulds, &c. for same? Give explanations, with drawing.

(3.) It is required to cut a moulded dentil course in brickwork (plan and elevation given). Shew by diagrams what moulds, &c. you would require, making them answer for both straight and circular work.

These are a few out of an unlimited number of questions, embracing that which the science syllabus leaves out, and I am sure every one will see how necessary it is for a bricklayer to be acquainted with such matters; yet we do not find one per cent. in the trade capable of doing work of this description.

My endeavour has been to shew in the preceding diagrams that it would be impossible for a bricklayer to learn how to apply the lines of a camber arch to actual work if taught under the present science syllabus.

I should also mention how much more easy it is to learn from models, which should, in my opinion, be used to a much greater extent in every branch of building construction as well as in solid geometry.

The problems I have criticised are only a few of the many left open to me. I have chosen them because I have those questions before me, as answered by the afore-mentioned science teachers. And more especially the camber arch, because it is a problem which cannot be worked out in practice, with strict adherence to the rules of geometry.

I do not for a moment suppose that these gentlemen whose works I have been criticising are in any way incompetent as science teachers, but this I do say, they cannot teach how science is applied to a trade unless they have a thorough practical knowledge of the trade in question; and I believe, before technical education becomes of great advantage to employers and artizans of this country, greater practical experience must be introduced, which will tend to make the application of science more simple.

Appendix C.

APPENDIX C.

MEMORANDUM handed in by Sir P. CUNLIFFE-OWEN. (See page 297.)

MEMORANDUM ON THE TECHNICAL ADVANTAGES AFFORDED BY THE CIRCULATION OF OBJECTS OF INDUSTRIAL AND DECORATIVE ART FROM THE SOUTH KENSINGTON MUSEUM.

1. From the outset in 1855 the students of the schools were urged and encouraged to sketch and otherwise study the examples placed before them by means of the permanent collection, especially those objects which bore upon their own pursuits.

At Birmingham on the first occasion a considerable number of drawings of the metal work were made, and some of them, drawn on stone and printed in lithography, were published for the use of manufacturers.

2. On the revision of the system of circulation in 1863 when it was decided to make up collections direct from the museum, it became a special point always to select as far as possible objects bearing on the local industries of the town or district to which the collection was about to be sent.

3. Of course, as the system became understood and extended, a larger use was made of the opportunities afforded, and as an example the result of the last contribution to the Manchester School of Art may be quoted.

The Manchester Society of Architects offered a prize for the best series of sketches of the objects exhibited.

Four students competed, and the prize was awarded to a youth of 20 for a series of 23 sketches.

At Glasgow the Lord Provost promoted a subscription, for the purpose of offering prizes to the amount of 50*l.* to the students of the School of Art for the best studies of the objects of industrial art in the collection sent from the Museum.

4. The arrangements for drawing and studying the collections at South Kensington, on students days especially, have always been with a view to give the greatest facility to all engaged in designing for or carrying out works of industrial art or decoration.

Sketching from objects the property of the nation is practically without restraint, but objects on loan can only be sketched with the written permission of the owner.

For making finished studies and drawings of objects, a form of permission is issued, upon the requisition of the student, on which he states the registered number and title of the object or objects he wishes for permission to draw.

This is issued, available for 30 days, and can be renewed for a further time if desirable. The metal work, pottery, and porcelain, furniture, wood carvings, textile fabrics to a great extent, Japanese and Persian objects generally have been made largely available during the last 8 or 10 years.

The following table will show the use made of the objects in the Museum, independent of the sketching, during the last 3 years:

Year.	No. of Applications.	No. of Objects.
1880	49	275
1881	94	200
1882	68	234
Total - -	206	709

Of course the regular students of the training schools have free access to all objects the property of the Museum, if authorised by ticket from the head master.

5. Manufacturers, designers, artisans, and others desirous to closely examine into the technique of any object are permitted to do so with proper precautions for the safety of the examples.

In the matter of woven textiles this has been of great advantage to many persons.

6. It is a rule throughout the Museum for the officers in charge of the various collections to give any information they possess on technical processes, design, &c., to all legitimate enquirers.

As a matter of course, the great amount of work imposed on these officers, who have to superintend the arrangement of the various collections sent out, and the short time they can remain in any one place, prevents their making their knowledge available to any marked extent; but they invariably make the best of their opportunities to point out any special objects of interest as bearing on local industries.

NUMBER OF TOWNS to which the first and second CIRCULATING COLLECTIONS were sent from 1855 to 1863, inclusive.

No. of Towns.	No. of Visitors.	Total Receipts.
41	735,856	£19,074 12 <i>s.</i> 9 <i>d.</i>

TOTAL NUMBER of EXHIBITIONS to which contributions have been lent from 1864 to 1881.

Total No. of Exhibitions	-	-	-	243
Total No. of Visitors	-	-	-	6,446,800
Total Receipts	-	-	-	£183,202 4 <i>s.</i> 0 <i>d.</i>
Total Surplus	-	-	-	£27,923 5 <i>s.</i> 10 <i>d.</i>

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Appendix C. TOTAL NUMBER of EXHIBITIONS to which contributions have been lent from 1855 to 1881.

Total No. of Exhibitions	-	-	-	284
Total No. of Visitors	-	-	-	7,182,656
Total Receipts	-	-	-	£202,276 16s. 9d.
Total Surplus	-	-	-	£27,923 5s. 10d.

NUMBER of LOCAL MUSEUMS to which contributions on DEPOSIT LOAN have been lent for one year and then changed.

No. of Towns	-	-	-	12
No. of objects lent	-	-	-	12,036
No. of Paintings, drawings, &c.	-	-	-	10,901
Total No. of Visitors	-	-	-	4,310,209

NUMBER of TOWNS to which CONTRIBUTIONS have been sent during the last five years.

Total No. of Towns	-	-	-	85
Total No. of objects	-	-	-	12,194
Total No. of paintings	-	-	-	9,243
Total No. of visitors	-	-	-	1,098,241
Total receipts	-	-	-	£28,914 4s. 5d.
Total surplus	-	-	-	£5,542 1s. 11d.

Eight towns have erected permanent buildings.

Appendix D.

APPENDIX D.

Examination Papers handed in by Mr. SHARPE. (See page 384.)

MALE CANDIDATES—FIRST YEAR.

BRITISH HISTORY.*

Candidates are not to answer more than eight questions.

1. Give a brief account of the Government of Britain by the Romans during the 3rd century.
2. State generally the portions of Great Britain included in the several Saxon kingdoms.
Give the origin of the names Strathclyde, Northumbria, Kent, and Yorkshire.
3. Give some account of the condition and manners of the Saxon peasantry under the Norman dynasty, and of the gradual change in their condition during the 12th and 13th centuries.
4. Relate the circumstances which gave rise to the enactment of the Constitutions of Clarendon, and recite their chief provisions.
5. Illustrate the truth of the following statement:—"Of six successive Scottish princes, from Robert III. to James VI., not one died a natural death, and the minorities were long and frequent."

* Candidates passing with credit in these subjects are allowed to substitute two optional subjects, i.e., languages or sciences, in the second year.

6. Give, as far as you can, the names that have been assigned to various styles of Gothic architecture, and name some public buildings, with which you are acquainted, as examples of each. Appendix D.

7. Give a short account of the conquest of Wales by Edward I.

What changes did he introduce into the judicial administration of the country?

8. In what respects did the constitution of the Scottish and English Parliaments differ in the 14th century? When and by whom were burgesses introduced into each of them?

9. Name some of the most distinguished Englishmen who flourished in the 14th and 15th centuries.

Write a brief life of one of the statesmen or poets you have named.

10. Show that the English constitution was steadily developed under the rule of the House of Lancaster.

11. Give some account of the causes which led to the fall of Wolsey, and relate the circumstances of his death.

12. Describe briefly the state of affairs in Scotland, from the death of James V. to the return of Queen Mary to Scotland.

13. What policy did Elizabeth pursue towards the Scottish nation?

Write a brief life of the Regent Murray.

14. Give some account of the Long Parliament.

Name some of the leaders of both parties, and write a brief life of Hampden.

15. Enumerate the chief events of the Protectorate of Cromwell, and sum up his character briefly.

16. Write a short account of the Revolution of 1688, and explain briefly the great change that the British Constitution then underwent.

17. Name the chief statesmen of the reign of George II., and write a brief life of the Earl of Chatham.

18. Describe briefly the campaign of Waterloo. Draw a plan of that battle field.

GEOGRAPHY.

Candidates must draw one of the maps in Question I., and must not answer more than *eight* other questions.

1. Draw a map of—

(a) Austria.

Or, (b) The Mediterranean Sea.

Or, (c) South America.

[N.B.—The map should be drawn on a scale sufficient to occupy all the blank space available. If the candidate put in and correctly number the lines of latitude and longitude it will add to the value of the exercise.

Places must not be indicated by letters or figures, referring to a list of names at the side, but *the names themselves must be inserted in the map.*]

2. Explain the terms ecliptic and great circle; point out the advantages and disadvantages of great circle sailing; and state briefly some of the methods of determining a ship's latitude and longitude at sea.

3. Explain the formation of glaciers; mention some of the remarkable glaciers of the world, and state some of the evidences of a glacial period having existed in Great Britain.

4. Give a full description of *one* of the chief mountain ranges or groups in Great Britain; and compare the characters of the Southdown Hills, the Grampians, the Yorkshire Wolds and the Cornish Heights.

5. Describe the Black Sea, naming the rivers that flow into it, and the places of historical interest on its shores.

6. Describe a coasting voyage from Marseilles to Venice, naming the mouths of rivers that are passed and the chief mountains that are sighted.

Appendix D.

7. Name the six great powers of Europe, state the chief natural sources of wealth of each of them, and compare them roughly in respect of population and area.

What material interest has each of these powers in the Eastern question?

8. Give briefly the chief historical or other associations connected with *six* of the following places, Shrewsbury, Plymouth, Deal, Perth, Glasgow, Londonderry, Athlone, Roxburgh, Derby, Winchester, and Cork.

9. Describe in words the course of the Ganges.

Give some of the historical associations connected with Delhi and Cawnpore.

10. Describe *one* of the colonies of Australia. Name its chief animal and vegetable productions, and give some account of its climate as compared with that of England.

Show how you would prove to children that its winter corresponds to the English summer.

11. Give some account of Equatorial Africa.

Name some of the chief African explorers of the present century; and state briefly the parts of Africa through which they travelled.

12. Enumerate the chief West Indian islands.

Give a brief account of the voyage of Columbus, and of the island on which he landed.

13. Name the chief seaports of the United States, with the State to which each belongs, and the nations by which those states were originally colonized.

14. Describe the Empire of Brazil.

In what parts of America are slaves still employed?

Give a brief account of the condition of the British West Indian Islands after the liberation of the slaves.

15. Enumerate the chief groups of islands of the Pacific ocean.

Describe the scene and the circumstances of the death of Captain Cook.

APPENDIX E.—Time Table handed in by the Rev. T. W. SHARPE. (See page 387.)

TIME TABLE.

Time.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
8.45 to 7.45	1. Reading. Mr. Searle. 2. Reading. Vice-Prin.	1. Euclid. Vice-Prin. 2. Method. Mr. Coombes.	1. Grammar. Vice-Prin. 2. French. Mr. Bright.	1. Euclid. Vice-Prin. 2. Hist. & Geog. Mr. Searle.	Algebra. Vice-Prin. Private Study.	1. French. Mr. Bright. 2. Euclid. Vice-Prin.
7.45 to 1.	PRAYERS AND BREAKFAST.					
9 to 10	Private Study.	Private Study.	Physiography. Mr. Searle.	Private Study.	Physiography. Mr. Bright.	Drill.
10 to 11	1. Arithmetic. Mr. Bright. 2. Private Study.	Acoustics. Vice-Prin. Botany. Mr. Bright.	Electricity. Mr. Bright. Private Study.	Acoustics { Vice-Prin. or Mr. Searle. Private Study.	1. Mental Arithmetic. Mr. Bright. 2. Private Study.	Electricity. Mr. Searle. Botany. Mr. Bright.
11 to 12	1. Old Test. Principal. 2. History and Geography. Mr. Searle.	1. } Algebra. Vice-Prin. 2. }	1. Latin. Mr. Searle. 2. Prayer Book. Principal.	1. French. Mr. Bright. 2. Political Economy. Principal.	1. Prayer Book. Principal. 2. Algebra. Vice-Prin.	Examination.
12 to 1	1. Caesar. Vice-Principal. 2. Epistle. Principal.	1. French. Mr. Bright. 2. Bacon. Principal.	1. New Test. Principal. 2. Euclid. Vice-Prin.	1. Mensuration. V.-Prin. 2. Shakespeare. Prin.	1. Geography. Mr. Searle. 2. Acts. Principal.	
1 to 4	DINNER AND RECREATION.					
4 to 5	Motel Lesson. 3 to 4.30.	1. History. Mr. Searle. 2. Private Study.	Half Holiday.	1. Private Study. 2. Mensuration. V.-Prin.	1. Latin. Mr. Searle. 2. French. Mr. Bright.	Half Holiday.
5 to 6	1. Music. Mr. Searle. 2. French. Mr. Bright.	1. Method. Mr. Coombes. 2. Music. Mr. Searle.		1. Caesar. Vice-Prin. 2. Private Study.	1. Arithmetic. Mr. Bright. 2. Music. Mr. Searle.	
6 to 7.15	TEA.					
7.15 to 9.20	PRIVATE STUDY.					1. Composition. 2. Music. Mr. Searle.

APPENDICES.

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Appendix E.

APPENDIX F.—Handed in by the Rev. T. W. SHARPE. (See page 387.)

TABULATED RESULTS OF EXAMINATION.—CHRISTMAS 1881. MALE STUDENTS OF THE FIRST YEAR.

TRAINING COLLEGE.	LANGUAGES.								SCIENCE.																		
	Latin.		Greek.		German.		French.		Mathematics.	Theoretical Mechanics.	Applied Mechanics.	Acoustics, Light and Heat.	Magnetism and Electricity.	Inorganic Chemistry.		Animal Physiology.	Elementary Botany.	Physiology.									
	Number examined.	Per-centage of Marks.	Number examined.	Per-centage of Marks.	Number examined.	Per-centage of Marks.	Number examined.	Per-centage of Marks.	Number examined.	Per-centage of Marks.	Number examined.	Per-centage of Marks.	Number examined.	Per-centage of Marks.	Theoretical.	Practical.	Number examined.	Per-centage of Marks.	Number examined.	Per-centage of Marks.	Number examined.	Per-centage of Marks.					
															Number examined.	Per-centage of Marks.	Number examined.	Per-centage of Marks.	Number examined.	Per-centage of Marks.	Number examined.	Per-centage of Marks.					
Bangor	3	40					30	45																			
Battersea	40	42					25	25																			
Borough Road	20	46					20	25																			
Cardiff	2	25																									
Cardiff	2	12																									
Cardiff	20	57					34	56																			
Chelsea	20	43					14	22																			
Cheltenham	15	36					23	37																			
Chester	22	43					32	47																			
Culham	24	42					10	42																			
Durham	12	33					6	19																			
Exeter							14	44																			
Hammer-smith	5	26					7	25																			
Honerton	11	47					4	23																			
Peterborough	11	47					28	43																			
Salisbury	35	37					10	22																			
Westminster	5	18					38	54																			
Winchester	5	18					19	42																			
York																											
Total	304	42					375	50						332	47	190	44	160	45	113	51	183	38	37	67	221	49

APPENDIX F.—(continued.)

TABULATED RESULTS OF EXAMINATION.—CHRISTMAS 1881. MALE STUDENTS OF THE SECOND YEAR.

TRAINING COLLEGE.	LANGUAGES.								SCIENCE.																														
	Latin.		Greek.		German.		French.		Mathematics.		Theoretical Mechanics.		Applied Mechanics.		Acoustics, Light and Heat.		Magnetism and Electricity.		Inorganic Chemistry.		Animal Physiology.		Elementary Botany.		Physiology.														
	Number examined.	Percentage of Marks.	Number examined.	Percentage of Marks.	Number examined.	Percentage of Marks.	Number examined.	Percentage of Marks.	Number examined.	Percentage of Marks.	Number examined.	Percentage of Marks.	Number examined.	Percentage of Marks.	Number examined.	Percentage of Marks.	Number examined.	Percentage of Marks.	Theoretical.		Practical.		Number examined.	Percentage of Marks.	Number examined.	Percentage of Marks.	Number examined.	Percentage of Marks.											
																			Number examined.	Percentage of Marks.	Number examined.	Percentage of Marks.																	
Bangor	7	48						41	54							10	51	20	46					6	84														
Barnston	23	40						41	83									47	49																				
Borough Road	31	38						80	44	23	41	23	41					37	37																				
Carmarthen	1	45																	4	70																			
Carnarvon																																							
Chelsea	17	48						40	45																														
Choltenham	21	35						18	41	16	33																												
Chester	12	38						15	33	1	41																												
Culham	25	38						47	37	7	36																												
Durham	24	36						11	45																														
Exeter	6	54			37																																		
Hammerwith								8	46																														
Homerton	2	27						6	28	5	37																												
Peterborough	5	43						5	38																														
Saltley	10	40						16	30	7	38																												
Westminster	26	26						17	30	26	38																												
Winchester	43	25						24	45																														
York	2	20						5	58	3	36																												
Total	221	37	1	37				321	41	101	36	40	46	3	41	229	51	220	46	41	52	4	68	97	29	20	53	347	53										

CIRCULAR TO MANUFACTURERS.

CLASSIFIED LIST OF REPLIES.

	Name.	Page.
<i>Iron-work, &c.</i>		
	1. Kitson and Co., Airedale Foundry, Leeds	643
	2. Jno. Dugdale and Sons, Sobo Foundry, Blackburn	643
	3. Hy. Pooley and Son, Albion Foundry, Liverpool	643
	4. Fox, Head and Co., Newport Rolling Mills, Middlesbrough	644
	5. Easton and Anderson, Erith Iron Works, Kent	644
	6. E., K., and F. Turner, St. Peter's Iron Works, Ipswich	645
	7. Bobey and Co., Engineers, Lincoln	645
	8. Peyton and Peyton, Bordesley Works, Birmingham	646
	9. Armstrong, Mitchell and Co., Elswick Works, Newcastle-on-Tyne	646
	10. Sharp, Stewart and Co., Atlas Works, Manchester	652
	11. Sharp, Stewart and Co., Manchester (2nd letter)	653
	12. Hayward, Tyler and Co., 84, Whitecross Street, E.C.	653
	13. Wm. Tonks and Sons, Moseley Street, Birmingham	653
	14. Morewood and Co., Lion Galvanizing Works, Birmingham	654
<i>Mining.</i>		
	15. Wigan Coal and Iron Co., Wigan	654
<i>Chemicals.</i>		
	16. Chas. Tennant and Co., St. Bollox, Glasgow	654
	17. Newcastle Chemical Works Co., 102, Quayside, Newcastle-on-Tyne	655
	18. Sharon Chemical Co., Derby	655
	19. Mr. James Young, LL.D., F.R.S., Kelly, Wemyss Bay	655
<i>Porcelain, Glass, &c.</i>		
	20. Thos. Webb and Sons, Stourbridge Glass Works, Stourbridge	657
	21. Brown-Westhead, Moore and Co., Hanley, Stoke-on-Trent	659
	22. Chance, Brothers, and Co., Glass Works, Birmingham	659
	23. Jas. Powell and Sons, Whitefriars Glass Works, Temple Street, E.C.	659
	24. Mr. Jas. Doulton, Lambeth Pottery, S.E.	659
<i>Cotton.</i>		
	25. Clark and Co., Anchor Mills, Paisley	660
	26. Horrockses, Miller and Co., 9, Bread Street, E.C.	661
	27. Shaw, Jardine and Co., Butler Street Mills, Manchester	661
	28. Crosses and Winkworth, Bolton	661
<i>Wool and Worsted.</i>		
	29. Marling and Co., Ebley and Stanley Mills, Stroud	662
	30. B. Hepworth and Sons, New Wakefield Mills, Dewsbury	662

	Name.	Page.	Appendix G.
<i>Flax, Hemp, &c.</i>			
	31. Old Park Printing Co., Old Park, Belfast	-	663
	32. Jno. S. Brown and Sons, Belfast	-	663
<i>Silk, &c.</i>			
	33. Thos. Chadwick, 141, Great Bridgewater Street, Manchester	-	664
	34. Pim, Brothers, and Co., 22, William Street, Dublin	-	664
<i>Elastic Web.</i>			
	35. Coventry Elastic Weaving Co., Coventry	-	664
<i>Hosiery.</i>			
	36. Nottingham Manufacturing Company, Station Street, Nottingham	-	665
<i>Lace.</i>			
	37. Steegmann and Co., Nottingham	-	666
<i>Carpets.</i>			
	38. Jas. Humphries and Sons, Kidderminster	-	666
	39. Thos. Tapling and Co., London and Glasgow	-	667
	40. James Templeton and Co., Greenhead, Glasgow	-	667
<i>Paper Hangings.</i>			
	41. C. and J. G. Potter, Belgrave Mills, Darwen	-	668
	42. Jeffrey and Co., 64, Essex Road, Islington, N.	-	668
<i>Furniture, &c.</i>			
	43. Gillow and Co., 406, Oxford Street, W.	-	669
	44. Geo. Trollope and Sons, Halkin Street West, Belgrave Square, S.W.	-	669
	45. Kendal, Milne and Co., Police Street, Manchester	-	670
	46. Collinson and Lock, 109, Fleet Street, E.C.	-	670
<i>House Decoration.</i>			
	47. Jno. G. Crace, 88, Wigmore Street, W.	-	671
<i>Art Metal Work, &c.</i>			
	48. Hunt and Roskell, 156, New Bond Street, W.	-	672
	49. Wilkinson and Sons, Pelican Works, Birmingham	-	672
	50. Jones and Willis, 260-264, Euston Road, N.W.	-	672
	51. Jas. Dixon and Sons, 37, Ludgate Hill, E.C.	-	673
<i>Carriages.</i>			
	52. Hooper and Co., 118, Victoria Street, S.W.	-	673
	53. Laurie and Marner, 311, Oxford Street, W.	-	675
	54. McNaught and Smith, Worcester and London	-	675
	55. Mr. Pendry, of Hooper and Co.'s, London	-	676
<i>Printing, &c.</i>			
	56. R. Clay, Sons, and Taylor, Bread Street Hill, E.C.	-	679
<i>Optical Instruments.</i>			
	57. R. and J. Beck, 68, Cornhill, E.C.	-	679
<i>Chief Engineers of Railways.</i>			
	58. Mr. A. Langley, Great Eastern Railway	-	680
	59. Mr. Chas. Sacré, Manchester, Sheffield, and Lincolnshire Railway	-	680

SPECIAL LIST.

LIST of LETTERS received from ENGINEERS, MANUFACTURERS, and OTHERS, concerning the PRACTICAL Use of the COLLECTIONS in the MUSEUM of SCIENCE and ART, EDINBURGH.

1. From Mr. J. Calderwood, Manager, Price's Patent Candle Company, Battersea, London.
2. From Mr. E. C. C. Stanford, Chemical Manufacturer, Glasgow.
3. From Mr. A. Betts Brown, Hydraulic Engineer, Rosebank Iron Works, Edinburgh.
4. From Mr. D. Drummond, Chief Engineer, Locomotive Department, Caledonian Railway, Glasgow.
5. From Mr. D. Corse Glen, of Glen and Ross, Mechanical Engineers, Glasgow.
6. From Mr. J. Small, Architect, Edinburgh.
7. From Mr. J. Rhind, Sculptor, Edinburgh.
8. From Messrs. Marshall and Sons, Jewellers, Edinburgh.
9. From Messrs. T. Nelson and Sons, Publishers, Edinburgh.
10. From Mr. A. D. Jenkinson, Glass Manufacturer, Edinburgh.
11. From Mr. W. Smith, Secretary to the Flint Glass Makers' Friendly Society, Edinburgh District.

CIRCULAR LETTER ADDRESSED TO MANUFACTURERS.

In order to secure the opinions of a larger number of manufacturers on the subject of Technical Instruction than we were able to obtain on our personal visits, we issued the following circular, to which we have appended the more important replies.

ROYAL COMMISSION ON TECHNICAL INSTRUCTION.

South Kensington Museum, London, S. W.,

February 8th, 1883.

SIR,

The Members of the Royal Commission on Technical Instruction have visited various foreign countries for the purpose of inspecting their technical and other schools, and of ascertaining the influence of such schools on the efficiency of the workmen, foremen, and employers engaged in the principal industries of those countries.

The Commissioners are desirous of obtaining information of a similar kind with regard to this country, and for that purpose have visited, and will visit, typical towns in the United Kingdom.

In order that their inquiries may be as extended as possible, I am directed to ask the favour of your opinion—

1st. As to the influence, on the industry in which you are engaged, of the Science and Art classes, and other sources of technical and general instruction, which are available to the workmen, foremen and employers of your district; and,

2nd. As to any means whereby such instruction may be rendered more useful.

Soliciting the favour of an early reply,

I have the honour to be, Sir,
Your obedient Servant,
(Signed) GILBERT R. REDGRAVE,
Secretary.

IRONWORKERS, &c.

Appendix G.

No. 1.

Airedale Foundry, Leeds,
February 13th, 1888.

DEAR SIR,

We have considered over the questions asked by your letter of the 8th instant.

In Leeds there are many institutions by which those who are desirous to learn may obtain knowledge in almost every branch of science and art; such knowledge must in many cases prove to be of great use to the students in their respective avocations, and will, we should imagine, improve the well-being and the general status of the town. We could hardly reply to your questions in a limited sense. We employ such a large number of hands, drawn from so many various sources. There is, however, in our Works, amongst the hands employed, a growing tendency to greater intelligence and earnestness in the execution of the work allotted to the respective departments. We have pleasure in testifying to this improvement, whether springing from science and art classes or from any of the other sources for the obtaining of knowledge.

The night classes of the Leeds Mechanics' Institution have long been an attraction to many of our young men, and the night classes at the Yorkshire College are also, we believe, now drawing some of the more intelligent who are employed with us.

G. R. Redgrave, Esq.,
Royal Commission on
Technical Instruction.

We are, &c.,
KITSON & Co.

No. 2.

Soho Foundry, Blackburn,
March 1st, 1888.

DEAR SIR,

In reply to your inquiry respecting technical instruction, we find some difficulty in answering your questions satisfactorily, as in our town we are not aware much such instruction is given outside the factories and workshops. The few cases that have come under our notice we can speak of very favourably. We have thought very carefully about the second question, and must confess our acquaintance with the subject is not sufficient for us to venture an opinion. To any good and practical scheme we would willingly contribute.

To Gilbert R. Redgrave, Esquire.

We have, &c.,
JOHN DUGDALE & SONS.

No. 3.

Albion Foundry, Liverpool, February 20th, 1888.

SIR,

We are in receipt of your circular letter, dated 8th inst., requesting our opinion on the following points:—

- 1st. As to the influence on the industry on which we are engaged of the Science and Art Classes, and other sources of technical and general instruction which are available to the workmen, foremen, and employers of our district, and
- 2nd. As to any means whereby such instruction may be rendered more useful.

For your information, we may state, our general business is that of mechanical engineers and ironfounders, our chief speciality being the manufacture of railroad and other weighing apparatus.

In reply to your first question, as to the influence exercised by science and art classes on our industry, we fear the *direct* influence is very slight,

Appendix G. for out of over 500 persons in our employment, we have only been able to ascertain that one of them, and he an apprentice, avails himself of the instruction afforded by the classes in question.

The employers of our district are, as a rule, a highly educated class of men.

As to your second question. The corporation of this city already supplement the usual art and science class instruction by a series of free lectures, on the various subjects treated of in the classes.

Our opinion is, that the science and art classes, being rudimentary, do not, and cannot, as at present constituted, take equal rank with the technical schools of the continent.

The few months allowed for the subjects pursued by the classes, do not suffice, in point of time, to cover the field, and therefore the instruction given is only superficial.

As to the means by which such instruction may be rendered more useful, possibly the establishment of technical colleges, with exhibitions thereto, open to science and art class students who have attained a certain standard, may stimulate those among the working classes who are really anxious to excel.

We feel it is quite impossible to do justice to the subject put before us, within the limits of a letter, and

We are, &c.

Gilbert B. Redgrave, Esq., Secretary, HENRY POOLEY & SON,
Royal Commission on Technical Instruction,
South Kensington Museum, London, S.W.

No. 4.

Newport Rolling Mills, Middlesbrough,
February 13th, 1883.

DEAR SIR,

We have your circular of the 8th, and in reply to your questions, beg to say—

First. The opportunities of technical instruction in this district have not hitherto been very great. We have the Cleveland Institution of Engineers, which has been in existence for 19 years, and which has undoubtedly had a most beneficial effect in the district. We have also had for a few years chemical lectures at the Mechanics' Institute, which have done good, though to a limited extent. During the last three or four years we have had the Cambridge University Extension Lectures, the benefits of which are now much sought after. Those who derive advantage from these sources of education are mainly the leaders of industry, their families, managers, foremen, clerks, and a certain proportion of the general public. These opportunities are almost entirely neglected by working men proper.

Second. Some of the employers in the district have recently formed themselves into a committee, to consider the question of a technical school. Mr. B. Samuelson, M.P., has been the leader of this movement, and his partner, Mr. W. Hanson, is the secretary. Probably the best means of forwarding technical education in this district would, for the present, be to work with and assist this committee, which includes the best men in the district.

We are, &c.

Gilbert B. Redgrave, Esq.

FOX, HEAD, & Co.

No. 5.

Erith Iron Works, Erith, Kent,
February 14th, 1883.

SIR,

In reply to your inquiry of 8th inst., we beg to state—
(1.) The influence of the improved education of young people during the last 10 or 12 years, has been more and more noticeable in the improving

character of boys and young men, especially in those branches of our work which require most skill and intelligence. The science and art classes have certainly had their share in effecting this improvement, though it is difficult to keep them going in such a small place as this, with a comparatively small number of young men, willing to avail themselves of the opportunity these afford of acquiring useful information.

(2.) We think the instruction given in the science and art classes, in the subjects which concern our business, mechanical engineering, might be improved by being more practical. Perhaps the only way of effecting this thoroughly would be to have experienced practical men for teachers, but this is, probably, not feasible. But the more practical experience a teacher has in machine construction, &c., the better, and this is the direction in which we think further improvement might be made.

We are, &c.

Gilbert R. Redgrave, Esq., Secretary, EASTON & ANDERSON.
Royal Commission on Technical Instruction,
South Kensington Museum, S.W.

No. 6.

St. Peter's Iron Works, Ipswich,
February 15th, 1883.

SIR,

In answer to your communication of the 8th instant, requesting our opinion as to the influence of the Science and Art Classes on the industry on which we are engaged, and as to any means whereby such instruction may be rendered more useful, we beg to reply—

1st. It is generally the studiously disposed and most intelligent of workmen and apprentices who avail themselves of the Science and Art Classes. From these foremen, leading workmen, and sometimes draughtsmen, are selected, in which capacities the knowledge and skill they have thus acquired is certainly an advantage.

2nd. We are unable to suggest a means of rendering such instruction more useful, unless, as regards our particular industry, mechanical drawing, the making working drawings especially, could be taught by an experienced mechanical draughtsman. It is not to be expected that a school of art master should be familiar with mechanical drawing as practised in an engineering factory.

We are, &c.

Gilbert R. Redgrave, Esq., Secretary, W. & F. TURNER.
Royal Commission on Technical Instruction.

No. 7.

Lincoln, February 13th, 1883.

SIR,

In reply to the inquiries contained in your circular letter of the 8th instant, we have to state—

Inquiry first.—That the establishment of the School of Art in Lincoln has been and is of considerable advantage to the workmen and boys in our employ, as it gives them an opportunity of acquiring a knowledge of mechanical drawing, which is necessary to their advancement in life in mechanical engineering.

We regret, however, to have to add, that the accommodation in the room or building in which the drawing classes are held, is so defective, that it seriously affects the health of the pupils attending the classes; and for this, and other reasons, a regular attendance at the classes has been seriously interfered with.

We earnestly wish the Commissioners would inquire into this matter.

Until the present winter no science classes have been held in Lincoln, but some have been established this winter in a separate building to the above-named, and are being carried on with marked success.

Appendix G. The importance of the subjects taught at these science classes to the future well-being of the working population of Lincoln, is quite equal, if not greater, than the subject of mechanical drawing. For with the rapid development of electrical science, and its undoubted close alliance to mechanical engineering in the near future, it is essential that they should be instructed in that technical subject.

Inquiry second.—What is urgently wanted in Lincoln is a large commodious building in a central situation, where science and art classes can be carried on with greater facilities and on a larger scale. So serious is the want of this, that we believe were the facts *fully known* to the Commissioners they would take immediate steps to cause this deficiency to be remedied.

Gilbert R. Redgrave, Esq., Secretary,
Royal Commission on Technical Instruction,
South Kensington Museum, London, S.W.

We have, &c.
ROBERT & CO.

No. 8.

Birmingham, February 13th, 1883.

SIR, We are in receipt of your circular of the 8th instant, and in reply to the first question beg to state that it is hardly possible to estimate too highly the value to workmen and employers alike of the science and art classes.

With regard specially to the former, the advantage is not limited to the precise knowledge derived from their studies, but is perhaps of equal value as a mental training. Anything which leads them to observe and to think, so as to apply their knowledge to their various occupations, is of the greatest possible value.

A large number of workmen having no general cultivation, work too much like machines; whereas the instructed and cultivated man, even though the precise knowledge he has obtained, has little or no bearing upon his work, works with intelligence; the result being that he makes fewer mistakes, and is always on the look out to economise his time by adopting the most ready method of completing what he has in hand. We do not make these remarks as in any way novel, but as a confirmation probably of the views held by the promoters of science and art education.

With regard to the second question, we are not prepared to reply, but will give the matter consideration; and if the Commissioners come to Birmingham, and are willing to see us, will, if possible, be prepared with some practical suggestions.

Gilbert R. Redgrave, Esq.,
South Kensington Museum, S.W.

Yours faithfully,
PETROS & PETROS.

No. 9.

Elswick Works, Newcastle-upon-Tyne,
February 20th, 1883.

GENTLEMEN,

We have the honour to acknowledge your circular of the 8th instant.

The technical instruction given in the institution attached to these works and in similar institutions throughout the district has undoubtedly a beneficial influence on the industries in the locality.

We enclose a syllabus of the classes at the Elswick Mechanics' Institute. Two hundred and sixty pupils attend these classes, 160 of whom belong to our works, chiefly apprentices; the remainder of the students belong to works of a similar character in the neighbourhood.

Our experience of these classes is that they not only develop thought and intelligence, but they also tend to foster studious and steady habits and to raise the tone of the students; we find as a rule, that the students who are most regular in their attendance and most earnest in their endeavours to benefit by the instruction, turn out to be the most efficient workmen, and are those we are most anxious to retain with the view of making them foremen, and ultimately placing them in higher positions. We recruit our drawing office from the apprentices at the works who have attended these classes and shown intelligence.

As regards your second inquiry, it is our constant endeavour to make the classes as useful as possible, and we gladly avail ourselves of anything which experience teaches us will tend to this result.

The tendency which is becoming more and more marked in the direction of increasing not only the difficulty of the examination in individual subjects but also increasing the range of subjects in all competitive examination, is, we consider, an evil which should be carefully guarded against; for while offering a strong inducement to those who happen to possess exceptional powers of being crammed, it deters many who, although equally intelligent and equally gifted with all the qualities which combine to make the highest class of usefully intelligent men, are deterred from a feeling of inferiority in their powers of reception from entering into the competition.

It does not always follow that those gifted with the power of absorbing a larger amount of information preparatory to an examination are the most practically useful in after life, and even were this the case, it is obvious that more general benefit will result from a larger number of students thoroughly well grounded than a few brilliant ones obtained at the cost of deterring others from completing.

We are, &c.,

For SIR W. G. ARMSTRONG, MITCHELL & Co.
HENRY S. DYER.
To the Royal Commission on Technical
Instruction, South Kensington Museum,
London, S.W.

ELSWICK MECHANICS' INSTITUTE.

Science and Art Classes.

The Instruction will be given in Courses I., II., III., IV., VII., VIII., and IX., by HENRY EVERS, LL.D. (Author of "Steam," "Navigation," and many other Science Text Books); and in Course V. and VI., by WM. JOHN GREY, Esq.; and in Course XI., by WILLIAM BOURN, Esq.

SYLLABUS.

COURSE I.—MATHEMATICS.—

- (a) Preliminary. The higher rules of arithmetic, algebra up to multiplication, Euclid, Book I.
- (b) Stage 1. Euclid, Book I., and algebra as far as simple equations.
- (c) Stage 2. Euclid, Books II. and III., algebra up to quadratic equations, trigonometry as far as solution of triangles, and logarithms.
- (d) Stage 3. Deductions from Euclid, Books I., II., and III., higher trigonometry, higher algebra, including binomial theorem, &c.
- (e) Stage 4. Euclid, Books IV., V., and VI., descriptive geometry, geometrical conics.

COURSE II.—DRAWING:—

- Subject (a) Machine drawing (elementary).
" (b) Plane and solid geometrical drawing (elementary).

Appendix G.

COURSE III.—DRAWING :—

- Subject (a) Machine drawing (advanced).
 „ (b) Plane and solid geometrical drawing (advanced).
 „ (c) Building construction.

Anyone taking this Course must have passed successfully in Subjects (a) and (b), Course II.

COURSE IV.—MECHANICS :

- Subject (a) Theoretical mechanics.
 „ (b) Applied mechanics.
 „ (c) Steam and the steam engine.

It is desirable that students taking up Course IV. should have a knowledge of the subjects taught in Courses I. and II.

COURSE V.—PHYSICS :—

- Subject (a) Magnetism and electricity.
 „ (b) Sound, light, and heat.

It is desirable that students taking up Course V. should take up Course VI. also, Preliminary Class.

COURSE VI.—INORGANIC CHEMISTRY (Lectures and Laboratory Practice) :—

- Subject (a) Theoretical inorganic chemistry.
 „ (b) Practical do. do.

COURSE VII.—MANUFACTURE OF IRON AND STEEL :—

This Course is held under the direction of the City and Guilds of London Institute, and will embrace instruction in the theory and practice of the processes of manufacture and the chemical changes consequent thereon. The students will have the opportunity of viewing the mechanical processes of manufacture.

COURSE VIII.—MECHANICAL ENGINEERING :—

This Course is also held under the direction of the City and Guilds of London Institute.

COURSE IX.—NAVIGATION AND NAUTICAL ASTRONOMY.

COURSE X.—FREEHAND DRAWING.

Geometrical drawing, elementary, model, and perspective.

COURSE XI.—SHORTHAND.

Notes.—The proficiency of students desirous of taking any of the stages in Course I. will be tested by a preliminary examination, on Friday, September 29th, at 7.30 p.m.; unless the student shall have passed first class in the stage preceding that he is wishful to take in Course I., at the science examinations.

For Course VI., places in the laboratory will be allotted, and deposits received, on Saturday, September 30th, at 3.15 p.m. As only a limited number of places are available, priority will be given—first, to those engaged in Elswick Works, and second, to those pupils who have already been one year in the laboratory. Should there then remain more applicants than places, there will be a competition in arithmetic and algebra.

FEES.

Registration fee for those engaged in Elswick Works :—

2s. 6d. for any single course, and 1s. 6d. extra for each course taken in addition.

For those not so engaged :—

5s. for any single course, and 3s. extra for each course taken in addition, except for Courses VI. and XI. The fee for Course VI. is 7s. 6d., and 1s. 6d. for Course V. if taken with Course VI.; for Course XI., 8s.

Premium apprentices must pay 1l. in addition to the registration fee, which will be returned to them on their sitting for examination.

Preliminary mathematics and physics, 6d. per course.

A free ticket will be issued for the above session to:—

Anyone who has, whilst a student of the Elswick classes, taken either three advanced first classes, or a medal at the last May examinations.

Anyone engaged in Elswick works who has attended a class regularly for the two previous sessions and taken at least one institute first class prize at the last May examination.

The secretary will be in attendance at the committee room:—

For the issue of free tickets to students applying to him for them on Friday, September 29th, from 7.30 to 9 p.m.

Tickets may be obtained on application to the librarian, any evening after the 26th September.

All tickets issued too late for the first meeting of the class will be charged 1s. additional; and no student can be admitted to any class later than October 16th, except by special application to Dr. Evers or Mr. Grey, with whom it must be left to decide whether the applicant is capable of taking up the studies without deranging the work of the class.

ATTENDANCE.

All who join the classes on these terms must attend regularly, and sit at the science and art examinations in May.

There will be a local examination of the preliminary mathematics and physics classes, also of the shorthand class.

The greatest regularity of attendance must be insisted on for the sake of the students generally. It is obviously unfair that the whole of the students should be retarded in their work by the irregular attendance of a few, and this must occur if such students be allowed to remain in the class. It must be distinctly understood that nothing but the most urgent circumstances must be allowed to keep any student away, and when possible, previous leave must be obtained from the teacher.

HOME EXERCISES.

Which will require, for careful work, at least three hours per week, will be given out on each class night. They are not optional, but are a necessary part of the duties of students. No excuse can be taken for neglecting them. Dr. Evers will be at the institute every Monday, Wednesday, and Friday evenings, from 6 to 6.45 p.m., and on Tuesdays, from 5 to 6.45 p.m., to give those who have experienced difficulties of consulting him. Mr. Grey will also be at the institute every Thursday, from 5.45, to give students an opportunity of consulting him.

PRIZES, CERTIFICATES, &c.

In addition to the prizes and certificates granted by the Science and Art Department, and the City and Guilds Institute upon the results of their examinations, the committee of the Elswick Institute will award prizes according to the following scheme of marks in which the marks will be allotted separately for each subject that an examination is held in:—

For attendance, 300 marks are given, and 50 deducted for each absence. If a student obtain leave, or if he be ill and away from work, he may, on application, make up the lost attendance; in such cases 25 marks will be returned.

For home exercises, 300 marks will be given; the proportionate number to be awarded weekly.

Appendix G.

For each first class at the science examination, or excellent at the art examination, 200 marks; and for each second class or pass at the same examinations, 150 marks will be given.

For mathematics, 300 and 200 will be allowed for a first and second class respectively.

For shorthand, 300 and 200 will be allowed for a first and second class respectively.

85 and 70 per cent. of the total number of obtainable marks will carry a first and second class prize respectively. Those obtaining 92·5 per cent. will receive a special award.

Special prizes will be given by Capt. Noble, R.A., C.B., to the Elswick students for advanced mathematics and chemistry.

BOOKS AND APPARATUS REQUIRED.

The prices in brackets are those at which the articles can be obtained at the institute, by members of the classes only.

COURSE I.—Euclid's Elements [1s. 4d.]; Atkin's Algebra [2s. 2d.]; and for stages 2 and 3 Todhunter's Trigonometry [2s. 2d.]; and Evers' Mathematical Tables [3s.].

COURSES II. and III.—Drawing instruments, which must consist at least of large pencil compass, dividers, and bow pencil in good order; drawing board, 24 in. by 16 in. [1s. 10d.]; portfolio of same size [10d.]; T square [1s.]; two set squares [10d.]; two pencils, hard and fine [4d.]; set of scales [6d.]; small compasses [2s. 6d.].

COURSE VIII.—Drawing board, 24 in. by 16 in. [1s. 10d.]; portfolio, of same size [10d.]; two pencils, hard and fine [4d.].

Students will find it to their advantage to consult Dr. Evers before buying drawing instruments, and can also obtain hints on colouring and shading from him on personal application.

COURSE IV.—Evers' Steam, and Twisden's Theoretical Mechanics.

COURSES V. and VI.—Students are requested to consult Mr. Grey before purchasing books for these subjects. The apparatus for Class VI will be lent; but each pupil must deposit 2s. 6d., or 5s. if not engaged in the Elswick Works, which will be returned to him when he has attended the examination in chemistry, and given up the apparatus lent to him.

For the preliminary physics class, Balfour Stewart's Primer upon Physics [10d.] will be used.

COURSE VII.—Text books for this course must be bought after consultation with Dr. Evers.

GENERAL AND REFERENCE LIBRARY.

Students not engaged in Elswick Works may avail themselves of the Institute libraries on payment of 1s. 6d. per quarter to the librarian. Strangers attending classes, and not paying this fee, are not permitted to attend or vote at any general meeting, or make use of the library.

HOLIDAYS.

The classes will not meet from Friday, 22nd December, to Thursday, January 4th, inclusive; nor on Shrove Tuesday; nor from the Thursday before Easter to the Wednesday after, inclusive.

ELSWICK MECHANICS' INSTITUTE.
Science and Art Classes.

Appendix G.

Time Table for Session 1882-83.

	7.0 p.m. to 8 p.m.	8.15 p.m. to 9.15 p.m.
Monday.	Theoretical mechanics. Course IV. Subject (a). Preliminary physics, 6.30 to 7.30.	Applied mechanics. Course IV. Subject (b).
Tuesday.	Steam, &c. Course IV. Subject (a). Shorthand.	Manufacture of iron and steel. Course VII.
Wednesday.	Machine drawing (ad- vanced). Course II. Subject (a). Building construction.	Plane and solid geometrical drawing (advanced).
Thursday.	Machine drawing (ele- mentary). Course II. Subject (a).	Plane and solid geometrical drawing (elementary).
	Magnetism and Electri- city. Course V. Subject (a).	Sound, light, and heat. Course V. Subject (b).
Friday.	Mathematics. Course I. All stages.	Euclid. Course I. All stages.
Saturday.	Theoretical and Practical Chemistry. Course VI. Subjects (a) and (b).	3.15 p.m. to 6.0 p.m.
		6 p.m. to 7 p.m.
		7 p.m. to 8 p.m.
		Mechanical Engineering. Course VIII.

The Lectures commence most punctually at the stated times, and all are requested to arrive a few minutes before.

For particulars in Art Class see posters.

The first meetings will be held as follows:—

For Courses VI., VIII., and IX., on Saturday, September 30th.

For Courses I., II., III., IV., V., and VII., on the nights appointed during the ensuing week.

WM. MAXWELL, Secretary.

Atlas Works, Manchester,
March 2nd, 1883.

SIR,
We have received your circular of the 8th February, containing two questions from the Members of the Royal Commission on Technical Instruction, and requesting our opinion thereon.

In reply to the first question. Dividing our employés into three sections, mechanics, foremen, and draughtsmen, and excluding from consideration the unskilled labourers, we may say that we have been unable to trace any appreciable influence on our mechanics or foremen, as a class, from the efforts made in Manchester in the science and art classes at the Mechanics' Institution and elsewhere, to promote technical instruction.

We are further inclined to believe that any tendency which there may be towards individual improvement in knowledge from these and other opportunities, has been neutralized partly by the growing practice of subdivision of labour which has tended more and more to confine each workman to a particular class of work, and partly by the action of trades' unions, which has always militated, by interference in the matter of wages, and making regulations against payment by the piece, against the individual workmen raising themselves above their fellows.

The result of this state of things is evidenced by the great difficulty now experienced in selecting foremen from among our own workmen.

As to the effect of the standard elementary education on the working class, we find that when boys have left school, and fail to keep up what they have learned, they in many cases become, as far as concerns writing and arithmetic, at all events, almost as illiterate as if they had never learned them.

Among our draughtsmen, on the other hand, there is a much greater disposition to avail themselves of the facilities for technical instruction, and we are disposed to believe that as a class, they have largely profited by these facilities. It appears difficult, however, to teach by any technical instruction other than an apprenticeship in the workshop, that most important part of the skill of a draughtsman, viz., how to combine fitness of form with economy of production.

We are not of opinion that the quality either of our work or of our workmen would be improved by the introduction of a system of technical instruction, such, for instance, as that in vogue in France; and we base our views upon the fact that in our own particular business of locomotive manufacture, the French engineers have arrived at machines heavier, more expensive, and more complicated than our English engines, doing practically the same work.

In reply to the second question, we consider that the instruction afforded by science and art classes such as exist in this city might be rendered more useful.

1st. By the promotion of a sound elementary education, free from cram, in our board schools.

2nd. By granting scholarships tenable in the Technical School of Manchester to boys who have successfully passed the highest standard in the board schools, and who wish to become engineers.

3rd. By granting scholarships, tenable in the Victoria University, to the successful students of the technical school who wish to continue their studies in the higher grades of engineering.

4th. By offering rewards to students for original research and the invention of labour-saving appliances.

5th. By the establishment of a Technical Museum of Engineering in this city.

We have, &c.,
FOR SHARP, STEWART & CO., LIMITED,
WM. STEELE TOMKINS.

Gilbert R. Redgrave, Esq.
The Royal Commission on Technical Instruction,
South Kensington Museum, S. W.

No. 11.

Appendix G.

Atlas Works, Manchester,
March 19th, 1883.

DEAR SIR,

IN reply to your letter of the 5th instant, we have pleasure in making the following suggestions as to the ways in which proprietors of Engineering Works might assist in the object in view, viz. :—

1. By affording information and assistance in the management of the institutions mentioned.
2. By giving preference (*oeteris paribus*) to successful students who may be in their employ when occasions for promotions arise.
3. By offering rewards for special study in the shape of exhibitions and scholarships in technical schools.
4. By contributing models and parts of machinery to technical museums.
5. By encouraging the attendance at evening classes for technical instruction of the young people in their workshops.

We have, &c.

For SHARP, STEWART & Co., Limited,
WM. STEELE TOMKINS.Gilbert R. Redgrave, Esq.,
Royal Commission on Technical Instruction,
London.

No. 12.

84 & 85, Whitecross Street, London, E.C.,
March 1st, 1883.

SIR,

IN reply to your circular letter of February 8th, we have pleasure in reporting as follows :—

At Luton, Beds., where our principal works are situated, the science and art classes have not been established long enough to enable us to speak of definite results.

We consider them distinctly useful—

- 1stly. As providing useful and congenial occupation to our apprentices, &c., in their leisure time.
- 2ndly. As stimulating an interest in the more intellectual aspects of the engineering trade.

We do not find, nor do we think it likely that any such system of instruction can ever prove more than a useful adjunct to the system of apprenticing learners for at least three or five years.

In our experience it is only in this latter way that a practical knowledge of mechanics can be obtained.

We are, &c.

Gilbert R. Redgrave, Esq.,
South Kensington Museum, S.W.

HAYWARD, TYLER & Co.

No. 13.

Moseley Street, Birmingham,
February 10th, 1883.

DEAR SIR,

IN reply to your circular inquiry of the 8th instant, we believe the science and art classes of our local school of Art and Midland Institute have a most beneficial influence on our special industry, and with sufficient funds they are capable of a development which would suffice for all requirements.

We believe the purely technical part of instruction may be acquired as well, or better, in our workshops.

A further supply of funds and good examples would increase the utility of the above-mentioned institutions.

Yours, &c.

The Secretary, Royal Commission
on Technical Instruction.

WILLIAM TOMES & SONS.

Appendix G.

No. 14.

Lion Galvanizing Works, Birmingham Heath,
Birmingham, February 12th, 1883.

SIR, We are favoured with yours of the 8th instant, upon the subject of "Technical Instruction." In reply to your queries, we beg to state that the means of obtaining technical instruction at the Midland Institute and Mason's Science College in this town, taken in conjunction with the classes at the school of art, are, in our opinion, amply sufficient for any instruction the working classes may require.

We are, &c.

Gilbert R. Redgrave, Esq.,
Royal Commission on Technical Instruction,
South Kensington Museum, London, S.W.

MORAWOOD & Co.

 MINING.

No. 15.

Wigan, February 20th, 1883.

SIR, I HAVE the honour to acknowledge the receipt of your circular letter of the 8th instant.

In reply to your queries:

1. A mining and mechanical school is established in Wigan, and affords excellent technical education at a very small cost to each student. Wigan is the centre of a large mining and manufacturing district. The school is very accessible to that district. Mining in all its branches is taught; mechanics, theoretical and applied metallurgy, chemistry, steam brick-making, &c., &c.. The classes are well attended. The instruction afforded is found most useful to both workmen and foremen, and especially is it so to youths who aspire to become foremen, managers, or proprietors. This school has been at work over 20 years. It is supported, principally, by the coal owners and ironmasters in the immediate neighbourhood of Wigan.

2. In my judgment, the instruction afforded is suited to the requirements of the district. I scarcely think it could be made more useful. The maintenance of such an institution falls heavily upon a few persons, but I see no help for that, unless the whole expense were undertaken by Government, which I should not desire.

I remain, &c.

Gilbert R. Redgrave, Esq.,
Royal Commission on Technical Instruction,
South Kensington Museum, London, S.W.

ALFRED HEWLETT,

Managing Director.

 CHEMICALS.

No. 16.

Glasgow, March 9th, 1883.

SIR, REFERRING to your circular of the 8th ultimo, and in reply to your inquiries as to the science and art classes, we have to state:—

1. That we find these classes are of considerable value to four of the young men engaged in our laboratory, but as regards the workmen and foremen in our employment, numbering about 1,200, we find

them practically useless, nor do we see any way in which they can be utilized. Appendix G.

2. In these circumstances we have no suggestions to offer.

We are, &c.

For CHARLES TENNANT & Co.,
DAV. BARLAS.

Gilbert R. Redgrave, Esq., Secretary,
Royal Commission on Technical Instruction,
South Kensington Museum, London, S.W.

No. 17.

102, Quayside, Newcastle-upon-Tyne,
February 13th, 1883.

SIR, In answer to your circular dated the 8th instant, I am of opinion that the science and art classes are of great benefit to the workmen and foremen employed in the chemistry industry, and I beg to state that a class on the alkali manufacture has been annually held in these works under the directions of the City Guilds of London.

I am of opinion that the technical instruction of workmen and others may be rendered more useful by giving more publicity to any conditional facilities to be offered to the workmen.

I am, &c.

ALFRED ALLHUSEY,
Director of Newcastle Chemical Co.

Gilbert R. Redgrave, Esq., Secretary,
Royal Commission on Technical Instruction,
South Kensington Museum, London, S.W.

No. 18.

Derby, August 12th, 1883.

SIR, In reply to your favour of 8th instant—
1st. We do not think that the science-classes, at any rate in our own neighbourhood, have had time to affect our manufacture, except in an indirect manner. For instance, our foreman has been in office for over 20 years. The writer has attended the science class here, and believes that the effect of such classes will ultimately be to bring more exact methods into use in this and other such manufactures.

2nd. Some idea of elementary chemistry might be given in national, board, and other schools, as part of the ordinary course, and so make these schools feeders to the Science classes.

I have, &c.

(Signed) H. SIMONS,
Managing partner.

Gilbert R. Redgrave, Esq., Secretary,
Royal Commission on Technical Instruction,
South Kensington Museum, London, S.W.

No. 19.

Kelly, Wemyss Bay, March 15th, 1883.

SIR, I AM honoured with your circular of 8th ultimo on the subject of the influence of technical schools on the efficiency of parties employed in the principal industries of our country.

I am not now engaged in any of these industries, but I have had a long experience in some of those which are associated with the science of chemistry, and my experience impressed me so much with the probable advantages to be derived by workmen, foremen, and others engaged in chemical pursuits through the establishment of technical schools, that in the year 1870 I endowed a Chair in the City of Glasgow for the purpose of

Appendix G. affording such instruction. I have the pleasure of enclosing a copy of the Deed of Trust, and of appending a Memorandum by the Secretary of the Trust on the past and present working of the Chair.

I shall be glad if the information thus communicated bears in any degree on the points indicated by you as those on which the Commissioners desire opinion.

The Secretary of the Royal Commission
on Technical Education.

I have, &c.
JAMES YOUNG,
pp., F.G.T.

MEMORANDUM by the Secretary of the Trustees of the "YOUNG" CHAIR of
TECHNICAL CHEMISTRY, Glasgow.

The "Young" Chair was founded in 1870, by Mr. James Young, LL.D., F.R.S., of Kelly, for the promotion of all branches of Technical Chemistry. It was the first of its kind in Great Britain. During the last 12 years its object has been diligently pursued, and many students trained in the laboratory now occupy important situations in works and elsewhere, particularly those who were educated through the assistance of bursaries hereafter referred to. A note is appended of young men known to have passed from the instruction obtained in connection with the Chair to situations of importance.

The present Professor is Mr. Edmund J. Mills, P.Sc., F.R.S., who has occupied the Chair since 1875.

All the more important industries in connection with Glasgow and the district have been made the subject of special courses of lectures. During the last session sufficient success has been obtained in connexion with special subjects to warrant the formation of a Dyeing School, and Iron and Steel School, both of which are in active operation and well attended. The course of lectures for this session embrace the following subjects:—General course, bleaching, dyeing and printing, iron and steel, fuel, agriculture.

The work in the day laboratory has led to the publication of an extended series of investigations connected with chemical industry in various departments. Excerpts from the annual reports of the Professor for the past few years are also appended, which give details of the work thus done.

The total entrants to the day laboratory since the foundation of the Chair, almost all of whom attended during three sessions, has been 84. The entrants for the evening lectures, more recently introduced, have been much greater, numbering for the present session 130.

At an early stage in the work of the Chair a system was originated for providing bursaries for students. The object and terms of appointment may be gathered from the following excerpt from the printed syllabus.

"The Trustees of the 'Young' Chair have the superintendence of the bursaries, regulating the appointment and terms in which they shall continue to be held.

"The nominees of donors to be appointed if they pass the necessary examinations.

"The bursaries are of the amount of 50l. each per annum, tenable for three years, during which the bursars shall be required to give their

"whole time and attention to the lectures and laboratory duties of the 'Young' Chair, paying the ordinary fees. Candidates to have attained

"16 years of age on application, to be of good moral character, and to pass such examinations as may be prescribed by the Trustees in the

"ordinary branches of an English education and the elementary principles of chemistry. The bursaries to be liable to forfeiture on the bursars

"failing to exhibit approved progress under the Professor of the Chair, or being guilty of conduct, in the opinion of the Trustees, unworthy of

"their position. The bursaries are only given to those whose means are limited, and who intend following some branch of manufacturing

"chemistry."

The sum subscribed to the present date has been 2,795*l.*, and through this instrumentality 17 students have passed through the full curriculum of study, and four others to a partial extent.

This short memorandum is perhaps sufficient to show that the "Young" Chair as established has become a centre for investigation into many interesting problems of a practical kind, whilst care has been taken to connect the work with the most advanced ideas in chemical science.

The memorandum also shows that, although the number of students is not so great as we desire, there has been a good beginning made, and it is expected that when it is seen how much more readily situations are obtained by young men who have attended a practical course than by those who have attended to the theoretical only, a greater claim for instruction will be made on the institution.

It cannot, however, be denied that some of the best students have been able to attend only because of the bursaries which have been provided for them. The institution now called Anderson College was not intended for the wealthy, and Dr. Young wished to continue the habit of providing education for those who were not well able to provide for themselves. It would, therefore, be a great advantage to have permanent bursaries attached to the practical work of the "Young" Chair, and Dr. Young has invited the co-operation of the citizens of Glasgow for that purpose.

ALEX. MOORE,

Secretary to Trustees of the
Young Chair.

14th March 1883.

POTTERY AND GLASS.

No. 20.

Stourbridge Glass Works, Stourbridge,
February 15th, 1883.

DEAR SIR,

YOUR circular on Technical Instruction came duly to hand. We recently sent a few notes on this subject (with special reference to our local school of art) to Mr. Alfred Harris, who, we presume, is acting in concert with you on this important question.

We have pleasure in enclosing a copy of the above-mentioned notes as a reply to your circular.

We are, &c.

THOMAS WEBB & SONS,
per J. A. SERVICE.

Gilbert R. Redgrave, Esq.,
South Kensington Museum.

Copy.

Stourbridge School of Art has undoubtedly had some little influence upon the trade of the district, as evidenced by the fact that a many of the leading artists in this district had their earlier training there; but that its influence upon the glass trade direct has been what it was originally intended it should be, is very doubtful. In the first place, the masters not having a practical knowledge of the trade, cannot impart it to the student; his efforts, therefore, are confined to the simple rudiments of drawing, leaving the pupil to form his own ideas, or copy those of his fellow workman away from the school. Secondly, the examples at the school of art have not been selected with a view to specially assist the worker upon glass. The Science and Art Department from time to time have sent down examples on loan for the use of the students, but, beyond the Mulready's, I never recollect anything useful to the glass decorator coming down. I should imagine this is, in a great measure, owing to the fact that the gentlemen who form the committee of the Stourbridge School of Art are, with one exception, totally ignorant of the requirements

Appendix G. of the glass trade. After a student has passed the elementary stages, there is no inducement held out to him to attend the schools; there are no examples or models for him to copy which would be of use to him, and the school is then only a place of practice, with this disadvantage, that the bulk of the students connected with the glass trade live at such a distance from the school that to simply practice drawing they will not travel the distance.

I think, until the students can obtain more practical assistance from the department in the shape of loan objects of art, bearing upon the trade, together with lectures from time to time by competent lecturers, that there is very little hope of the school finding its way out of the Slough of Despond in which it has been floundering so long. To call it a school of design is a perfect farce. The bulk of the most successful students of the school have been connected with the glass trade, but their success is to be attributed more to their own skill and industry, and the genius and enterprise of their employers, than to any connexion with the school of art, which can only claim having taught them the rudiments of drawing.

The desire to produce pretty landscapes or handsome portraits seems to be encouraged too much to the exclusion of the more vigorous and practical style of drawing which is so essentially necessary in the training of the artisan.

Stourbridge Glass Works, Stourbridge,

February 15th, 1883.

DEAR SIR,

PRAY pardon the liberty I take in addressing you, but seeing from the circular addressed to my firm that you are desirous of obtaining information with reference to schools of art, &c., and having been connected with our local school for many years, I may be able to give you useful information, and for this purpose place myself at your command.

The Stourbridge School of Art may have, and would have, a great influence on the trade of the district if conducted in a proper manner. It is really pitiable to see what it has degenerated into of late. Within my knowledge the results have never been so poor as at the present time. A goodly portion of the work of training the younger students devolves upon the assistant master, and the majority of the most successful persons who have held this appointment have been artisans connected with the glass trade. Mr. John Northwood and Mr. Thomas Noodall, who are now, without a doubt, at the very top of their profession, being notable instances.

Men who would be of use at the school as assistant masters cannot afford to give the time and attention required for the miserable salary attached to the post. I myself held the position for two separate periods, devoting three nights per week (2½ hours each) to assistance at the school of art, besides giving instruction at three separate local schools in the daytime (necessitating my absence from my usual employ) for the handsome sum of 15*l.* per year.

I know there are several gentlemen on the local committee working very hard to keep the concern up, and I sincerely trust they will have such help from the department that their efforts may meet with success. I consider, with reference to the local committee, that it would be far better to have a few members, directly connected with the glass trade, men who would take an interest in the concern and assist in guiding it into the proper practical channel. I must plead my anxiety for the fate of our school as my excuse for troubling you with these few remarks.

I am, &c.

JOHN A. SERVICE.

Gilbert E. Redgrave, Esq.,
South Kensington Museum.

No. 21.

Appendix G.

Cauldon Place, Hanley, Stoke upon Trent,
February 16th, 1883.

DEAR SIR,

REPLYING to yours of the 8th instant, we beg to say that as china or earthenware manufacturers, we have shown our appreciation of art classes by supporting the Hanley School of Design by our contributions, and given every facility to our young people by paying their fees, &c. for making use of its advantages; but whilst in some cases this has been appreciated and made use of, in others it has not, and these have been in the majority.

We remain, &c.

N. H. BEARD.

Gilbert R. Redgrave, Esq.,
London.

For T. C. BROWN-WESTHEAD, MOORE & Co.

No. 22.

Glass Works, near Birmingham,
February 15th, 1883.

SIR,

In reply to your circular of the 8th inst., we regret to say that we are not in a position to afford you any information, because there are no classes of science and art or technical instruction near enough to our works to be available for the people in our employment.

We are, &c.

CHANCE BROS. & Co.

Gilbert R. Redgrave, Esq.,
South Kensington Museum,
London, S.W.

No. 23.

Whitefriars Glass Works, Temple Street, E.C.,
London, February 21st, 1883.

DEAR SIR,

In answer to your circular of the 8th February respecting technical instruction, we would say that, as far as we can judge with respect to students who come to us seeking employment as draughtsmen for stained glass, that the instruction they have received in drawing the figures is very good, but they have no practical knowledge of the art whatever, and are at a loss for some time in consequence. A little direction in their studies to this end would be very useful, and ample specimens are at hand in the museum for the purpose. Also all knowledge of the Gothic style seems to be ignored, and it is in this period of art that the grammar of stained glass is to be learned. Hoping this is the kind of information you require,

We remain, &c.

JAMES POWELL & SON,

p. J. C. P.

Gilbert R. Redgrave, Esq.

No. 24.

MEMORANDUM respecting ART SCHOOLS and TECHNICAL SCHOOLS in relation to the LAMBETH ART POTTERY.

In presenting this memorandum, it is to be remarked that the uninterrupted advance made by the Lambeth Art Pottery since its establishment has been to a very large extent due to the facilities afforded by the Lambeth School of Art in obtaining abundant supply of local talent trained in that school.

1st. The influences of the above classes on the work now carried on at Lambeth Art Pottery may be considered most satisfactory, and, provided that the intimate relations which now exist between the manufacturer and the school of art director are fully maintained, the outcome of the connection must continue healthy and vigorous as at present.

Appendix G. The art classes have enabled Messrs. Doulton to lay down a definite standard of proficiency for those employed in the art department, and to graduate their various employments according to the proficiency attained, as shown by the certificates obtained through South Kensington. Moreover, it has also allowed of a duplicate form of remuneration in many instances, based partly on examinations passed and partly on proficiency in execution. This has made it possible to bring the various treatments and methods more distinctly under art control than would otherwise have been the case.

The classes have further provided a very much larger supply of qualified assistants and artists than previously, so that at the present time the numbers applying are always much in excess of the demand.

The above remarks apply entirely to those definitely employed in the decorating and modelling department.

The number of workmen and foremen in the factories who have availed themselves of the classes is very limited.

2nd. The technical schools have perhaps hardly been at work sufficiently long to allow of a full estimate of their value. The designing classes, as well as the modelling classes, have been most useful in showing true principles of work, but it can hardly be expected that they should do more than this.

The design classes have especially been most satisfactory in their influence, and the life classes have rendered very valuable aid to those employed in the higher branches.

It is felt, however, that, unlike many other technical arts, the large proportion of the work carried on in the decorating department of the Lambeth Art Potteries is too entirely confined to manipulation peculiar to the Doulton specialities of art ware to allow of those employed in it being instructed in its details in technical schools.

The examinations and certificates do not in all cases indicate fully the qualifications of the worker, as many are found unable to pass who are in the highest degree valuable in their respective handicrafts. Moreover, in an establishment of such large extent, various moral qualities, rendering some suitable for control and supervision, and instruction of others, have also to be taken into consideration. The necessity for commencing very early in the technical training here in subordinate work to ensure deftness of hand, points to the need of special attention being devoted to the junior department of the art school, otherwise the technical knowledge outstrips the art training, and thereby hinders the development of the worker's ability. It will be seen that this is the more important, inasmuch as the terms of service of females are necessarily short, because a large proportion leave on attaining a marriageable age.

COTTON.

No. 25.

Anchor Mills, Paisley.

February 13th, 1883.

SIR,

It is extremely difficult to reply to your circular of the 8th, as our manufacture is very much routine, and the workpeople occupying much the position of skilled labourers, without much opportunity of exercising their knowledge, there are a few departments in which we should like to see some improvement, such as bleaching and dying, and should the Commissioners visit Paisley, we should be glad to see them.

There are no means in Paisley, for any workman desirous of improving himself, obtaining facilities for so doing, if we except the school of design.

We are, &c.

CLARK & Co.

Gilbert R. Bedgrave, Esq., Secretary,
Royal Commission on Technical Education,
South Kensington Museum, London, S.W.

No. 26.

Appendix G.

9 Bread Street, London, E.C.
February 16th, 1883.

SIR,
WITH reference to your inquiry in your communication of the 8th instant.—

"1st. As to the influence, on the industry in which you are engaged, of the science and art classes, and other sources of technical and general instruction, which are available to the workmen, foremen and employers of your district."

It is difficult to form precisely any estimate of such influence on our branch of industry and possibly much of the influence may not come directly to our notice, but undoubtedly many occupying leading positions in our employ owe their general competency to such advantages.

"2nd. As to any means whereby such instruction may be rendered more useful"

We find not unfrequently that persons possessing some theoretical information are untrained in its practical application. Anything in the way of a practical training would be a gain.

We are, &c.

The Secretary,
Royal Commission on Technical Instruction,
South Kensington Museum, S.W.

HORROCKSES, MILLER & Co.

No. 27.

Butler St. Mills, Manchester,
February 7th, 1883.

DEAR SIR,

In reply to your circular letter having reference to the influence of science and art teaching upon the industry in which we are engaged, viz., spinning and doubling of fine yarns.

Without any experience of technical school training, it is difficult to estimate results, but this we do know, that the most successful in our business are those who from early practical training became thoroughly acquainted with the working of machinery and the best application for ensuring the most economical working, coupled with the best results (in point of quality) from the material in process of working. Men otherwise ignorant are often the most successful and it too often happens that young men of education, without the practical training referred to fail in coming to the front.

No doubt technical instruction would be advantageous in the first instance, but we do not think any system of training would be at all equal to the practical knowledge acquired in a "cotton factory" and more particularly if the student is impressed with the conviction that a successful livelihood or otherwise is to be the result of his efforts.

We are, &c.

G. R. Redgrave, Esq.

SHAW, JARDINE & Co.

No. 28.

Bolton, March 3rd, 1873.

GENTLEMEN,

In reply to inquiries contained in your circular of the 8th ultimo, we beg to say:—

1st. That we regard the science and art classes carried on in Bolton, as having conferred incalculable benefits on the industries of the town and district, which are chiefly cotton and iron, and that we look to them principally for the improvement in general knowledge of our workmen and to fit them to become foremen.

We think that an extension of these classes in technical subjects, allowing more practical application, is highly desirable, and believe they would have a beneficial influence on our products and greatly add to the efficiency of our workmen.

Appendix G. Up to the last few years classes have only been held for teaching science and art subjects, but there are now in the town classes for teaching theoretically, technological subjects such as cotton, weaving, engineering and tools, all of which have been well attended, and we have found that many young men in our employ who have attended them have shown an increased desire to understand the working of the machines and materials on which they are engaged.

At present we have in our mills 49 young persons attending evening classes, and think this number would be greatly increased if technical classes were established bearing more directly on their daily work.

2nd. As we have before intimated, the instruction which is being given requires supplementing by more practical teaching to make it more useful. And having regard to the fact that evening classes are not self-supporting, and that their first establishment and continuance are dependent on voluntary effort, which is very unreliable, we would suggest that Government grants should be made to institutions carrying on technical classes to enable them to purchase machinery sufficient to teach the subjects practically as well as theoretically, or that schools especially adapted for the purpose and supported by public funds should be established in suitable districts.

We think the encouragement of more practical teaching would very greatly influence and improve our manufactures.

We are, &c.

For Crosses and Winkworth, Limited.

Royal Commission on Technical
Instruction.

W. H. BROWN.

WOOL AND WORSTED.

No. 29.

Ebley and Stanley Mills, Stroud.

February 14th, 1883.

SIR,

In reply to the inquiries of your circular of February 8th,—

1st. We think the present art and science classes are of little or no service to the woollen industry, in which we are engaged.

2nd. We think that classes for the study of mechanics, chemistry, and designing for weaving, at fees which would make them accessible to foremen, workmen, and their sons, would be of great advantage; but the instruction should be of a practical kind, and the students taught to experiment for themselves. If they have only to sit and listen, their attendance and their interest soon decline. A small laboratory in connexion with the chemistry classes would be a great attraction.

Technical instruction in chemistry and design was given in this district for two or three seasons, a few years ago, under the auspices of the Bristol College of Science, and in part defrayed by the liberality of the London Company of Clothworkers.

We are, &c.

G. Redgrave, Esq., Secretary,

Royal Commission on Technical Instruction.

MARLING & Co.

No. 30.

DEAR SIR,

Dewsbury, March 8th, 1883.

REPLYING to your favour of 8th February, respecting "Technical Instruction," and to which we have not previously given a reply, in consequence of pressure of business,—

1st. We believe the science and art classes have a very beneficial effect upon the industry in which we are engaged, but we find that workmen or foremen employed in our various departments do not avail

themselves of the advantages offered by these classes to the extent desired, one reason probably being the lack of satisfactory schools in our town, as compared with neighbouring ones, and the cost of periodically visiting, such places as Bradford, Leeds, or Huddersfield, being more than workmen feel justified in spending during the present depressed times.

2nd. Instruction could only be rendered more useful in our town by erection of suitable premises, but in our humble opinion greater interest would be taken in technical education by the working classes, could protection be granted to the various industries upon which so many of our countrymen depend for a livelihood. The want of bare necessities for life in some parts almost forbid a working man thinking of "science."

We are, &c.

Gilbert R. Redgrave, Esq., Secretary, B. HEFORTH & SONS.
South Kensington Museum, London, S.W.

FLAX, HEMP, &c.

No. 31.

The Old Park Printing Company (Limited),
Old Park, Belfast, February 15th, 1883.

SIR, I HAVE received your circular of February 8th, addressed to Messrs. Wm. Girdwood & Co., the predecessors of the present firm.

At present there are only the classes held in the Working Mens' Institute and the school of design, available for workmen and foremen, both of which classes have been a great assistance to many of our employes attending them.

In regard to the means "whereby such instruction may be rendered more useful," I would suggest the establishment of a good technical museum, attached to which there might be, with advantage, a good chemical laboratory.

I am, &c.

Gilbert R. Redgrave, Esq., Secretary,
Royal Commission on Technical Instruction. J. K. GIRDWOOD.

No. 32.

Belfast, February 12th, 1883.

SIR, In reply to your circular of the 8th inst. I do not think that the linen trade of the north of Ireland would be benefited by technical schools, as this trade has been brought to such perfection that it holds the first place in the world for the production of linen fabrics. It follows that there is little likelihood of the linen trade being much benefited by any teaching to be had in a school, which would obtain the most part of its information from the manufacturers in its neighbourhood. Again, if these schools are open to all comers, they would be injurious to the linen trade, as it is most probable that many students would come from the Continent to learn our mode of manufacturing. Hitherto we have generously taught young men from other countries how we made and bleached our goods, and we are now suffering for so doing by having raised successful opponents in the countries from whence they came, who have displaced our manufactures with those of their own production, and beside have interfered with us in those countries where our goods were the only goods in use.

It may be that technical schools would introduce other manufactures of other fabrics; if so, this would be of service, as we should not have to depend entirely on one trade as we are doing at present, but as I am very ignorant of the working of these schools, I cannot give a reliable opinion as to their desirability. However, I mean to make myself acquainted

Appendix G. with their working, and if I find them desirable will support one that is about to be established in Belfast.

There is no doubt that science and art classes could be made very useful for designing ornamental work, but the Kensington folk do not encourage that class of designing, and, as a matter of course, the students in the Government school of art in Belfast do not care about devoting their time to a study that is not likely to obtain a prize.

Mr. Gilbert R. Redgrave,
South Kensington Museum, London.

Yours, &c.
JOHN S. BROWN.

SILK, &c.

No. 33.

14, Great Bridgewater Street, Manchester.
February 20th, 1883.

SIR, In reply to your circular of the 8th inst., I beg to observe that, as regards my own trade, technical instruction in the manufacture is likely to be of much greater service than instruction in design.

I am not able to offer any suggestion as to means for rendering such instruction more useful; the chief obstacle consists in the lukewarmness and indifference of those employed.

Your letter being misdirected did not arrive in due course.

I have, &c.
THOS. CHADWICK.

No. 34.

22, William Street, Dublin,
February 27th, 1883.

SIR, In reply to your circular of 8th inst., in reference to technical instruction, we have to say—

1st. The only instruction now given in Dublin that affects our manufacture, so far as we know, is the Royal Dublin Society's School of Design. Unfortunately the demand for designs for our goods is not sufficient to make the local school of design of much moment to us. As a rule we find it more to our advantage to get our designs in England and France, from persons who not only supply the drawings but also the cards for the Jacquard machines.

2nd. Technical instruction in the mounting of looms, and in actual weaving, would be of advantage, but the trades union of silk weavers here, would, we fear, consider this an attempt to break down or set aside their apprenticeship system, and would therefore oppose it and do all they could to prevent young men from taking advantage of such instruction.

Gilbert R. Redgrave, Esq. We are, &c.
PIM, BROTHERS & Co.

ELASTIC WEB.

No. 35.

SIR, Coventry, February 15th, 1883.
In reply to your circular of 8th instant, I have the honour to inform you that in Coventry we have at present no classes for subjects having a direct influence upon our trade, which may for your purposes be taken as an ordinary textile trade. The science classes do not at present take up any subjects bearing directly on weaving or machinery, though it is

intended to take up some of those subjects next winter. Our trade (elastic webs for boots) is too plain for art classes to be any use to us. I fear that one great obstacle to the means at present at our disposal being of great use is the lack of interest in such classes among the working classes. At the commencement of the present session I (being secretary to the science classes) offered to pay all fees for any of our employes who would join the classes, and only got one youth (a clerk) to join out of about 200 male and 100 female hands. I fear no great result will be gained unless either Parliament or employers insist upon youths, say, up to 18 years of age attending some evening class. A difficulty we find in trying to start technical classes in connexion with the City and Guilds of London Institute is the providing competent teachers. All the best men are actively engaged all day, and are earning enough to be unwilling to undertake evening classes in addition. Any further information that I can give or get is at your disposal at any time.

Appendix G.

Yours, &c.

JOSEPH C. ODELL,
Managing Director.

G. S. Redgrave, Esq.

HOSIERY.

No. 36.

Station Street, Nottingham,
February 12th, 1883.

SIR,

YOUR circular of 8th instant has had my attention, and, in reply to your first question, I have been unable to discover, after careful observation and inquiry, that the science and art classes, or the other means for conveying general instruction, have tended in any perceptible degree to increase the intelligence of the workmen, foremen, and employers engaged in the hosiery business. As far as my experience goes, the workpeople treat with indifference invitations to attend the classes and lectures at our University Buildings (erected two or three years ago at enormous expense, in the hope of promoting and extending the benefits of education among all classes). At first curiosity was excited, but much of the interest then felt seems to be gradually passing away. In fact, only a few youths here and there seem eager to avail themselves of the opportunities afforded at such institutions.

This reply to your first question will prepare you for my opinion in regard to the second. I have asked young fellows whose advancement in social position has been the outcome of a desire to obtain information, and the replies have been somewhat as follows:—"I once in my eagerness imagined that I was held back from learning, but I soon found that I could obtain all I wanted; and now that I have become a master I find I cannot drive into the heads of the young people the idea that they would gain anything by seeking theoretical and 'book-knowledge.' They seem convinced that the best technical knowledge is to be had in the workshop, and there is much truth in this for the majority. As to the technical schools abroad, let us judge by results. Which is the most intelligent workman? Why, an Englishman or an American. And what countries produce the best machinery? Why, England and America."

I add that managers of factories, &c., confirm this statement, and at the same time direct attention to the fact that technical knowledge is likely to deteriorate, inasmuch as the old form of apprenticeship to a trade is disappearing, owing to the restrictions imposed by trades unions, and also to the fact that parents require that their children shall be free to accept the highest remuneration obtainable in any trade.

There is no doubt that in the lace business (one of the local industries) it is essential that every facility be afforded for growth in the art of designing, and without question the Nottingham School of Design has

666 ROYAL COMMISSION ON TECHNICAL INSTRUCTION :

Appendix G. done excellent work in that direction, while manufacturers are fully aware of the advisability of increasing its resources and power for good.

I am, &c.

For the NOTTINGHAM MANUFACTURING COMPANY, Limited,

W. J. HENLOP,
Managing Director.

To Gilbert R. Redgrave, Esq., Secretary,
Royal Commission on Technical Instruction,
South Kensington Museum, London.

LACE.

No. 37.

GENTLEMEN, Nottingham, 1883.

In reply to your circular with questions as to the influence of the science and art classes on our industry, we are not so well placed to give you information as many of the houses in our town, but can briefly answer you as follows:—

1st. The influence of the classes is decidedly good, and the science classes are very well attended.

2nd. In order to render such instruction still more useful (and this refers particularly to the art classes), men should be chosen as instructors who are *practical* as well as artistic, and who could teach *designing* as well as painting.

Means should also be taken to bring *clearly* to the notice of workmen, by means of advertisements, &c., that they can obtain such valuable information at so low a price. At present many workmen who actually know of such classes are too apathetic to inquire as to means of availing themselves of the above.

We are, &c.

For EDWARD STEEGMANN & Co., Limited,

E. H. STEEGMANN, Director.

The Royal Commission on Technical Instruction,
South Kensington Museum, London, S.W.

CARPETS.

No. 38.

SIR, Kidderminster, February 12th, 1883.

In reply to your inquiry respecting the influence of technical and other schools on the efficiency of workmen, foremen, and others engaged in our principal industries, we beg to say,—

1st. That we have an excellent school of art, which has proved of great use in assisting to raise efficient draughtsmen and designers for our principal industry in this town, viz., the manufacture of carpets, whereas some years back we were compelled to go to France and Germany for designs, we are now practically independent of other countries as far as carpet designing is concerned.

2nd. We much need a school for the teaching of chemistry as applied to the colouring of worsted and other yarns; our dyers generally know very little of chemistry, and work only by rules which are handed down from one to another; they get results without knowing the reason why; there is much waste, which a thorough knowledge of chemistry might save; it would be a great boon to the next generation to have such a school established here.

With that should also be established a school for the teaching of practical mechanics; our weavers and foremen would be more valuable if they had such teaching.

A class for teaching the weaving of different textile fabrics would be invaluable in Kidderminster; we have ample opportunity to start any kind of industry here, but we have great ignorance to contend with; the establishment of a technical school would be of immense advantage to the rising generation, and would add to the prosperity of the town.

We shall be at all times pleased to answer any questions you may put to us to the best of our ability.

We remain, &c.

Gilbert R. Redgrave, Esq.,
South Kensington Museum,
London, S.W.

JAMES HUMPHRIES & SONS.

No. 39.

31 to 45, Gresham Street, and
108 to 110, Wood Street, London, E.C.,
February 15th, 1883.

SIR,

In reply to your circular asking our opinion as to the influence of the science and art classes upon the industry in which we are engaged, we cannot do better than enclose you the report of the distribution of prizes at the Kidderminster School of Art, wherein you will find our views fully stated. As regards our speciality, carpets, the influence of art classes in raising the style of design and workmanship cannot be too fully appreciated and encouraged.

We are, &c.

G. R. Redgrave, Esq.,
Royal Commission on Technical Instruction.

per pro THOMAS TAPLING & Co.,
VICTOR L. TAPLING.

"Mr. JOHN BRINTON, M.P., the Chairman, in moving the adoption of the report, remarked that all the supporters of the school would be gratified to know that the quality of the work done at the school was equal to any hitherto sent up to the Department, while the number of works forwarded was in excess of any previously despatched. The quality of the awards was also particularly worthy of notice. They had this year gained a gold medal—(applause)—also two bronze medals; while the gold medalist also had the distinction of winning the bronze medal in the Owen Jones competition—(cheers). He begged to congratulate the gold medalist upon his success, and upon the very excellent character of the work which he had exhibited. He never saw such a high quality of work produced, and it not only reflected great credit upon Mr. Mein, but also upon the town. He could not help adverting to the success of the feature which was introduced last year for the first time, that of giving free studentships in the school of art to the various elementary schools in the town who chose to take advantage of the offer. Seven of the schools responded to the proposal, and no less than 16 youths were admitted as free students, and were now partaking of all the advantages which that important institution afforded. Out of that number several had obtained employment, and had begun a successful career in the studios of designers and manufacturers in the town. He felt that that experiment could be regarded as eminently successful; the object of the committee being to give every facility for the accommodation of the boys of those parents who found it sometimes even difficult to pay the school pence, and who wished their sons to improve themselves in that art culture in which they had shown so great an interest.

No. 40.

William Street, Greenhead, Glasgow,
February 12th, 1883.

DEAR SIR,

In reply to your letter of the 8th instant, we beg to say in reply the first question that we consider the art classes or school of design to

Appendix G. be of great use for the purposes of our manufacture, but we attach no value whatever to weaving classes or other similar technical instruction. As to the second question, we have no suggestions to offer.

Yours, &c.

Gilbert E. Redgrave, Esq.,
South Kensington Museum, London.

JAS. TEMPLETON & Co.,
J. & J. S. TEMPLETON.

PAPER HANGING.

No. 41.

Belgrave Mills, Darwen, Lancashire,
March 7th, 1883.

SIR,

By oversight we neglected an earlier reply to your circular of 8th ultimo. Please pardon the delay.

In reply to your two inquiries, we beg to say:—

1st. That the establishment of science and art classes has not materially affected the status of our workpeople; in our vicinity their career has been too short and their scope too limited for the effect to be very marked, but we do of course observe among the younger people signs that the meagre efforts are not without fruit.

Where, however, we do observe a great alteration, is in two directions; how this alteration arises you may be able to judge and say how far the credit belongs to science and art classes.

The first is a marked improvement in the taste of the masses, shown in the rapid rise in demand for our goods in chaste colourings and artistic forms and a corresponding decrease in the sale of those crude colourings and forms which formed a few years ago almost the entire demand in the cheap classes of paper-hangings.

The second and still more remarkable alteration we observe is in the status and skill of English designers. Whereas a few years ago we were unable to procure, except from abroad, anything but the most limited range of designs, and these, from their want of merit, of a cheap and indifferent type, we now find a large class of men whose training, skill, and grasp, cause their designs to be valuable in a merely marketable sense, but not less valuable as giving impetus to the improvement in the public taste which we have already named.

Our disbursements to English and foreign designers have in consequence completely reversed their former proportions.

We shall be glad at any time to give you any further information you may desire, and as to the future we can only indicate that in our opinion the education given in the art classes should go in the direction of practical application of theory to the reproduction of decorative objects and effects in all classes of production, and with some special attention to local industries so that the pupils may learn some idea how to apply their skill to their trades.

Gilbert E. Redgrave, Esq.,
South Kensington Museum,
London, S.W.

Yours, &c.

p.p. C. & J. G. POTTER.
H. S.

No. 42.

64, Essex Road, Islington, London, N.,
February 18th, 1883.

SIR,

In reply to your circular of February 8th, we do not consider that our workmen derive benefit from the science and art classes, and hardly see how any technical instruction will help them. We find that our best workmen are those who have worked in our shops from young lads.

Yours, &c.

G. E. Redgrave, Esq.

JERRARDS & Co.

FURNITURE.

Appendix G.

No. 43.

406, Oxford Street, London, W.,

February 21st, 1883.

DEAR SIR,

WE have the pleasure of sending enclosed memorandum in answer to your inquiry of the 8th instant.

Yours, &c.

Gilbert R. Redgrave, Esq.

GILLOW & Co.

MEMORANDUM.

Our business is divided into the following branches, and we indicate opposite each the kind of teaching specially required in it:—

- | | |
|---------------------------------------|--|
| 1. Cabinet and chair making. | Principles of construction and form. |
| 2. Carving. | Drawing, modelling, and knowledge of the various styles. |
| 3. Marquetry. | Design and harmony of colour. |
| 4. Painting, decorating, and gilding. | In the two former, drawing in various styles, and harmony of colour. |
| 5. Upholstery. | Form and harmony of colour. |

At present the only sources of information in our district are:—1st. The designs by artists for works to be made; 2ndly. Workshops where the teaching is practical, but not very systematic; and, 3rdly. The West London School of Art, where no serious attempt has yet been made to adequately teach either styles, harmony of colour in decoration, or drawing applied to actual manufactures.

We find it comparatively easy to make good workmen in what is purely mechanical, but when knowledge of form, style, or colour is wanted, the number who are found efficient is very limited, and their work has to be produced under direct and expensive artistic supervision.

Answering the second question, we feel sure that the technical education of English workmen would be greatly promoted:—

1. By providing in all public schools trained teachers to prepare the children for higher instruction in art classes when they are older.
2. Increasing largely the number of schools of design in London, and giving, at nominal fees, instruction in applied art by competent teachers.
3. Supplying London with, say, four additional technical museums, and sending to them *all duplicates* from South Kensington, together with good models of woodwork, ironwork, electro-plate, pottery, jewellery, &c.
4. Opening all national museums and galleries after 1 p.m. on *Sundays*.
5. Giving in museums, board school premises, public offices, and manufactories, free illustrated lectures upon applied art, to workmen and others, at night, tickets being sent to their clubs, societies, and employers for distribution.
6. Establishing free libraries of technical works at all the museums, and having these open every day and evening.

GILLOW & Co.

No. 44.

Halkin Street West, Belgrave Square,
and 15, Parliament Street, Westminster, S.W.,
London, February 13th, 1883.

SIR,

In reply to your inquiry, we beg to say that—

1st. We believe the influence of the art classes has been beneficial to those of our employees engaged in design, but for the working classes

Appendix G. they have done but little as yet, we find, however, they are attending these classes in considerable numbers, and we hope for the best.

2nd. We have not sufficient information of the working of the classes to express an opinion.

We have, &c.
GEO. TROLLOPE & SONS.

To the Secretary of the
Royal Commission on Technical Instruction.

No. 45.

Police Street, Manchester,
February 21st, 1883.

SIR,
1st. There is no doubt that technical classes, if diligently attended by our workmen, would have a considerable influence in a few year's time.

2nd. The classes should be free to artisans, as in many instances when an apprentice is willing to study, the fees make it prohibitory. Their parents are invariably of the artisan class themselves, and it is frequently a sacrifice on their part to place their sons in a trade which brings them in such small wages during their long apprenticeship, so that they have little to spare for school fees.

It might be part of the agreement with an apprentice that he should attend a technical class on certain evenings in the week. At the end of a term his employers, by applying at the school, might receive a return of his attendance.

No modelling class has been properly formed in Manchester. Pupils have been invited to give in their names at the school of art, but only two or three responded.

Such a class we have no doubt would be of great value to the cabinet and kindred trades.

Gilbert Redgrave, Esq.

We are, &c.
KENDAL, MILNE & CO.

No. 46.

109, Fleet Street, and 3, St. Bride Street,
London, E.C., February 12th, 1883.

DEAR SIR,

We have many branches in our business:

Wood and marble carving.
Modelling in clay.
Designing for textiles and paper-hangings.
Decorations generally.
Fine cabinet work.
" metal work.

For each of these branches the practice of drawing and designing and a knowledge of form are of the utmost value.

We are unaware of the technical instruction that may be had in your classes, but we are very confident that all technical instruction is of the greatest help to young artisans, and we should be delighted to see it much more widespread than it is now.

Gilbert R. Redgrave, Esq.,
South Kensington Museum.

We have, &c.
COLLISON & LOCK.

HOUSE DECORATIONS.

Appendix G.

No. 47.

38, Wigmore Street, W.,

February 12th, 1883.

SIR,

In reply to your letter dated the 8th instant, making inquiry as to the influence of the existing science and art classes, available in this district, upon the industry in which I am engaged (interior decorations in its various branches), I have to state my opinion as follows:—

1. Although a general advance has been made during the last 30 years both in the taste of the public demand, and in the design of objects produced, there is still a lamentable want of sound technical knowledge of the principles and practice of decorative art; particularly as applied to decorative painting.

The advance made is probably due to several causes:—

1. The opportunity of comparison afforded by International exhibitions, and by the increased facilities for foreign trade and travel.

2ndly. The establishment of museums, and the exhibition of collections of applied art.

3rdly. The establishment of the science and art classes.

4thly. The influence of a few earnest and enterprising artists and employers.

The weak point in the advance is that it is not accompanied by any extended knowledge of art, nor by such a sound knowledge of style as to facilitate healthy criticism, nor in the case of "decorative painting" is it accompanied by any advance in technical facility of execution. It is almost impossible to find a student in the schools of art with any competent knowledge of how to paint ornament for interior decoration, nor have the masters and teachers themselves the knowledge requisite for instructing them.

In the schools of art the masters are interested in the encouragement of those studies which secure prizes or grants. The present tendency of the departmental system is to encourage the preparation of *prize winning* drawings, or other works, often at great sacrifice of time. Still, life painting receives too much attention and reward. There is a general want of training in rapid freehand drawing of ornament on a large scale.

2. As to the means of rendering the schools of art more useful:

a. The schools should be kept more closely to their original purpose as schools of design; less encouragement should be given to the special preparation of laboured prize drawings, and the most valuable awards should be made on a student's *collective work for the year*.

b. All departmental prizes should be such as to assist an earnest student in prosecuting his work, not such as to encourage the vanity of dilettante students.

c. The number of petty prizes should be diminished, and local scholarships and travelling studentships multiplied, the local scholarships should be attainable in the several grades; and the higher grade prizes should be open to those students only who show proficiency in the *application of art to decorative purposes*.

d. It would not at once be possible, but I would look forward to the time when it should be the necessary qualification of any head master of more than 100 students, that he should have taken a travelling studentship and spent not less than three months in the study of decorative art abroad.

I entertain the strongest convictions (one which is shared largely by the principal employers of art workmen in London), that the present system in work in the various "schools of art" connected with the department, requires extensive remodelling before it can render any real help of importance to art workmen or their employers.

The Secretary,
Royal Commission on Technical Education.

I have, &c.
JOHN G. CRACE.

ART METAL WORKS.

No. 48.

156, New Bond Street, London, W.,
February 15th, 1883.

DEAR SIR,

We are favoured with the circular of the Royal Commission on Technical Instruction, dated 8th instant, and in reply to the two inquiries put forward therein, beg to say that as regards the first, in our opinion the influence of science and art classes on our artizans is of the highest value, for it develops ideas of conception and taste that would otherwise lie dormant, and raises the workman above the mere mechanical drudgery of his employment. We believe the same influence awakens a desire to cultivate refinement in the execution of his work, a sentiment that might have been lost but for the exterior educational aid of the classes.

It appears to us that, with the present facilities, an apprentice has a higher aim than formerly.

In past years, he was content, as the result of serving his time, to have acquitted himself to his master's satisfaction, and to have become a steady journeyman. Now he has the opportunity, with the aid of technical instruction, to become a highly skilled workman or even a great artist.

With regard to the second question, we think the simplest method of extending the influence of the art classes would be to throw open for free admission on Sundays and holidays, every museum in town and country, so as to give the workman the chance of self education, without the sacrifice of his time, which to him is loss of capital.

To Gilbert E. Redgrave, Esq.,
South Kensington Museum, S.W.

We remain, &c.
HUNT & ROSEKELL.

No. 49.

Great Hampton Street, Birmingham,
February 15th, 1883.

DEAR SIR,

In reply to your inquiry No. 1, we would say,—

That so far as the influences of the science and art classes have reached our works, they have been beneficial, but we must wait for the next generation before the full improvement can be secured.

No. 2. Our town is already working on lines which are most likely to succeed, viz. :—

The science and art classes in connection with the board schools for the boys.

The school of art belonging to the Midland Institute for the youths.

And soon we hope Mason College will add the fine arts to its classes for the young men and women.

This will, we believe, place our town in as good a position as we can see our way to, at present.

But to make good workmen requires more than simply a knowledge of the fine arts.

We remain, &c.
G. R. Redgrave, Esq. T. WILKINSON & SONS.

No. 50.

260, 262, 264, Enston Road, London, N.W.,
February 14th, 1883.

SIR,

In reference to circular of the 8th instant, our experience of the drawing schools is that they are very useful, as far as they go, but to be really useful to *mechanics*, the people that ought to be taught there, the teaching wants to be more practical, such as geometrical drawings, architectural plans, and section drawing from actual objects to different scales.

Of course the great difficulty is to get workmen to go the schools at all. Appendix G.

G. R. Redgrave, Esq.,
South Kensington Museum, S.W.

Yours, &c.
JONES & WILLIS.

No. 51.

37, Ludgate Hill, London, E.C.,

February 22nd, 1883.

SIR,

In reply to your inquiry under the date of the 8th instant, respecting technical education in Government schools (Government art and science classes); first, we are of opinion that these schools have had from the beginning a very beneficial effect upon the foremen and workmen in our district, and that the amount of benefit that is accruing to the trade is increasing year by year, as the men who were old scholars are more intelligent and artistic workpeople, their influence has a corresponding effect upon their apprentices, and induces them to send them to the schools. These scholars having more intelligent men to work under, and being instructed in the rules of art by efficient masters, where a really fine collection of drawings and models are to be seen and used, cannot but be of service to a manufacturing town like Sheffield. We can say without hesitation, that the school of art at Sheffield has made a great impression not only in the work that is sent out of the town, but even upon work at South Kensington Museum, for instance, Godfrey, Sykes, and Stevens, and we think it would not be a wise thing to allow the Board Schools to take the wind out of the sails of the South Kensington Schools. We asked some of our leading designers if they thought it would be advisable to close our schools of art and leave the thing in the hands of the Board Schools. They were very firm in their reply, and said they hoped such a thing never would happen. We trust, therefore, the Government will firmly stand by the schools of art, as our opinion is that art instruction has by no means reached the important and high position that it is destined to occupy.

We hope they will not lose sight of this, but that they will uphold the schools in order to aid the nation to hold its own against foreign competition.

Second. We have nothing to suggest as to any means whereby such instructions will be rendered more useful. We have only to observe, we think that until recently (since the appointment with the present headmaster) the youngest scholars had not sufficient attention from the masters of the school, and the efficient ones had more than was necessary. If young scholars do not receive sufficient attention they become sick of the thing, and leave sooner than they otherwise would do.

We have, &c.

JAMES DIXON & SONS.

Gilbert R. Redgrave, Esq., Secretary,
South Kensington Museum.

CARRIAGES.

No. 52.

113, Victoria Street, London, S.W.,

February 22nd, 1883.

SIR,

REPLYING to your favour of February 8th:—

The existing schools of science and art have had a considerable influence on certain manufactures to which they ministered, and for which they prepared students, in many cases with much success, pottery, china, lace, cotton-printing, wall papers, metal casting, carpets, gas fittings, &c., glass engraving, book illustrations and binding, furniture, tiles, terracotta, &c. &c.

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Appendix G. There are other trades on which they exercised scarcely any appreciable influence; among these, is the manufacture of carriages.

This may probably be accounted for by reason of the excessive intricacy of the work, partly mechanical, partly artistic, and much besides, neither one nor the other to any great extent; but requiring skill by practice, knowledge of materials by experience, and general arrangements by observation of the effects produced in practice.

The past and present teachers have probably done their best where they found they could apply their teaching readily, and where the goods to be ornamented (to a certain extent) invited their aid without the necessity of a long previous training or apprenticeship; but where the finished goods are extremely intricate and difficult of production (the parts being so extremely inter-dependent), it seems to have been thought useless to undergo this training in order to invent and found a correct system of teaching to meet the wants of the manufacturer. The difficulty is increased by the number of entirely distinct trades carried on in the carriage manufactories.

The difficulties have been in a great measure overcome in Paris (as regards the carriage manufacture), by reversing the procedure.

Thus, the practical foremen and workmen studied art and science, and applied them to their wants in their own way; they afterwards undertook to teach others, they themselves advancing in knowledge by the necessity of study, to enable them to hold their position above the level of those they taught.

They required a great deal of energy, enthusiasm, economy, industry, tact, and perseverance; they obtained support among their fellow workmen, and from traders in the French provinces and foreign countries, the employers in Paris bestowing little notice on the work going on in their midst for many years.

The founder and organiser of the work exhibited his plans in the Paris Exhibition of 1867, and obtained a bronze medal. He again appeared in the lists in 1878. In the meantime his labours had become more appreciated, and he was awarded a gold medal.

The time came when the employers could no longer leave the system to fight its way unnoticed, and the Syndical Chamber of Carriage Manufacturers in Paris took up the matter and placed it on a more permanent footing.

Of all the manufacturers of Paris, few, if any, have made such great strides as the carriage manufacture, both as regards improvement and expansion.

A member of our firm long ago in his jury reports foretold the extension of this Paris industry, by reason of the skill and energy of many of those employed in it, and its capability of standing and extending without a heavy protective duty to support it artificially. It has long since developed, and has successfully competed with British carriages in many foreign markets, carrying off much of the trade formerly done by English makers.

A similar method of teaching has been carried on for nearly seven years at St. Mark's Drawing and Technical Classes for Coachmakers in London. In addition, pupils have been taught free-hand drawing, geometry, perspective, and been prepared for the technical examinations of the "City and Guilds of London Institute," with some success.

For seven years a member of our firm conducted the examinations in carriage technology for the Society of Arts, and has been Chairman of the St. Mark's classes since their foundation. He also holds the office of President of the Institute of British Carriage Manufacturers, founded to promote and improve the carriage manufacture in this country.

We venture to suggest that the Science and Art Department should (for a time at least) employ some clever organising agents, who should first draw up (with the assistance of manufacturers) a list of manufacturers to which science and art training would be an advantage; invite leading employers, foremen, and workmen to a meeting, and explain the objects of the Science and Art Department; invite their sympathy and aid, form committees for management, arrange a prize list, enter names of students, appoint teachers, and periodically visit the classes.

It was found an advantage to invite intelligent foremen and workmen to act on the committee of management of St. Mark's classes. Much of their success was due to the enthusiasm, energy, and tact of these members, who have shown their appreciation of the classes by their perseverance in aiding the work, and inducing suitable students to attend them. Appendix G.

Gilbert R. Redgrave, Esq.

We have, &c.
HOOPER & CO.

No. 53.

Carriage Manufactory, 311, Oxford Street, W.,

February 15th, 1883.

SIR,

In reply to your communication from the Royal Commission of Technical Instruction of the 8th instant, we beg to say as nearly all the workmen engaged in the body and carriage department have been in the employ of the firm some years, and are experienced men, they have not felt the effects of the science and art classes, but no doubt younger men have; and we consider the trade will eventually be benefited by the said classes.

Gilbert R. Redgrave, Esq., Secretary,
Royal Commission on Technical Instruction,
South Kensington Museum.

We are, &c.
LAURIE & MARNER.

No. 54.

Worcester, and

45, Park Lane, Piccadilly, London,

February 15th, 1883.

SIR,

In reply to your inquiries on behalf of the Royal Commission on Technical Education, we are very glad to find that so much attention is being given to the extension of science and art classes in various towns of the United Kingdom.

We find the Art School of Worcester very helpful to our apprentices, a fair proportion of whom attend its classes; our firm offering special inducements with a view to increasing the number who do so.

It will not be needful for us to point out how needful a knowledge of drawing is to workmen in the various branches of our business, where so much depends upon beauty, and accuracy of form, and good taste in the use of curved lines.

Up to the present time, Worcester has not had the advantage of a science school. The want of this has been much felt. We believe that such classes would enable any of our workpeople who attended them to take a more intelligent interest in their employment, especially those who are engaged in the manipulation of steel and iron, to whom a knowledge of metallurgy would be an advantage.

Or in the use of colours and varnish, for which a knowledge of chemistry and atmospheric influences would be helpful.

A knowledge of electricity as a medium for signals, and also as a motive power, is also required, and this want we have already felt.

In addition to these, there are questions of weight, strength, and draught, most important in carriage building, and for the solution of which scientific training is greatly needed.

G. R. Redgrave, Esq.

We are, &c.
McNAUGHT & SMITH.

Few trades or industries have greater need of technical education than carriage building, principally because it consists of a number of different parts which must work together in relative proportion and harmony, to suite the requirements and taste of a luxurious and scrutinizing people.

Again, it is an absolute necessity that, in addition to beauty, whereby the cultivated eye is gratified, there must be durability and strength. For what workmanship is so exposed to wear and tear as that of the operative carriage builder, be it the woodman, smith, painter, or trimmer, each in his branch must study "durability," namely, the atmospheric influence on all smooth and polished surfaces, on joints, mitres, and timber in general, on silk, cloth, carpet, and all dyed materials for the interior of carriages, which are more or less exposed to the air of a damp and trying climate.

Next is the continual resistance and variation in roads a carriage with when in motion. This must be overcome without perceivable friction or strain to light parts, and at the same time prevent jolting to occupants.

Should this not be accomplished, the carriage is no longer a luxury.

A few far-seeing men of our trade have, for some years past, seen the growing necessity of technical education for coach artificers, that the coach-building trade of England might withstand foreign competition for taste and design. At the same time they have watched with jealous eye the progress made by other nations in that respect.

It has been my good fortune to have learnt my trade under the employ of one who may be called the pioneer of technical education for carriage building, and to this circumstance I owe a great deal.

When I first joined the trade as coach body-maker in 1875, Messrs. Hooper pointed out the great necessity of drawing, in order to produce good designs for carriages.

Acting upon this, I attended classes for drawing, geometry, and perspective, where I gained an elementary knowledge in these subjects, but to no great advantage could I apply them to my trade, until, in 1879, I was sent by the firm of Hooper & Co. to M. Dupont's technical school in Paris, where I found the missing link between the art class and workshop, which had been so long sought for by the intelligent workmen of our trade.

On first arriving in Paris I was at a disadvantage, possessing only a scanty knowledge of French, which I had learnt in evening classes; however, in a few weeks I understood my instructor, who first set me to draw side elevations of different coach bodies, then I was taught how to get the plans, with all the necessary angles, lengths, and widths, which previously had troubled me in the workshop, as every workman had his own particular way of setting his work out.

After passing one month in the elements of carriage drafting, I went through a number of lessons in placing the under-carriage under the body, namely, the necessary provision for locking or turning of fore-carriage without touching the body, next how to regulate the height of body from ground, then in fixing hind carriage to prevent wheels touching door when open, also the general proportion given for the various parts of under-carriages of different size and shape.

Having learnt the general rules which govern the designing of carriages, students are allowed to design carriages after their own taste, which are corrected by the principal, who is a practical man, and has worked at the bench as body-maker, therefore possessing both a practical and theoretical knowledge of carriage-making.

Students that are learning for the practical part of the trade, are taught to apply their drawings to practice in the school-workshop, where various parts of carriages are got out in the wood by a geometrical system.

It is here I first saw the benefit of geometry to my trade, both for the saving of time and the precise manner in which the work may be done.

This school can only accommodate six students at a time, but its fame is known throughout Europe. During the six months I spent there I had

as fellow students young coachmakers from Russia, Austria, and Spain, showing how keenly alive are foreign coachmakers to the advantages of the teaching of this comparatively small school.

The coachmakers of Paris are greatly indebted to this school, for it has been the means of setting new fashions, in introducing new shapes and lines to carriages, which are continually looked for by the carriage-riding public.

The French have then been the first to see the necessity of educating young men in the theoretical part of their trade, in order to produce light and elegant carriages.

Looking at each branch of our trade separately, one may see where the workmen might apply a knowledge of technical education appertaining to his trade, and so master many of the present difficulties which arise from want of sound principles to work upon.

The woodman must attain a knowledge of the strains his work will meet, and so provide against them accordingly, otherwise the occupants of carriages would be continually in danger. To do this he must first be acquainted with the nature and properties of various woods used by him. Then it is essential that he should possess some knowledge of geometry, either by scientific training or, as it is more often attained, by long experience in his trade. It is well known that not only does strength of his work depend on the quality of the timber used, but rests even more on the precision with which it is put together, and it is in this the good workman distinguishes himself. Thus we find that one man provides the brains for several others, who work under his responsibility, and it is well to mention that these positions are only gained by those who have spent many years in their craft.

The smith must acquire a knowledge of iron of various brands and their weldable qualities; also of steel, and the precautions and methods in using it. Then in construction he must use discretion where to apply strength in form and substance, and where he can safely dispense with it for appearance sake, bearing in mind the ever increasing demand for light carriages, both in weight and appearance.

The painter should be acquainted with chromatics, on which he may display taste and judgment in his daily work, to produce delicate shades and tints. He at present can only come to results by long practice in his trade, in the same way he gets a knowledge of the various pigments, ground forming material, and varnish. All this might be learnt in comparative little time were it taught in a well directed technical class.

It would be an advantage to both employer and workmen if the trimmer had a knowledge of geometry. In the first place, that he might cut expensive materials with as little waste as possible, and so economise the cost of goods in producing carriages. Secondly, that in the case of a carriage being wanted at short notice the trimmer could take the necessary dimensions while the body was being painted, then cut his cloth, carpet, morocco, and leather, that they may fit. The art of drawing is also desirable, for by drawing "taste" is created, cultivated, and governed, and if there is one characteristic that should show forth more than another in trimming, it is taste.

Another advantage of drawing to the trimmer is that after he has the given dimension of head-room, leg-room, and seat, he can draw in the development of the human body in a recumbent position, and so form his squabs, and cushions, or place his spiral springs to afford the greatest amount of ease, at the outlay of a few lost minutes, where hours are now spent in refitting and re-adjustments.

Here are the four fundamental branches of our trade; in each may be traced the great necessity of technical education; at a glance one may see the great saving of time it would afford the intelligent workmen, who at present are untaught in the general technology of their trade drudges on, learning only what they themselves find out.

Formerly it was the custom to bind or apprentice lads at the age of 14 to the master coachbuilder, he being a practical man, undertook to instruct the lad in coachbuilding generally; here it is seen that the apprentice of years back had better means of obtaining a general knowledge of his trade than young men of to-day.

Appendix G. For since the increase of carriage building generally the master of the present is not an operative in the mechanical part of his business, but the general designer, seller, and capitalist, therefore, he cannot be responsible for the teaching of young men, his time being so much occupied in other matters.

Again the modern capitalist coachbuilder has been forced by circumstances to regard one of the laws of political economy, namely the subdivision of labour, by which the revolution of business is quicker and returns likewise, but while this has been a great boon in producing carriages with rapidity, and so affording facilities to offer them to the market at low prices, it has had this one drawback, it has confined the artisan to one particular branch; should he the artisan be at all indolent he remains in comparative ignorance of his trade in general.

Now it is time we had some equivalent for the old apprenticeship; one thing is certain, we cannot establish it again, since the director or pieceman is a man of business and not a teacher, consequently he will not part with his knowledge, neither spend his time in instructing young men unless he sees means or intelligence that will readily repay him for his trouble. In the case of a father teaching a son, the parent would of course use his best endeavours to make a good mechanic of the young man; but this is by no means general between man and man.

It is only by technical schools young men or improvers can gain a perfect knowledge of their trade, which it should be their ambition to do, so as not only to equal the old apprentice in his general knowledge of his trade, but to surpass him in the application of science and art to our craft, so overcoming many of the old difficulties and misunderstandings.

The Science and Art Department of South Kensington has for years past held classes and examination which have benefited many, but not the artisan to any great extent, as from an artisan's point of view it is one thing to learn science and another equally important to apply it to his trade. What we ask is that science should be taught by practical men who know the difficulties that are to be met with in practice, which theory makes no allowance for.

The question is, then, where and how shall we get these teachers who shall possess both a scientific knowledge with a practical experience.

There is but one way clear at present, that is by establishing technical colleges where men may first learn in theory the science appertaining to their trade, then apply that knowledge gained direct to practice, for it has been shown this can seldom or never be done in the workshop, because who will pay for the time spent in experimenting or application of theoretical knowledge, if for want of practice it cannot be done in the same time as by the old rule of thumb.

Certainly there are masters who have done all in their power to raise their employées above the level of mere machines, and given both time and money for the advancement of the industry to which they belong; but these are few indeed.

The technical examinations of the City and Guilds Institute are excellent tests of the laying out of plans or general knowledge of our trade, but there is no examination of the practical part itself. Neither will there be until the practical as well as theoretical part is taught by a scientific method. For so long as practice is taught by rule of thumb, opinions will differ. What then shall be our criterion by which we may condemn one piece of work or mode of construction, and uphold another.

In reference to technical education in France, it is by no means so wildly taken up as it is here just now, but where it is taught it is more thorough, and is carried more direct to practice; for instance, at one of the leading firms in Paris the work is laid out as a geometrical problem by the foreman. His duty is first to draw the side elevation of the required carriage, then to form his plan from it, showing all the necessary lines and angles, therefore, he is generally responsible for the construction, strength, and working of the carriage.

All the workmen have to do is after planing one side of the various pieces of wood true, and flat, to mark off from the drawing the required

tenons, mortices, bevells, lengths, and width, then, providing the men work to their lines, the work will go together and fit.

The one advantage of this method is that a single coach-body can be distributed amongst many workmen at one time, so saving labour and time in putting things together to find the various sweep and bevells, therefore doing more work in the same time.

It is a known fact that it has been the pride of French workmen to do all for the advance of their trade, either by communication of knowledge, or by forming classes where they meet, discuss, and prove various theories of their trade.

It may be added that the advance made by the French during the last 20 years is due principally to the enthusiastic workmen who, seeing their opportunity for improvement grasped it, and the coachbuilding world knows the result.

In conclusion, let the English artizan be instructed in a method similar to that of the French, then, with the sound principles of English durability, I firmly believe he will hold his own against the world.

PRINTING.

No. 56.

Bread Street Hill,
Queen Victoria Street,
London, E.C.,
February 13th, 1883.

SIR,

In answer to your inquiry we beg to say that there are so many details and niceties in our business that we do not consider any technical instruction given outside our office would be of any value, or in any way obviate the necessity of the apprenticeship which is now the custom in our trade.

We find that the best workmen for our purpose are those brought up by ourselves, while others, even after their apprenticeship, are often quite unfit for any but the most ordinary work.

Yours, &c.

Gilbert R. Redgrave, Esq.

R. CLAY, SONS, & TAYLOR.

OPTICAL INSTRUMENTS.

No. 57.

68, Cornhill, London, E.C.,
and Lister Works, Holloway, N.,
and 1016, Chestnut St. Philadelphia, Pa. U.S.A.,
February 14th, 1883.

GENTLEMEN,

I FEAR I cannot assist you in the most valuable work you have in hand. Unfortunately my workmen are in no way influenced by science classes, and the want of more technical knowledge is continually felt. I have a strong feeling that if the instruction given at our board and middle class schools was of a more practical and technical character, lads would be started in life far better able to engage in industrial and scientific work than at present. Applied science is almost unknown amongst this class, and after lads get into the workshop, unless started beforehand, they are too apt to sink into the sluggish state of other workmen and work for their

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Appendix G. week's wages without taking an intelligent interest in the manufacture in hand. This I find applies to machinery as well as scientific and optical instruments.

To the Members of the Royal Commission.

Yours, &c.
JOS. BECK.

No. 58.

The Great Eastern Railway,
Engineer's Office, Liverpool Street Station, E.C.,

DEAR SIR, June 9th, 1883.

I AM in receipt of your favour of 8th instant.

This Company have at Stratford an institution where science and art classes are held, and all the employes in the London district can avail themselves of the instructions provided, but it is optional.

Yours, &c.

Gilbert R. Redgrave, Esq., Secretary,
Royal Commission of Technical Instruction,
South Kensington Museum, S.W.

ALF. A. LANGLEY.

No. 59.

Manchester, Sheffield, and Lincolnshire Railway,
Engineer's Office, Manchester,

DEAR SIR, June 14th, 1883.

In reply to your circular letter of the 8th instant, I beg to say:—

1. That with us the science and art classes, and other sources of technical instruction are little appreciated, and so poorly attended by the workmen that their influence on the industry of the district is very slight.
2. Such instruction might be made more useful by the Science and Art Department being more liberal in their grants, and not make them dependent solely upon the results of the examinations. Encouragement should be given for attendance.

I am, &c.

Gilbert R. Redgrave, Esq., Secretary,
Royal Commission on Technical Instruction,
South Kensington Museum, London, S.W.

CHARLES SACRÉ.

OPINIONS OBTAINED BY PROFESSOR ARCHER respecting the EDUCATIONAL VALUE of the MUSEUM of SCIENCE AND ART, EDINBURGH. Appendix G.

Museum of Science and Art, Edinburgh,
April 19th, 1883.

SIR, WHEN the Royal Technical Commission visited this museum a few weeks ago, the Chairman, Mr. Samuelson, M.P., asked me to furnish him with any written testimony that I could produce from practical men respecting the use of the collection of models and specimens here. It has been found impracticable to get this from any registered documents, because in the great majority of cases such testimony is given verbally. I therefore addressed the accompanying circular to several gentlemen, most of whom have frequently visited the museum for practical purposes, and I enclose their replies.

I have, &c.
THOS. C. ARCHER,
Director.

G. Redgrave, Esq., Secretary.
Royal Commission on Technical Instruction.

CIRCULAR LETTER.

Museum of Science and Art, Edinburgh,
March 31st, 1883.

DEAR SIR, FOR the information of the Royal Commission on Technical Instruction I am anxious to learn any facts tending to show whether this museum has been of any special use in affording information of practical value to the industries of the country. Is any such fact within your knowledge?

I have, &c.
THOS. C. ARCHER,
Director.

No. 1.

Price's Patent Candle Company, Limited,
Belmont Works, Battersea, London, S.W.,
April 3rd, 1883.

DEAR SIR, I AM favoured with yours of the 31st ultimo, and have much pleasure in saying that during the years when I was manager of the Addiewell Chemical Works of Young's Company, I frequently applied to the officers of the museum for information bearing on practical questions, or to learn where such information could best be obtained. On many occasions I found the museum very useful in this way. I am confident that it would be of service to practical men to take occasional opportunity to examine the collection of models and specimens in the museum.

I AM, &c.
JOHN CALDERWOOD, Manager,
Price's Patent Candle Company,
Limited.

Thomas C. Archer, Esq.,
Director of the Museum of
Science and Art.

No. 2.

The North British Chemical Company (Limited),
149, Hope Street, Glasgow,
April 10th, 1883.

DEAR SIR, I HAVE great pleasure in testifying to the value of the Edinburgh Museum of Science and Art as a place of reference for manufacturers. I have frequently had occasion to visit it myself, and to apply to you, both personally and by letter, for information on various subjects.

Appendix G.

I consider the collections there admirably arranged and of great scientific and technical trade importance, and I only wish it was near enough to send all our workmen to study there; they would thus acquire a knowledge of which they are at present greatly in need.

Thanking you for the constant and polite attention you have invariably given to all my applications,

Professor Archer.

I am, &c.

EDW. C. C. STANFORD, F.C.S.

No. 3.

Rosebank Iron Works, Edinburgh,
April 14th, 1883.

DEAR SIR,
In answer to your inquiry as to the usefulness of the mechanical model department of your museum, I have to make the following observations, which I do from my own personal knowledge:—

1st. I have found that, in the absence of large hydraulic engines, &c. in these works, the models prepared by you were exceedingly useful to parties coming from a distance, whom I have taken to the museum to explain the same.

2nd. I have learned much myself from repeated afternoons I have spent there inspecting models of marine and other engines.

3rd. I think the department for apprentice engineers is of the greatest possible value, and would be more so still if you had a convenient arrangement of showing the various engine models in motion, which, I think, could be easily done.

Lastly, I have only to add that the workmanship of your models is simply perfect, and most faithfully executed to scale down to the very pins and bolts and nuts. I have taken many engineers to inspect them, who have been delighted with their excellence of finish, and I know of no other establishment where equal quality of modelling is to be seen.

I am, &c.

To Prof. Archer, Director,
Industrial Museum, Edinburgh.

A. BETTS-BROWN,
Mem. Inst., M.E.

No. 4.

Caledonian Railway Company,
Locomotive Department, Saint Rollox,
Glasgow, April 14th, 1883.

DEAR SIR,

I AM in receipt of your circular letter of 31st ultimo.

On every occasion when visiting Edinburgh, and have time at my disposal, there is no place I can spend a few hours with greater profit and pleasure than your museum of science and art, and have much pleasure in testifying to the great good to be derived to old and young alike in visiting this most interesting place, and to engineering students specially.

The collection and selection of machinery is of the greatest importance to them, owing to the correctness of the models in all their essential details. They show the most simple and correct method of educating the youth I know of, and would recommend strongly that the Commissioners would kindly consider the propriety of making duplicate models for the Glasgow Museum for the benefit of the mechanical students of Glasgow; such an arrangement would be of incalculable benefit to the youth of this large and important manufacturing city.

I advise this more so on account of the models in the Edinburgh Museum being the finest collection I know of, and their execution, to the most minute detail, is faultless, and reflects great credit on all concerned.

Yours faithfully,

Thos. C. Archer, Esq.,
Museum of Science and Art,
Edinburgh.

D. DRUMMOND.

No. 5.

Appendix G.

Greenhead Engine Works, Glasgow,
April 6th, 1883.

DEAR SIR,

I HAVE repeatedly examined the various mechanical models in the Edinburgh Museum of Science and Art.

I have found these very carefully executed, and the workmanship of a very superior description.

These models are made to such a scale, and several being shown in section, a more correct and practical idea is learned of the various parts of the machine, and also of their movements by any one wishing to study the same, much better than from a drawing or description.

I have also for many years regularly visited the industrial department, more particularly the mineralogical section, and have derived much information from the methodical and scientific arrangement of the various exhibits, and also from the useful catalogues published.

I remain, &c.

Thomas C. Archer, Esq.,
Edinburgh.

D. CORSE GLEN,
of GLEN & ROSS, Engineers.

No. 6.

56, George Street, Edinburgh,
April 4th, 1883.

DEAR SIR,

I HAVE frequently had to consult the specimens of decorative art in the Industrial Museum here, both those which form part of the permanent collection and those which have been lent at various times; and as an architect much engaged in designing furniture and internal decorations, I have found it decidedly advantageous to study these examples; indeed, I should say the greatest benefit to designers if the number of good examples of ornamental art in the museum were largely increased, and a library formed, even on a small scale to begin with, where art books could be consulted, with the facility and ease with which this can be done at South-Kensington.

I am, &c.

JOHN W. SMALL.

The Director of the Museum of Science and Art,
Edinburgh.

No. 7.

St. Helen's, Cambridge Street, Edinburgh,
April 9th, 1883.

DEAR SIR,

IN connection with the work I extensively execute in all the departments of sculpture, I have frequently found the casts and other objects in the Edinburgh Museum of Science and Art of much service, and I have had occasion to learn that, to my workmen, the study of these has often been of valuable practical use. So great is the benefit that I believe to have been derived, especially by young men, from the present collection of such casts, &c., that I should very much like to see the number of examples of mediæval and later decorative works of merit in the museum increased.

I am, &c.

The Director of the Museum of Science and Art,
Edinburgh.

JOHN RHIND.

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No. 8.

DEAR SIR,

87, George Street, Edinburgh,
April 5th, 1883.

It affords us very great pleasure to state, for the information of the Royal Commission on Technical Instruction, that the advantages offered by the existence of the museum of science and art have been of great service to us. We employ a considerable staff of workmen, consisting of jewellers, silversmiths, engravers, and watchmakers, and have for many years done our best to remove the idea, particularly in the upper ranks of life, that nothing good nor artistic can be got out of London.

Through the advantages of the museum, and also of the school of design, it has been our happy privilege to prove that this is a totally mistaken idea, and we sincerely trust that the legislatura will open up still greater facilities. Anyone who has travelled abroad must be struck with the numerous advantages compared with this country.

Thomas C. Archer, Esq.

We are, &c.
MARSHALL & SONS.

No. 9.

DEAR SIR,

Edinburgh, April 9th, 1883.

In reply to your circular, dated March 31st, 1883, we have much pleasure in stating that we have frequently availed ourselves of the facilities offered by the museum of science and art, and the information we have there obtained has often been of considerable benefit to us for business purposes.

Prof. Archer.

Yours, &c.
THOMAS NELSON & SONS.

No. 10.

DEAR SIR,

10, Princes Street, Edinburgh,
April 16th, 1883.

I must apologise for not replying to your note sooner, but have been from home.

Fourteen or 15 years ago, when I first started the glass works, I made nothing but the most common goods, now, through the aid of the industrial museum, I not only make the best quality, but in certain classes have the monopoly.

I will remember when I first started to make the imitation of the Venetian glass how my principal workmen were in the habit of spending their Saturdays in the museum, examining the large selection of Venetian glass, and how you personally encouraged them, not only by explaining in the museum the different kinds of specimens, but devoted a large portion of your valuable time at the works, showing the men how to make them, and the result is that I have as fine a class of workmen as any employer could wish for, and am glad to say that the principal workmen have all been reared at the works.

I take this opportunity of thanking you and your assistants for the kindness and attention my employes and self have received at your hands.

Professor T. C. Archer,
Museum of Science and Art.

I remain, &c.
A. D. JENKINSON.

No. 11.

DEAR SIR,

3, North Elliot Street, Edinburgh,
April 16th, 1883.

I HAVE much pleasure in saying, on behalf of the Flint Glass Makers Friendly Society (Edinburgh District), that the collection of both ancient and modern glass in the museum of science and art has been of great

benefit to us as glass makers, especially on Fridays and Saturdays, when we have been able to give the collection our careful attention, owing to us being finished work for the week, and we consider it a great boon to us as tradesmen. Appendix G.

I have, &c.
(For the Edinboro' District),
Wm. SMITH, Secretary

Mr. Thos. Archer, Director,
Museum of Science and Art,
Edinburgh.

APPENDIX H.

Appendix H.

CORRESPONDENCE WITH OFFICERS OF TRADE SOCIETIES.

The following letters from secretaries of some of the more important trade societies in Manchester contain the views of the writers, as representing their unions, on the subject of technical instruction, and in some cases respecting the question of apprenticeship and piece-work.

DEAR SIR, 50, Grosvenor Street, Chorlton-on-Medlock,
January 17, 1883.

As promised, I now give you my own opinions as regards technical education, and what would be beneficial to the working engineers and machinists of the United Kingdom. Up to the time of 14 or 15 years of age (just as parents could afford), I would allow boys to remain at school, learning reading, writing, and arithmetic, including fractions, decimals, and mensuration in its rudimentary form, also English history during the present century; and from 16 years of age to 21 years, I would suggest they should be taught (that is those who have a taste for these subjects) mechanical drawing (to scale), algebra, and geometry, at some good night school. These subjects, if mastered, together with at least (5) five years of an indentured or agreed apprenticeship at one or more branches of the engineering trades, would make the machinists of this country second to none in the world, and as at present they would have no cause to fear competition from any foreign workmen in our branches of trade. And then I would say if we cannot, with the above, hold our own in "the neutral markets" of the world (if there be any), let those go first who have greater abilities.

I am, yours faithfully,
ROBERT AUSTIN.
District Secretary, Amalgamated Society
of Engineers, &c.

The Secretary of the
Royal Commission on Technical Instruction.

DEAR SIR, 50, Grosvenor Street, Chorlton-on-Medlock,
February 24, 1883.

IN reply to your questions, 1st, do I consider children should be taught free-hand drawing in an elementary school, &c., &c.

I say yes, where a child is fond of it, or shows an inclination to practice or to be taught the same, but not otherwise. This should never be forced. If it is, they will never practice mechanical drawing afterwards, where it can be avoided.

A mechanical draughtsman, in my opinion, should have a love for his art, in addition to its usefulness, or he cannot achieve success.

2nd. Do I think where drawing is now taught in our elementary schools sufficient time is devoted to this study; I again say yes. That is, in our

Appendix H. board schools in Manchester, there is sufficient time allowed, and the kind of drawing is of that nature which has a tendency to develop the inclination towards it.

My experience and remembrance of my own boyhood's school days is such, that, on no account, would I attempt to make all children learn or attempt to study those things which they have a thorough distaste for, nor should all learn alike in the school hours. I have an idea (it may be a mistaken one) that a boy or a girl will not have discovered the true value of mechanical drawing until after sixteen years of age; and then there are other schools at night where the student can devote as much time as he can spare from his daily labour to the acquisition of a thorough knowledge of his favourite pursuits.

I am, yours truly,

ROBERT AUSTIN.

The Secretary of the
Royal Commission on Technical Instruction.

260, Ashton New Road, Manchester,

January 29, 1883.

SIR,

In answer to your request that I should give my views as to the best mode of supplying "technical" education to the artisans of the country, and also as to what should be taught, I have pleasure in submitting the following suggestions, which must be taken as referring to the cotton trade—

- 1st. Schools.—These should, I think, be established in every industrial centre, and where school boards exist, either under their control or in connection with them, and should be supported as board schools are, viz., by local rates (the districts in which the schools are situated deriving most of the benefit) supplemented by Government grants for results. There are already in existence a large number of prizes available for successful students, and no doubt these would materially increase with the popularisation of the classes, which should in all cases be held in the evening.
- 2nd. Popularising the classes.—For this purpose, I am of opinion that it would be advisable when the classes were opened in any district, that one or two lectures should be given explanatory of the reasons for the step taken, and illustrating its necessity. The lecturer should be well known for his practical knowledge of the principal industries of the district in which he has to speak, and the meetings should be made widely known by posters, &c., and the intimation should not be confined to a dry and often a scientific announcement in the papers.
- 3rd. What should be taught—
 - A.—A thorough and practical knowledge of the different classes of cottons, their length of fibre, their strength and other qualities, and how and why these are applied to the different requirements of the trade.
 - B.—Theoretical and applied mechanics to be illustrated by actual working models of cotton machinery, as almost every rule and system in mechanical appliances is illustrated in the multifarious machines working in a cotton mill.
 - C.—The rules of arithmetic which bear on the calculating of wheels and changes required.
- 4th. Piece-work.—This I believe to be the best system where the work is or approaches to being of a uniform character, and I do not believe that it has a tendency to induce the scamping of work, as men on piece require less oversight to keep them at work, thereby leaving the overlooker more time to examine the results when finished.
- 5th. Apprenticeships for seven years.—I have no faith in this as a means of improving our workmen. It might have had its advantages when it was customary to teach a lad several departments of a

trade. With the exception of those who are being trained to superintend works, this, with the present system of labour division, is neither necessary nor desirable, as a man who had served his time to half a dozen different classes of work would have to be exceptionally clever to compete with one who had devoted his whole time to one department. Not only so, but a lad who went to a shop at fourteen and who knew he was tied to it at a slowly progressing rate of wages for seven years, would not have the same inducement to put forth his energies as another who knew that at any time he could command the full market value of his services; and as active habits form a large proportion of the stock-in-trade of the best workmen, other circumstances being equal, I should assume that an unindentured workman would best serve his employers interests.

Yours truly,

JAS. MAWDSLEY.

General Secretary of Amalgamated Association of
Operative Cotton Spinners.

The Secretary of the
Royal Commission on Technical Instruction.

SIR,

In the letter-press printing trade, very similar rules and practices prevail in all the chief towns of the United Kingdom, and there are several distinct organisations or unions existing among the men. The London Society of Compositors is an independent body numbering over 5,000 members. The Typographical Association, which has its head-quarters in Manchester, includes all the chief towns in England, Ireland, and Wales, except Dublin and Leeds, and has a total of 5,500 members. Scotland has an Association of its own on a similar basis. The general custom throughout the United Kingdom is for apprentices to be bound for a term of seven years. In Scotland and the north of England, a verbal agreement takes the place of a binding indenture, but the time served is the same.

Proposals have been made to reduce the term to five years, but so far they have met with little favour. All the unions make efforts to limit the number of apprentices, though their rules on the subject vary very much in their stringency. The essentials for becoming a good compositor are, a fair general knowledge of grammar, history, and literature, and a mechanical dexterity, not difficult for a smart boy to acquire, in picking up types. To attain to a high degree of efficiency the compositor would find it a great advantage to have greater facilities than he has had in the past for acquiring a knowledge of foreign languages, of science, and of the other topics with which the books and newspapers of the day are occupied. The ordinary jobbing printer, that is the one who does all the other work, except that referred to, wants a rather different training, less of the literary and rather more of the mechanical. A knowledge of colour and an idea of graceful forms would be of great value to him. To all classes of young printers, the opening of evening classes where their elementary education could be supplemented by technical training would be a great advantage; and as the reporting and editorial staffs of the newspapers are largely recruited from the journeymen compositors, the effects of a better training would be felt in that sphere.

Foreign competition has not so far had much influence upon the printing trade.

In the United States a much shorter apprenticeship is served, with a result that the men become less acquainted with the general trade, though equally apt as type setters. The division of printing offices, or works, as they are now frequently called into departments, is having the same effect as in other trades, that is, that men gain greater proficiency in some parts of their trade, but have a less general or all-round knowledge of it. This operates very disadvantageously in places where the work is of a special character, and young men learning their trade in such places often find themselves lamentably ignorant of it when compelled by force of

Appendix H. — circumstances to seek employment elsewhere. The employer, though he has bargained to teach the trade, seeks only to teach so much of it as will enable him to make the greatest profit, and the disposition to take things easy too often makes the apprentice readily fall into this course.

Upon many of these points the establishment of technical schools could not fail to have a good effect. They should be held in the evening and sufficiently near the homes of the workmen to obviate any great inconvenience in reaching them, and the fees should be fixed at as low a rate as possible. The School Boards in the various towns would appear to be the proper body to have the supervision and management; or where no such boards existed (as in Preston), the duty should be undertaken by the Town Council or by any body to whom the Education Department might depute it.

Yours faithfully,

H. SLATTEK,

Secretary Manchester Typographical Association.

The Secretary of the
Royal Commission on Technical Instruction.

Market Buildings, Thomas Street,
Shudehill, Manchester,

February 7th, 1883.

SIR,

At the recent interview of Trades Union officials with the Commissioners, it was deemed advisable that each of the former should submit their opinion in writing on the question of technical education, and for this purpose I was, on Saturday last, supplied with a memorandum containing four questions, which I will endeavour to answer.

1st. "What is the system of apprenticeship or agreement between employers and employed in your trade?"

In the days of our forefathers, few apprentices were put to the engineering trade, but such as were bound by indenture for periods varying from five to seven years, and it frequently occurred in those days that premiums were given to the employer to teach the youth his trade in a workmanlike manner, which resulted in such youth securing a technical knowledge of various branches in the trade.

This system has been abolished, and it is only in rare and isolated cases where any apprentice is bound by indenture; but the boy is engaged as an ordinary employé, who can be discharged or leave at any time (according to the general rules of the establishment where he may be employed); whilst the employer is under no obligation to teach him more of his trade than what the men with whom he works may voluntarily show him.

2nd. "What are your views with regard to piece-work and the division of labour as influencing the efficiency of the workman and the excellence of the finished products?"

Piece-work has caused a deterioration of the general workmen, and, coupled with that of division in labour, compels me to arrive at the conclusion, that the young men of the present day are not so perfect in the various branches of trade as the same class of artisans in years gone by. In times past, when the indenture system was in force, an employer caused the youth to be instructed in all the branches; but, by the present system of common employment, a youth is put to one class of work, at which he becomes an adept, and he is retained at that particular class of work for long periods, and, in some cases, until he becomes a journeyman.

As an incentive to the youth to remain at that class of work, he is frequently put to work by the piece, and the result may be assumed to be fatal as to his general knowledge of the engineering trade, when we consider it in all branches of stationary, locomotive, and marine engines. In my own case, I worked at one of the principal locomotive works in this city as man and boy for 16 years; the first six years being on a class of work that a youth would become a perfect master of in two years; but there was no advancement, and no instructors other than the men in the same workshop; and there were numbers of youths and young men in the same position who, however much their desire might be to do

so, could not advance in the knowledge of their trade, unless they left and sought other employment. This was frequently done, and is the same to-day, as I should say, in a majority of cases, when a youth becomes 21 years of age, or very soon after, he leaves his employment to learn other branches of the trade, or secure the average rate of wages which his employer (during the supposed apprenticeship) refuses to give him when he becomes a journeyman. This opinion has become an experience during the past 11 years that I have held my present position, and one of my chief duties is to assist such young men to other employment, where they may have a prospect of gaining experience that has been previously denied to them.

The division of labour appears to have become so firmly established in most of the large engineering firms, that it bids fair to ultimately abolish skilled labour in many of its branches, whilst in agricultural engineering firms, this has to a great extent been already accomplished, as the proportion of general skilled workmen is very small as compared with the number of men who have not so claim to the trade by any term of servitude, previous to their becoming 21 years of age. In addition to this, the applications which I am receiving daily to fill vacant situations are, in 90 per cent. of cases, coupled with the proviso that the man must not be over 45 years of age, and accustomed to a specific class of work as named in such application. My opinion is, that with the present system in the division of labour, a youth cannot learn the engineering trade to make him a competent workman when he reaches the age of maturity, owing to the privileges being denied him at a time when his mind is susceptible, and while he could be easily trained as a competent workman.

The piece-work system may cheapen the material worked upon, but it causes the youth to be careless as to the quality, so that he completes the quantity that secures his week's wages.

3rd. What, in your opinion, would be the most useful kind of education for boys and young men engaged in the industry with which you are connected?

I am afraid that technical education would not effect any great improvement, unless it were coupled with more studious training in the workshop where the youth may be employed. To my mind, if the future generation of workmen are to be improved, it will be more of a social than a political question, and could be effected if employers adopted a policy in the workshop similar to that of the Government in the dock-yards, where chosen workmen are appointed as instructors to the trade boys who are employed there.

If the system of indentured apprenticeship was returned to, and instructors appointed in the various workshops, coupled with a change of work to be manipulated, it would do more to elevate the class of workmen than any legislative enactment could ever hope to accomplish. As, however, the race for wealth is so predominant, and home competition is so keen, it is not probable that this, the best means, will be resorted to, so the question has to be met by the consideration of what the community can do for themselves. The Education Act of recent years has not had sufficient trial to see its results amongst the journeymen tradesmen (over 21 years of age), but there is little doubt that, if, as the Act provides, a sound elementary education is given the youth up to 14 years of age, he will prove to be superior to those of the present day, who, to use a vulgarism, work by the rule of thumb. The Elementary Education Act will effect this improvement, whilst the prizes, scholarships, and various privileges offered by educational bodies and school boards, give facilities to the precocious youths to secure a higher class education, and such as would have to have been dearly purchased 30 years ago. Amongst the working class generally there is an anxiety that the family should be put to work at as early an age as possible, so as to help to support the remaining portion. Owing to the scant income in many cases of the head of the family, as soon as the child can begin work by having passed the necessary standard and is of legal age, as provided by the Factory Acts, he does so.

Legislative enactments having been complied with, it is here where voluntary efforts could accomplish good results by causing the opening

Appendix H

of night schools in large cities, and at these schools competent teachers could instruct the young men but even those advanced in years in the higher branches of metallurgy, mechanical drawing, and mechanics generally, and by this culture the workman would be able to bring to bear his knowledge thus gained upon the work he has to manipulate. To create technical schools where the art of fitting, turning, planing, or boring would be taught, would be scarcely feasible, as it would be almost utopian to think of having locomotive, stationary, or marine engine schools at an immense cost for plant and tools, whilst the youth who has toiled at this class of work through the day would not be inclined to follow it up at night, and the more so when we know the heavy strain that is put upon them to complete sufficient work under the piece system to secure their wages. As to the means of supplying the instruction at night schools, there are already some of the requisite subjects taught under our own (Manchester) School Board, and this with little expense could be extended into adjacent districts, by the instructors in special subjects taking certain localities on certain nights so that their services would be spread over the locality and be the means of distributing knowledge which is now denied to great masses of the people.

4th. How would you propose that the expense of such education should be defrayed?

I am not certain of the plan adopted by the School Board in Manchester, not having their syllabus at hand, but believe that the charges to their night (science) classes are nominal. This system, I think, could be extended by the appointment of skilled workmen (by examination) to teach the first grades of special trades, whilst the certified master could instruct those who had passed to an higher grade. The payment of such skilled workman instructors would not be excessive, and need not entail much extra cost in taxation. The schools thus worked should be supported by the municipal rates and a nominal fee charged for the students, whilst Government could supply examiners as to progress the same as is now done in the elementary schools. This question, however, is one that the legislature will be best able to deal with under the advice of their Education Department who must possess a fair experience upon such an important matter.

Apologising for not complying with your wishes earlier,

I beg to remain,

Yours obediently,

JAMES SWIFT,

General Secretary of Steam Engine
Makers' Society.

The Secretary of the
Royal Commission on Technical Instruction.

Monsieur Arnoux, who has been the scientific adviser of a large firm, and has had a great deal to do with the reputation which that firm enjoys. His case shows that Minton's have trusted a man in that capacity, and they have derived benefit from it.

938. But what you have said would apply generally to the manufacturers in the pottery district?—Yes, there is no potter that I know of, except Messrs. Mintons, who has employed anybody with scientific attainments as chemist, and Mr. Arnoux has the rare advantage of embracing both scientific and artistic qualities. I do not suppose there is another man in the kingdom, or perhaps in the world, like him in that respect.

939. Your observation of these matters has not been limited to our own country, I believe?—My extent of knowledge elsewhere has been solely that which I have gained by a short visit to one or two other works abroad.

940. But you have visited the works at Sarreguemines?—Yes, I have visited the works at Sarreguemines, in company with Mr. Campbell and Mr. Arnoux. They are the largest pottery works in the world. What we chiefly admired in them was the wonderful organisation; the works are admirably laid out, so as to save labour in every point; and there the whole construction of the works and control of the machinery is in the hands of an educated man, a man specially educated as an engineer, who has nothing else to do but that.

941. (*Chairman, to M. Arnoux.*) Do you know whether the director, M. Geyer, was trained at the *École des Arts et Manufactures*, at Paris?—I do not know, but he has two engineers with him who came from the *École Centrale*.

942. (*Mr. Woodall, to Mr. Wedgwood.*) You have also visited the works of M. Regout, at Maestricht?—Yes; that is an admirably arranged work; without spending as much money as at Sarreguemines, I should say there is quite as much skill in the arrangement. I believe it is one of the partners who controls the machinery, and the scientific part of the works.

942a. Was there anything that you noticed in the works of Mr. Haviland, at Limoges?—I did not go there.

943. Do you know anything of the successful potters round about Paris?—No.

944. You made some reference to M. Deck just now?—He is not a commercial manufacturer; he is an artist in pottery. The brothers Deck have perfected their special branch of pottery in a way that no other potters have.

945. You agree, I understand, with the statement made by M. Arnoux in the remarks which he made about foremen?—Most fully; my words are almost the same as his, you will find.

946. That the foreman is usually the most steady, sensible, reliable, and able workman that a master can pick from amongst his workpeople?—Yes.

947. How far do you think that the working potter benefits, or would benefit, from any training, any school instruction having direct relation to his work?—All our working potters are piece-work men, or at least nine-tenths of them work piece-work; and their work is so differentiated and so divided, that I do not see how any other education than what such a workman gets in the seven years' apprenticeship could benefit him. A man makes plates all his lifetime from Monday morning to Saturday midday, simply laying a piece of clay in a mould, pressing it down, and taking it off again when dry enough to fettle. I do not see where any scientific education can be of service to him. You were

Mr.
G. Wedgwood.
—
3 March 1882.

Mr.
W. Morris.

17 March 1882.

designer to the museum and say, I want a thing done in such and such a way; therefore I think it very much better that the provinces should have their own museums; if small ones, it does not matter so long as they are typical.

1610. (*Prof. Roscoe.*) Typical in one direction, that is to say, a museum containing specimens of articles of the manufacture of the district?—Yes, chiefly original specimens. I would not press that too strongly; a good museum might be made up mostly of copies.

1611. (*Chairman.*) The system of circulation, I suppose, is of a certain amount of use in training customers to appreciate beauty?—Doubtless; but both because of the risk in transit to articles, and for many other reasons, I should like to stimulate the populations of towns to form their own museums.

1612. Take small towns of 20,000 inhabitants?—I do not know that there are any isolated towns of that size that really could be called manufacturing towns. If we take Lancashire, Manchester practically is the centre for all the towns in that district.

1613. Take agricultural towns, it is desirable that they should have museums, is it not?—Certainly. I do not wish myself by any means to limit the idea of technical education wholly to workmen and people of that sort. I think it is most desirable from my point of view, that the public should know something about it, so that you may get a market for excellence and not for appearance.

1614. What you would recommend, as I understand you, would be this: without entirely suspending the present plan of circulation, you would give aid to the formation of permanent provincial museums, of such a nature as to be best calculated to be of use to the industries carried on in the district?—I would certainly. I would give all the national aid to such museums that could be given without robbing the great existing museum.

1615. You would make the existing central museum your first care, but at the same time you would not devote the whole of the national funds to it?—No. I feel that the provinces have a claim to some of the money spent upon these things.

1616. (*Mr. Woodall.*) You said just now that you had some doubt as to whether there were manufacturing towns of the population named by the Chairman; you know something of the towns in the Potteries?—A little.

1617. You would regard a museum, established in one of those towns, as worthy of aid from the central collection?—Yes, those towns are centres of a large industry.

1618. But objects that would suffer in transit ought not to be exposed to the risk of travel. You know something of the system of reproduction which has been carried out at South Kensington?—Yes.

1619. You would regard a fresh series of reproductions as very useful?—Very useful. When any objects were acquired by the nation for the central museum, those objects ought, where possible, as a rule, to be copied, and the copies ought to be distributed among the provincial museums; in many cases they would be almost as valuable for study as the originals.

1620. While, in your view, it is desirable to encourage the formation of permanent collections in provincial centres, would not you think a certain advantage would be obtained by making them more attractive by adding novelties from time to time?—Of course I know that there is something to be said for that, but I cannot help looking upon the thing

Mr.
T. Armstrong
and Mr.
H. A. Bowler.

3 Nov. 1882.

In 1855 I saw some of the men at work in these schools; and they went into the school without any preliminary, and asked to draw something they at that moment wanted in their trade, found it, and then made their drawing, perhaps two or three drawings, and then went away.

3380. What is there in the South Kensington system to prevent the same thing being done?—The aim of the South Kensington system is to give a good art education, not merely to supply an accidental want of that kind. Students under our system pursue a systematic course, which would give a sound taste as the result. We, for instance, use casts from old examples in teaching drawing. The French schools often allow a man to take an ornament just made, and make a drawing of it.

3381. I believe that in the schools which we visited the models were chosen by the teachers, and the whole class were drawing from one, or at the utmost two, models. Did you see any classes in which a different method was pursued?—I saw a number of students making individual drawings for themselves. I should like to read a report of a conversation I had with an English student who had just visited Limoges, which I noted down. He stated, that staying at Limoges, he had been admitted, without any formality, to a municipal drawing school, fully equipped with casts and other art school fittings. He paid no fees, was taught to draw from the flat and from the round, and was under no compulsion to attend examinations, but if he absented himself, was asked about it when he next attended. That facility seems to me to be part of the advantage of the French schools.

3382. If you consider that more advantageous, then why adhere to a system which compels a man to go through a whole course, and which ultimately leads to a result which, though æsthetically of a higher average, is not of such direct value in regard to industry?—I have not intended to convey that I thought it was better as a whole. There are a number of other considerations which enter into that question. It seems to me that under that system you would not get what we get, an improvement in the general taste; and, bearing upon that, I may observe that on looking at a report I made in 1855 on the *École Nationale des Arts Decoratifs* which we visited lately, we found that the same observations as were then made might still apply. If you take the report on an English school in 1855, and compare it with the present, you would find a very great difference.

3383. Do you consider that our taste is better than that of France?—I consider that the educated taste of a student in an English school of art is better than that of a French student, because the English student has been brought up on more refined examples.

(*Mr. Armstrong.*) I was taking the low ground of working for the career of an artizan. I agree that, generally speaking, the tone of the country is raised by this higher and more extensive education; but then, at the same time, I see great utility in giving these facilities to the workmen who have not the time or the means to get this more extensive education. For my part, if I could see that, I would willingly see it go, on concurrently with the more extensive system of education.

3384. Do you see any way of combining the two?—I have not yet mastered the subject enough to see how it could be done.

3385. You consider that it would be desirable that instruction in art should be given to artizans, which should have a more direct and immediate bearing upon their industry?—I should like to try that.

3386. And that I suppose would apply not only to facility of execution, but also to facility in designing? When I say facility of execution,

I mean the execution of a design placed before a man; and when I say facility of designing, I mean the origination of design?—I think that the best means of educating the student in designing is to show him good examples. I take the museum, with some guidance, to be the instrument for educating the designer, rather than the school. The school provides him with the skill for drawing the design when he can understand it and invent it, but the museum or the collection is the instrument for educating the designer.

3387. You would like, then, to see good designs disseminated throughout the country?—That is of the very first importance.

3388. And you would like to see those accessible to students of the art schools and art classes?—Yes; I have been visiting schools during the last month, and on every occasion have tried to impress upon the committee that the best thing they can do, if they wish to foster the art of design, is to have some small beginnings of a museum, no matter how small, attached to the school, which shall also be a public museum for the town on certain days of the week, but of which the students shall have the run, as the students of our training school here have of our museum; and I should consider that the museum and the school should, if possible, be under one roof; at any rate there should be constant reference; and I found in Germany, in the Nuremberg Exhibition, that there was abundant evidence that the museums were used.

3389. Did you inquire into the teaching of design in France, or in Germany?—Yes; I do not know exactly whether we saw the teaching of design as we should see it here (and I might suggest that I should wish you to see the teaching of design as it is practised in the school here), but we saw the work of the designers, and of that you will find a record in my report on France. At the school of M. de Lajolais, which is especially for industrial art, we saw designs, and also at a very interesting girls' school, and there we found much more designing power than in the exhibition at Nuremberg.

3390. M. de Lajolais made a curious statement to us with reference to the teaching of design in his school; he said, "I do not profess that the designs of my students are capable of being executed in the material for which they intend them; I consider that to be of little consequence. What I care about is that the design *quod* design shall be an admirable one." What should you say to that?—I should say that the practised designer ought to acquire a knowledge of his material; that he ought to design especially for the material; in fact, that he ought to have some knowledge, which might be acquired in a short time, perhaps, of the processes of manufacture. But, on the other hand, we hear that a trade has sprung up in Paris for furnishing designs for all kinds of manufactures, which are produced probably by people who have never come into contact with the processes of manufacture. My own opinion is, that other things being equal, the design would be much better if the designer had a knowledge of the processes of manufacture, and could ensure fitness.

(*Mr. Bowler.*) I think that as a rule the designing for specific manufactures is held by us generally to be necessarily preceded by the study of the principles of design, and a reference to the making of things harmonious amongst one another.

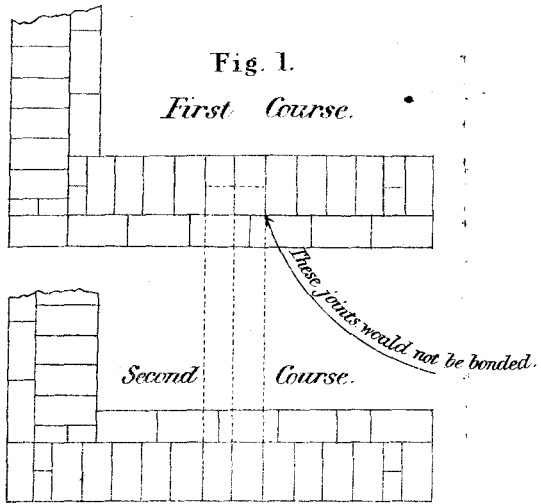
3391. But when those principles have been acquired, do you encourage your students to proceed to design?—Yes.

3392. In what way?—By giving high prizes for them, and by making high payments to masters in whose schools designs are made.

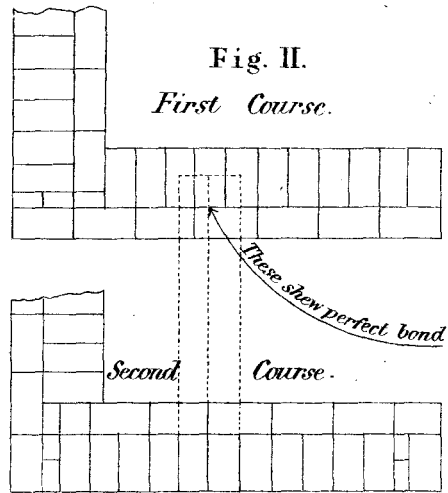
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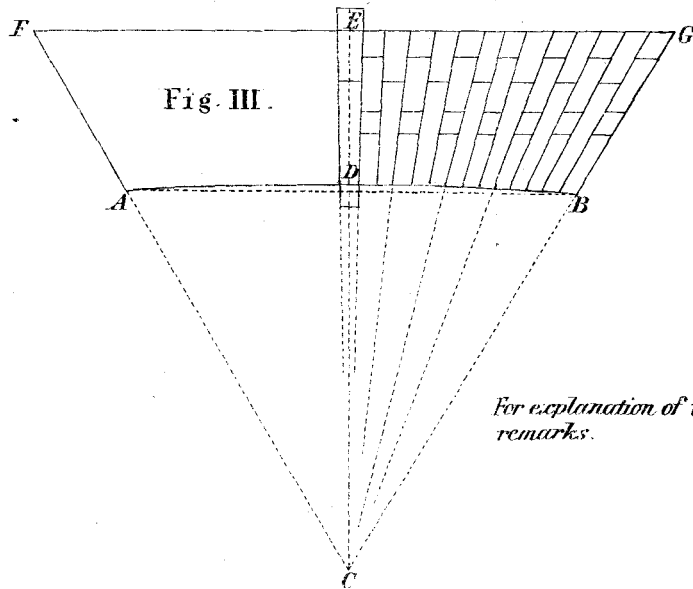
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