

NOTE

ON THE DEVELOPMENT OF A NATIONAL SYSTEM OF EDUCATION

FOR

THE BARODA STATE

BY

T. K. GAJJAR, B. Sc., M.A.,

SOMETIME DAKSHINA FELLOW, ELPHINSTONE COLLEGE,
PROFESSOR OF CHEMISTRY, BARODA COLLEGE.

“ The education of the
people has within itself an inherent life
which can never perish, and which will
throw out new and ampler growths from
generation to generation.”

SIR W. W. HUNTER.

Bombay

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Note on the development of a National System of Education for the Baroda State.

His Highness the Maharaja Saheb having expressed his desire to introduce the Technical Branch into the present system of education in the Baroda State, it occurred to me that this could not be effectively done without a re-organization of the entire scheme in vogue at present, and I set about constructing a National System of Education which should provide means of imparting various kinds of instructions suited to the position and circumstances of pupils in various grades of life. The extremely laudable object of His Highness to advance the interests of his subjects by imparting to them the benefits of a high-class education, would be only partially attained by attending to Technical instruction alone. Man is a many-sided being, and as the object of all education is to secure his happiness, it follows that the education proper to be given should be such as to satisfy all his wants. Undue development of one side of man often results in the dwarfing of the other instincts, and the product is not on the whole very enviable. What is true in the case of the education of an individual is much more so in the case of the education of a nation. Accordingly there never can be too much time and labour spent upon the sketching of a general plan of education, before its portions are taken up. I am aware that from various causes, such as the want of appliances, teachers, funds, &c., it will not be possible for any one State to attempt to cover the entire field of knowledge. But for that very reason, I think, it is necessary that the entire scheme should be before the mind of the statesman before he sets his hand to the development of any particular branch of

knowledge or skill. With every change in a nation's circumstances, there will be a change in the particular branch of instruction which is considered the most important of all ; and if each is attended to separately without regard to the whole, an incongruity may result, which it will require great effort to undo. In this view, I have formulated a scheme, and submit it for consideration. I have condensed my ideas on the subject in the shape of a semi-circular diagram which will show the correlation of the several institutions for developing various branches of knowledge and skill, and I propose to expound my scheme in reference to that diagram which may be considered the key-note thereof. Before I enter into details I might premise that the diagram is made in view of what a State may properly undertake to do in furtherance of the education of its subjects. For various political reasons, State action in this matter has to be confined within definite limits which cannot be ignored in the settlement of a scheme. It is for such reasons that I have limited my scheme to the first twenty-two years of a man's life ; else I am not unmindful of the fact that pursuit of knowledge and skill is the life-long occupation of man during his sojourn in this world. Again physical and moral education has been excluded from the diagram, not because I do not properly value them, but because I consider them as essential to the well-being of man in all stages of life as the supply of necessaries, and therefore an indispensable portion of the curricula of every institution I have named. The inattention at present shown to those branches is deeply lamentable, and I cannot too earnestly crave the early adoption of steps to counteract the mischief caused thereby. No separate place has been given to them in the diagram because there need not be special institutions for them.

HOME EDUCATION.

Beginning with the centre of the diagram, the first six years of infancy are assigned to home education. Much can be done in this period in the way of inculcating habits of observa-

tion and steadiness ; but as I am concerned in the present scheme with governmental action alone in National education, the question of home education is outside the limits I have set to myself. I will, therefore, say nothing about it. It is said that human brain begins to develop at the age of seven, thus marking the period when the child by the opening of its intellect comes within the range of State action.

PRIMARY EDUCATION.

The first period of school education commences with the seventh year, and ends with the tenth year, during which time a boy receives what is called Primary or Elementary Education. It comprises the first four Vernacular Standards, which are framed with a view to educate youths in reading, writing, and arithmetic; or the essential mechanism of instruction. Those whose circumstances do not permit them to continue their studies further and who have to leave school at the end of this period are furnished with little more than three 'Rs.' without knowing the use and application of them. Reading and writing are useless, if the boys do not learn something useful, interesting and worth reading or writing about, in the same way arithmetic is useless if the pupil has not learnt something that can be set down in figures.

What I propose, therefore, is that, along with the processes of reading, writing and counting, an elementary knowledge of the subject-matter of these processes should be imparted.

With respect to the nature of the subject of instruction in Public Elementary schools, the Royal Commissioners on Technical education make the following recommendations :—

(a). That rudimentary Drawing be incorporated with writing as a single elementary subject, and that instruction in elementary Drawing be continued throughout the standards.

.....That drawing from casts and models be required as part of the work, and that modelling be encouraged by grant.

(b). That there be only two class subjects, instead of three, in the lower division of Elementary schools, and that the object lessons for teaching elementary Science shall include the subject of Geography.

(c). That.....a school shall not be deemed to be provided with proper apparatus of elementary instruction unless it have a proper supply of casts and models of drawing.

(d). That proficiency in the use of tools for working in wood and iron be paid for as a "special subject," arrangements being made for the work being done, so far as practicable, out of school hours. That special grants be made to schools in aid of collections of natural objects, casts, drawings, &c., suitable for School Museums.

(e). That in Rural schools instruction in the principles and facts of agriculture, after suitable introductory object-lessons, shall be made obligatory in the upper standards.

The following are some of the recommendations regarding Primary education of the Indian Education Commission :—

(1). Primary education be regarded as the instruction of the masses through the Vernacular in such subjects as will best fit them for their position in life, and be not necessarily regarded as a portion of instruction leading up to the University.

(9). The standards of primary examination in each province be revised with a view to simplification, and to the larger introduction of practical subjects, such as Native methods of arithmetic, accounts and mensuration, the elements of Natural and Physical science, and their application to agriculture, health, and the industrial arts; but no attempts be made to secure general uniformity throughout India.

(12). Physical development be promoted by the encouragement of Native games, gymnastics, school-drill and other exercises suited to the circumstances of each class of school.

I will now proceed to submit a few general suggestions for the practical organization of Primary schools.

I would, at the out-set, remark that the number of Primary schools is inadequate. In round numbers there are about 250 schools under the Vernacular department of the State; taking care of 25,000 pupils. Referring to the Census details, it will be observed that the number of boys whose ages range from 6 to 12 is 200,000. If schools are to be established for the instruction of all these youths, the present number will have to be multiplied eight-fold. Such a provision would, however, be unnecessary until Elementary education is made compulsory. It is not for me to discuss the question from a statesman's point of view; but I will take leave to remark that an elevation of the general National standard would be impossible without the adoption of some apparent stringency for ulterior good. It is hardly to be expected that people will avail themselves of the appliances and means placed at their disposal by the State, and the evil of encroachment on individual liberty by making Elementary education compulsory will be more than counter-balanced by the good it will bring in its train. However until this is done, it may fairly be assumed that only half the number of boys between 6 and 12 will care to attend schools. Thus the State should open in all 1,000 Primary schools. The Administration Report of 1884-85, says that His Highness has sanctioned the opening of thirty additional schools every year. If this far-sighted and benevolent policy of His Highness the Maharaja Saheb be continued for twenty years more, there will be sufficient schools for the present needs of the people.

Next with a view to improve the quality of these schools, I beg to propose that the curriculum in force may be thoroughly revised, so as to carry into effect the recommendations of the Commissioners. I do not wish that any practical subject should be introduced into any of the first four Standards, but I would wish that the rudiments of general Science must be introduced in the third and fourth Standards. Full effect must be given to the practice of giving object-lessons. Gym-

nastics and Drawing should be introduced in the third and fourth Standards.

For carrying out all these reforms, the Reading series will have to be revised and compiled again. Sir Theodore Hope's series in the words of the Indian Education Commission, affords an admirable instance of what school books should be ; but *events have not stood still since they were written*. I therefore beg to propose that a Committee of competent men be formed to revise the present series or to publish altogether a new one and also to compile such other text books as may be necessary for the new Standards.

Lastly, with respect to the Primary schools, I beg to draw attention to a point that is of main importance.

Any one who has visited a village school of this country has been painfully struck with the want of good and efficient teaching Mechanism—both living and material—of the Elementary schools. Something has indeed been done of late to improve matters in this respect by the State but I hope it will be no disparagement to say that the present arrangements can yet admit of further improvement.

I would propose that at least four School-masters who have been taught not merely the things they have to teach, but also the principles and practice of teaching, should be sent to these schools on decent salaries. As for the Material appliances, I beg to propose that every school must be furnished with a collection of select works useful for Elementary education, a small Natural History Museum containing a few objects, materials and models for drawing, Gymnastic apparatus and some of the Kindergarten gifts.

TRADE SCHOOL DIVISION.

In the diagram, after leaving the arch of Primary Education there will be seen three chief divisions of the next concentric arch, viz., 1, Trade School ; 2, Upper Primary Division ; and 3, Anglo Vernacular School.

I shall begin with the consideration of ~~Trade-School~~ Division, of which we have no analogue in our present Educational System. There are several students who cannot afford to continue abstract and pure studies long, and wish to learn the practical applications of theory to their own business. This Division is intended to serve as finishing education of such students. According to the varying requirements of different districts, the Trade-school will have to be divided into three sections.—Agricultural, Industrial and Commercial. It is not necessary to have separate institutions to be styled Trade-Schools. What I propose is that one or two or three of these sections may be incorporated with the Primary schools at convenient centres. Suppose the district is agricultural and pastoral; then the agricultural section only should be added to one out of every three or four Primary schools of the district, which would be the principal school of that portion of the district and the rest will serve as feeders. If the district is mercantile or manufacturing, commercial or industrial section should be opened in connection with one of the Primary schools. In important villages we shall have thus what may be called Village Agricultural School combining within themselves the Primary school and the agricultural section of the Trade school division, as most of the inhabitants of villages are farmers and agriculturists, while in towns we shall have what I may call Town Trade schools combining within themselves the Primary school together with the Industrial or Commercial section or both of the Trade school division.

It will be seen from the diagram that the course of each of these three sections extends over three years. The following are the Programmes of Studies which I submit for consideration.

AGRICULTURAL SECTION.

- Agricultural Chemistry.
- „ Book-Keeping.
- Levelling and Surveying.
- Botany—Economic.
- Veterinary Science.

The course of studies of this section should be nearly on the same level with those prescribed for the Elementary examination of the Science and Art department of England,

INDUSTRIAL SECTION.

Scientific Education.

Model and ornamental Drawing.
 Geometry applied to Design.
 General Arithmetic and Book-keeping.
 Mechanics including Mechanical calculation.
 Technical Chemistry.
 Elements of Natural Philosophy.

Manual Education.

The students may be permitted to select any one or more of the following trades and crafts :—

Modelling in Fine Clay or in Wax.
 Carving in Wood.
 Moulding and carving in gypsum.
 “ In sand and in Wax.
 Chipping and Filing.
 Casting in Bronze.
 Shaping and Planning.
 Drilling.
 Turning in wood.
 Turning in metal.
 Chasing in the Lathe.
 Pressing, Stamping and Coining.
 Forging.
 Soldering.
 Burnishing.
 Embossing.
 Chasing.
 Engraving.
 Etching.

Scouring.
 Varnishing.
 Nickel-plating.
 Fire gilding.
 Galvanising.

COMMERCIAL SECTION.

Commercial Arithmetic—Accounts and Book-keeping.

Knowledge of Goods.

Political and Commercial Economy.

Commercial Geography.

„ Correspondence in Gujarati.

Two additional teachers who have received a certificate from the proposed Technical College of the State should be provided for each of these sections of the schools to which any of them be attached.

The requisite material appliances of instruction must also be supplied to these Trade-school divisions.

UPPER PRIMARY EDUCATION.

This corresponds to the fifth and sixth Vernacular Standards of the present system, and in the proposed system occupies the intermediate position between the Lower Primary School and the Technical College. It is thus preparatory for those students of the Primary schools who wish to prosecute further studies in general theoretical subjects and ultimately to join the Technical College. The provision for this preparatory general education may be made in some of the central Primary Schools in the same manner as for the finishing sections of the Trade Schools, and no separate schools are required for this division.

The Primary Schools thus formed may be classified as follows :—

(1). Elementary School intended for Lower Primary Education, i. e., teaching the first four Vernacular Standards.

(2). Village Agricultural School comprising the Lower Primary and Agricultural Sections.

(3). Upper Village School having Lower Primary, Upper Primary, and Agricultural Sections.

(4). Town Schools having Lower Primary and Upper Primary Divisions.

(5). Town Industrial Schools, combining within themselves the Lower Primary, Upper Primary and Industrial Schools.

(6). Town Commercial Schools having the Lower Primary, Upper Primary, and Commercial Sections.

The Syllabus of the subjects of instruction will be as follows:—

Subjects of Instruction for the Upper Primary Division.

Mathematics.—

- (1.) Arithmetic, Complete.
- (2.) Geometry, Euclid Book I.

Vernacular language including Grammar and first principles of style and composition.

Botany—Structure and functions of familiar plants.

Zoology—Principal Mammals.

History of India, complete—with some notions about its Administration.

Geography of India, Commercial, Political and Agricultural.

Physical and Mathematical Geography—Elementary notions.

Human Physiology and Hygiene—The most important facts useful for the preservation of health.

Geology of the District.

Caligraphy and Drawing.

For the Upper Primary Section two additional teachers who have received the license as trained teachers from the proposed Technical College should be provided in each school to which this Section may be connected.

ANGLO VERNACULAR MIDDLE SCHOOL DIVISION.

According to the rules in force the students who have passed their Vernacular V. Standard examination are only admitted to the Anglo-Vernacular Schools. I beg to suggest that the rule should be relaxed a little in order to establish uniformity and admission may be made from those who have passed their IV. Standard examination which is the final test of the Lower Primary School.

The first three English Standards are taught in these schools, and they are framed with a special view to prepare students for the High School whose sole object is the Matriculation examination. I do not see any reason why the influence of Matriculation should be carried down to the Anglo-Vernacular Schools.

Instead of the present Standards which include no portion of useful knowledge, I beg to suggest that subjects prescribed for the Upper Primary Division be all taught with the addition of the English Language which should occupy the place of the second language, the medium of instruction being Vernacular.

The head teacher of these institutions must be a graduate of the Bombay University or one having a diploma of the proposed Polytechnic University. All other men or teachers are to be selected from those who have received education either at the High School or the Real School of the new system.

TECHNICAL COLLEGE.

In the diagram on the top of the Upper Primary Division is placed the Technical College. The chief duty of this College is to serve as a finishing institution for those Middle Class Professional men who cannot afford to learn the English language and then take the benefit of University Education either literary or technical. I would recommend that four such institutions should be established at the capital cities of the four districts.

At present there exists in Baroda a Training College whose chief object is to supply well trained teachers to the Vernacular Schools of the State. This institution itself may be so expanded as to perform all the functions of a Technical College.

Students will be admitted to these colleges principally from those who have passed the final examination of the Upper Primary Section. The admission should not, however, be restricted to them, but some of the students of the three sections of Trade school Division, who may have attained distinction or shown special aptitude for higher courses of study, may also be given admission.

The practical organisation of these colleges will greatly resemble that of the central Technical University. The chief differences may be enumerated to be these:—(1) The medium of instruction will be the Vernacular language; (2) The treatment of subjects will be less elaborate; (3) The scope will be limited, (i.e.) the institution will be developed in fewer sections

As for the curriculum of these institutions, I would beg to refer to the Programme of Studies laid down for a Polytechnic Academy at Surat in a pamphlet which was published by me in the year 1886.

Professional staff of the Technical College.

Professor of Chemistry and Physics and Principal of the College,	from	Rs. 200	to	Rs. 400
Professor of Mathematics	,,	100	to	,, 200
Professor of Biology				Ditto.
Professor of Geology, Mineralogy and Geo- graphy				Ditto.
Professor of Agriculture				Ditto.
Professor of Mechanical Engineering				Ditto.
Professor of Languages				Ditto.
Professor of History and Philosophy				Ditto.
Teachers of Drawing, Surveying and Level- ling	,,	75	to	,, 150
Gymnastic Master	,,	50	to	,, 100

When the central Technical University will be fully developed, this entire staff will be supplied from the graduates of the University.

As for the material Mechanism of these colleges I may merely say that Museums, Laboratories, Collections, Workshops, Drawing and Modelling rooms, experimental farms must all be of a similar nature to those provided for the Central University to be described hereafter, with this difference that they should be on a smaller scale here.

THE REAL SCHOOL.

This is altogether a new addition to the existing system of education, and corresponds to the modern or scientific schools of Europe which are styled Real Schülen (Schools) in Germany. This school is intended to lead the students of the Anglo Vernacular schools to the Polytechnic University, and so far it has a preparatory function. But it has yet another duty to perform, viz., to serve as a finishing school for those students who wish to have liberal education and also ordinary knowledge of the English language; in fact for those who wish to present themselves at the recently created Final School examination of the Bombay University with a view to enter Government Service.

Looking to the present state of matters, High Schools are regarded as merely Preparatory schools for the Matriculation examination. The Indian Education Commission says that "the attention of students is too exclusively directed to University studies, and that no opportunity is offered to the development of what corresponds to the 'modern side' of schools in Europe. It is believed that there is a real need in India for some corresponding course which shall fit boys for Industrial or Commercial pursuits, at the age when they commonly matriculate, more directly than is effected by the present system.

"The University looks upon the entrance examination, not as a test for the fitness of duties of daily life, but rather as

a means of ascertaining whether the candidate has acquired that amount of general information and that degree of mental discipline which will enable him to profit by a course of liberal or professional education. In these circumstances, it appears to be the unquestionable duty of that department of the State which has undertaken the control of education to recognise the present demand for educated labour in all branches of Commercial and Industrial activity and to meet it so far as may be possible with the means at its disposal." The Honourable Mr. Justice (now Sir) West, late Vice-Chancellor of the University of Bombay has expressed his views on the point in the following terms. "The preparation for ordinary business may with advantage proceed up to a certain point along the same course as that for literature and science. It is a defect of our system as I understand it, that it does not provide for a natural transition to the further studies which may be the most proper for a man of business, not even propose to encourage and conduct such studies. When a boy reaches the age of about fourteen, he may have plainly shown that he has not the gifts that would make him a good subject for literary culture. His tastes or his circumstances may disincline him to be an engineer or chemist. He ought not then to be forced on in a line in which failure is almost certain. He should be put to work on matters that he really can master, unless quite exceptionally dull, such as arithmetic, rudimentary economics, mercantile Geography, the use of manures, or others determined by the locality of the school and its needs." The Commissioners then proceed to dilate on the same point and ultimately recommend "that in the upper classes of High Schools there be two divisions, one leading to the Entrance examination of the Universities, the other of a more practical character, intended to fit youths for commercial or non-literary pursuits." The curriculum of High Schools includes Elements of Chemistry, Mechanics, and Astronomy. The instruction even in this portion of science is not quite up to the desired mark. Mr. Justice West has aptly said: "In Physics, and Natural Science

the deficiency is simply lamentable, and general information means general ignorance.”

Thus the necessity of this modern side in High Schools has been fully recognised and my proposal for these Real Schools is based upon it.

These Real schools need not be altogether separate and independent institutions. Economical considerations lead me to propose that they may be established in connection with the High schools or even with the Technical colleges. Under this arrangement the teachers of the High schools or Technical colleges with the addition of a few more teachers will be able to conduct these schools efficiently. I wish that some of the Anglo-Vernacular schools may also be extended and Real Schools may be added to them.

The medium of instruction in these schools is intended to be the Vernacular language, and English to be taught as a necessary second language.

SUBJECTS OF INSTRUCTION FOR REAL SCHOOLS.

First year—corresponding to Standard IV.

Mathematics.

Commercial Arithmetic.

Accounts—courses preparatory to Book-keeping.

Geometry.

Physics—general properties of bodies and heat, and its applications.

Chemistry—metalloids.

Geography of India—agricultural, industrial, and commercial.

Geology—study of the district.

Botany—elementary notions of vegetable Physiology.

Zoology—birds, reptiles, fishes and insects.

The Gujerati language.

The English language.

History of India and leading facts of Ancient History.

Caligraphy and Drawing.

Second year.

Mathematics.

Algebra.

Geometry—descriptive mechanics.

Accounts and Book-keeping.

Physics—acoustics, optics, and electricity.

Chemistry—Metals.

Geography—Commercial.

India considered in her relations with other countries.

Astronomy.

Geology.

Botany—Systematic, distribution of plants.

Zoology—Animal Physiology; Classification of animals.

Gujerati—Course of Literary composition and History of literature.

English—

Ethics—Private Morality.

History of India and leading facts of Modern History.

Principles of Legislation.

Drawing.

Third year.

Mathematics :—

Algebra.

Geometry—Descriptive.

Mechanics and Mechanism, application to Local Industries.

Accounts, Exchange, Finance.

Physics—Recapitulation and Development of the most important points.

Chemistry—applied to Industrial manufacture.

Geology.

Meteorology.

Botany—Agricultural and Industrial.

Zoology in its relation to Agriculture and Industry.
 Hygiene and Human Physiology.
 Gujerati Exercises in Special Literary Composition.
 English—
 Ethics—Public Morality.
 History of India—British Period in detail,
 History of Industrial Invention.
 Commercial and Industrial Legislation.
 Rural, Commercial and Industrial Economy.
 Drawing.

THE HIGH SCHOOL.

With regard to these institutions, the Commissioners say that “they have been regarded exclusively as preparatory schools for those who are to become students of the Universitythe course of instruction is determined by the Matriculation standard, which again is arranged solely with a view to subsequent University studies.” It is then almost impossible for us to effect any thorough reform in the existing standards of a High School, unless and until there be a corresponding reform in the Matriculation curriculum. As I am chiefly concerned with Technical education, and as the creation of the Real School is adequate to meet its ends, I would like to let alone the question of the High School curriculum.

THE LEARNED UNIVERSITY.

There exists in Baroda at present an Arts College teaching up to the Previous Standard. In the beginning of the last year a B. Sc. class was opened in connection with the College, with a view to encourage scientific education. Looking to the B. Sc. curriculum, it will be seen that the aim of this Science course is mainly to impart theoretical scientific education to the students without any reference to practical applications, in other words it is disciplinary or non-technical. The B.

Sc. class here has not attracted sufficient attendance, nor is there any prospect of matters improving in view of the fate of that class in the other colleges of the Bombay Presidency. Besides there will remain no necessity of continuing this class when the Polytechnic University already referred to would be established where ample provision would be made for all the useful branches of knowledge. Thus the B. Sc. curriculum may be dropped in course of time. In its stead the full Arts course may with advantage be adopted, if found necessary. In regard to the Faculties of Medicine, Law, and Engineering, I would omit them in this scheme on the ground that for Engineering a distinct place will be given in the Polytechnic University and as regards Law and Medicine, the limited scope which Baroda presents for these professions, and the high expenditure requisite for maintaining institutions therefor make it advisable that Baroda should draw upon the University of Bombay for that purpose.

THE POLYTECHNIC UNIVERSITY.

At the head of our system of Real Education stands the Polytechnic University, as we have got the Learned University of Bombay at the head of humanistic education. Here we must give the highest degrees and diplomas to our Technical men who would occupy the place of Professional leaders and future teachers of the State. This will be the central place of not only radically and substantially improving indigenous industries but also for the emanation of new manufactures. The influences of this metropolitan institution will be radiated in all directions.

As all other subordinate institutions will be merely reproductions of this on a small scale, the utmost care and foresight are needed for its constitution and development. The task of formulating a scheme for such a grand institution which is destined to promote the Material and Moral welfare of the whole province of Gujarat that has always been forward in Agriculture, Industry and Commerce, seems formidable. Any

attempt on my part to suggest a practical scheme should be looked upon simply as tentative and is intended to serve to attract the attention of eminent educationists and far-sighted statemen.

CONDITIONS OF ADMISSION.

Candidates for admission must have gone through the regular course of instruction of the Real School and must be prepared to submit themselves to an Entrance examination to be held annually by the Professors of the institution. Besides these students may be taken from those who have passed either the Matriculation or the Final School examination of the Bombay University. Some of the students of the Technical College who have shown special aptitude for advanced studies may also be admitted. All these students shall have to follow the prescribed order of studies as will be detailed presently and will be entitled to the Diplomas of the University.

THE MEDIUM OF INSTRUCTION.

Before proceeding to lay down the courses of instruction I may say a few words about the medium of instruction to be adopted at the University. We must acknowledge the sad truth that our Vernaculars possess very few Scientific works and even these few treat the elements of two or three sciences merely. I have not yet come across a single work on Applied Science worthy of the name published either in Marathi or in Gujerati. The phraseology of science is not even settled as yet. Under such circumstances it is imperative that the medium for higher studies must be the English language, at least for some time to come. As long as our Vernaculars do not possess a decent collection of Scientific and Industrial works the highest truths of Science and the valuable treasures of Art cannot but be communicated through the instrumentality of the English language. It is, however, my earnest desire that this deplorable state of our Vernaculars

may soon come to an end and that we shall be able to conduct our own National universities equipped with a native Professorial staff and furnished with a rich library of Scientific works compiled in Vernacular and laboratories and workshops fitted by our indigenous native skill.

THE PROFESSIONS.

I shall now try to enumerate the classes of students for whom this University is contemplated ; in other words, the professions that will find their place therein. The Bombay University has made provision for the learned professions of the Lawyer, the Doctor, the Statesman, the Political Economist, the Pure Mathematician, the Philosopher, the Historian, the Theoretical scientists and consequently these professions should be omitted from our list. All remaining professions may be grouped together under the head of non-learned (not meaning by that term that these professions do not require any learning but signifying merely that they are not popularly considered among the ancient learned professions) or modern or technical Professions, which are appropriately classified as follows :—

- The Agriculturist
- The Miner
- The Metallurgist
- The Civil Engineer
- The Architect
- The Mechanical Engineer
- The Machinist
- The Manufacturer
- The Merchant
- The Practical Chemist
- The Surveyor
- The Teacher or Professor.

The above list includes almost all the Modern Professions except the Naval ones, which I purposely omitted, as our State has not much to do directly with maritime pursuits.

At first it might seem almost impossible to provide for all these dozen professions in one institution, but the solution of

this problem is not so difficult as one might imagine. These dozen professions do not require so many separate establishments and altogether different courses of instruction. For most of these professions the preliminary courses of auxiliary science would be alike. For instance, all those who have to deal with inorganic matter may learn its laws and properties together in one lecture-theatre and may work in the same Physical cabinet; while all those who have to deal with organic matter may study Vegetable and Animal life in the same room, in the same Museum, in the same Botanical garden and in the same Zoological menagerie.

FACULTIES.

To provide for the instruction of all these multifarious professions the University shall have to be divided into the following faculties.

- I. The Faculty of Chemical Technology.
- II. The Faculty of Agriculture and Forestry.
- III. The Faculty of Mechanical Technology.
- IV. The Faculty of Civil Construction.
- V. The Faculty of Mining and Metallurgy.
- VI. The Faculty of Commerce.

THE PROGRAMME OF COURSES OF INSTRUCTION.

I shall now proceed to lay down a syllabus of subjects of instruction for these several Faculties. A detailed curriculum taken from Owen's College prescribing courses of studies for each year is given for the faculty of Chemical Technology while I have rested satisfied with the enumeration of subjects for the other Faculties after the model of the curriculum of the Zurich Polytechnic University.

I.—THE FACULTY OF CHEMICAL TECHNOLOGY.

First year.

Mathematics.—

Geometry, Euclid I, III and VI, propositions 1, 19 and 38.

Algebra.—

As far as Progressions.

Experimental General Physics.—

Properties of Bodies; principal propositions in Statics, Kinetics and Hydrostatics.

Systematic Chemistry.—

Laws of Chemical combination, description of Physical and Chemical properties, and the mode of preparation of the non-metallic elements and of their compounds.

Geology.—

Stratigraphical Geology. The physical structure, classification and history of the Rocks.

Analytical and Practical Chemistry.—

The methods and practice of Qualitative Chemical analysis.

Geometrical and Mechanical Drawing.—

Second year.

Experimental Physics.—

The chief phenomena of sound, heat, light, electricity and magnetism.

Systematic Chemistry.—

Chemistry of the metals and of their most important compounds. Elements of organic Chemistry giving the compositions and relations of the best defined groups of organic bodies and the laws regulating their formation.

Analytical and practical Chemistry—

Laboratory course, quantitative chemical analysis, volumetric analysis.

Technological Chemistry lectures—

Sulphuric acid and soda manufactures, bleaching powder, potassium chlorate.

Mineralogy: introduction to the study of—

the Chemical properties of minerals, classification of minerals, descriptive mineralogy.

Geometrical and mechanical drawing

Third year.

Systematic Chemistry—

Organic chemistry, chemistry of the carbon compounds, history of the old and new theories, and of the most recent important discoveries in organic chemistry, &c.

Chemical philosophy.—

Sketch of the History of chemistry, development of modern chemistry, chemical laws and theories, relation of chemistry to physics.

Analytical and practical Chemistry.—

Laboratory course, water analysis, organic analysis, vapour densities, gas analysis, coal-gas, photometry; the preparation and analysis of various pure chemical substances or series of these; the extraction of various pure chemical substances from certain crude commercial products, their identification and analysis.

Technological chemistry lectures—

Destructive distillation of wood and products derived, destructive distillation of coal, distillation of coal tar, and separation of the crude tar products. Ammonia and ammonium salts from gas liquor.

Visits to Chemical Works.

Physical Laboratory—

- (1) Instruction in performance of the experiments seen in the lecture-room; and
- (2) In the use of the instruments, of precision in the physical laboratory.

Practical Mineralogy—

Practical determination of minerals, by their crystalline form, measurement of the interfacial angles of their

crystals with the hand, goniometer or reflecting goniometer, and their reactions with the blow-pipe and re-agents.

Technological Mineralogy.—

Treatment of the minerals used in the arts and manufactures (especially those treated in the foregoing courses of technological chemistry), with regard to occurrence, recognition, composition, and properties.

Mechanical drawing.—

Fourth year.

Organic Chemistry Lectures.—

Technological Chemistry Lectures.—

Manufacture of Glass and Pottery, manufacture of pure coal tar products, of the commercially useful intermediate derivatives and of the coal tar Dyes, colouring matters, &c.

Visits to Works.

Analytical and Practical Chemistry, Preparation or extraction of pure Chemical substances with their analysis.

Original investigation and Re-search. The solution of various problems arising in the processes of the Chemical industries.

As an example of one branch of study may be specified :—

For Calico—Printers, Dyers and Colour manufacturers.

The analysis and valuation of the entire series of Printer's and Dyer's Chemicals.

The Qualitative determination and detection of colouring matters, Technical determination of the tinctorial value of alizarins, the preparation of pure coal tar products, and coal tar colours and other derivatives.

Chemistry of Colouring matters.

Dyeing and Calico Printing.

Mechanical Drawing.

II.—THE FACULTY OF AGRICULTURE AND FORESTRY.

Pure Science.

Mathematics.
 Physics.
 Chemistry.
 Natural History.
 Geology.

Applied Science.

Anatomy of Plants.
 Physiology of Plants.
 Anatomy of Animals.
 Physiology of Animals.
 Geology of soils.
 Chemistry of soils.
 Chemistry of manures.
 Chemistry of Food.
 Veterinary medicine and Surgery.
 Surveying, Levelling, Plan-drawing and Drawing.
 Practical Mechanics.
 Principles of steam Engines.
 Agricultural Machinery and Implements.
 Nature and influence of climates.
 Buildings, Roads, Gates and Fences.
 Training Fruit Trees and Timber.

Practical Work.

In the Mechanical Work-shop.
 In the Hospital for Animals.
 In the Farm.
 In the Chemical Laboratory.
 In the Physical Laboratory.
 In the Drawing Office.
 In the Museum of Natural History.
 In the Museum of Geology.

III.—THE FACULTY OF MECHANICAL TECHNOLOGY

Pure Science.

Higher Gometry.

,, Algebra.

,, Arithmetic.

,, Statics.

,, Dynamics.

,, Energetics.

,, Chemistry.

,, Metallurgy.

Applied Science.

Descriptive Geometry

Constructive Geometry

Geometric Movements.

Sources of Materials.

Properties of Materials.

Strength of Materials.

Elements of Machines.

Structural Mechanics.

Machinery and Tools.

Engines and Prime Movers.

Economics of Work.

Endurance of Machinery.

Machine shops and buildings.

Mechanical Manufactures.

Political Economy.

Workshop Economy.

Principles of Designs.

Practical Work.

In the Drawing Office.

In the collection of Machines.

In the collection of machine materials.

In the collection of raw materials of manufacture.

In the collection of engines, &ca.
 In mechanical experience.
 In the factory.
 Round the tour of Indian manufacturies.
 In foreign travel.

IV.—THE FACULTY OF CIVIL CONSTRUCTION. (ENGINEERING DIVISION.)

Pure Science.

Higher Geometry, Algebra and Arithmetic.
 Statics and dynamics.
 Energetics.
 Hydrology.
 Chemistry.
 Geology.
 Crystalloggy.

Applied Science.

Engines and prime movers.
 Theory of Vehicles and locomotive machines.
 Chemistry of building materials.
 Geology of stones and cements.
 Mineralogy and metallurgy.
 Stability of foundations.
 Building combinations of materials.
 Sources of materials of construction.
 Theory of bridges, roofs and tunnels.
 Constructive Geometry.
 Perspective Geometry.
 Geometric movements.
 Strength of materials.
 Machines and tools.
 Theory of rivers, tides and waves.
 Theory of roads, rail-roads and canals.
 Principles of architectural designs.
 Economics of construction.

Endurance of Structures, Engines, machines and imple-
ments.

Practical Work.

In the Drawing office.
In the collection of engineering models.
In the collection of building materials.
In the collection of machines.
In the Laboratory of strength of materials.
In the Chemical Laboratory.
In the Engineering experiment.
In the Factory.
On the Works.
In Foreign Travel.

(THE ARCHITECTURAL DIVISION.)

Pure Science.

Higher Geometry.
Laws of Number and Proportion.
Statics.
Psychology.
Aesthetics.
Physics.
Chemistry.
Animal Physiology.
Botanic Organography.
Geology.
Art History.

Applied Science.

Descriptive Geometry.
Geometry of Vision.
Constructive Geometry.
Graphic Geometry and Surveying.
History of Building materials.
Strength of Materials.

Chemistry of building materials.
 Geology of Stones and Cements.
 Mineralogy.
 Stability of foundations to structures.
 Theory of arches and roofs.
 Forms of Beauty.
 Forms of Strength.
 Proportions of mass.
 Linear Decoration.
 Surface Decoration.
 Solid Decoration.
 Building Processes, Tools and Machinery.
 Building Economy.
 Building Endurance.
 Domestic Health.
 Domestic Economy.
 Domestic Comfort.
 Laws of sound and hearing in building.
 Laws of climate and weather.
 On use, purpose, and fitness.
 Principles of Design.
 Laws of property of building.
 Landscape Design.

Practical Work.

In the Drawing Office.
 In School of Design.
 In Modelling School.
 In Mechanical Experiment.
 In the Museum of ancient Models.
 In the Museum of Modern Architecture.
 In the collection of Building Materials.
 In the collection of Decorations and Art workmanship.
 In an Office of Works.
 On the Works.
 In Foreign Travel.

V.—THE FACULTY OF MINNING AND METALLURGY.

(MINNING DIVISION.)

Pure Science.

Mathematics.

Physics.

Chemistry.

Geology.

Political Economy.

Applied Science.

Descriptive science.

Trigonometrical Surveying.

Mineralogical Drawing.

Distribution of minerals.

Practical Mechanics.

Elements of Machinery.

Steam Engines and Boilers ventilation.

Drawing.

Physiology and Chemistry of life.

Practical Work.

In the Chemical Laboratory

In the Physical Laboratory

In the Drawing Office.

In the Museum of Geology.

In the Mine.

In Foreign mines.

(THE METALLURGICAL DIVISION.)

Pure Science.

Mathematics.

Physics.

Chemistry.

Geology.

Applied Science.

Swelting and refining.

Practical Mechanics.
 Strength of Materials.
 Descriptive Geometry.
 Mineralogical Drawing.
 Combustion and ventilation.
 Elements of Machinery.
 Steam Engines and Boilers.
 Statics of Buildings.
 Nature of Machines and Tools.
 Hydrolic Machinery.
 Electro-Magnetic Metallurgy.

Practical Work.

In the Chemical Laboratory.
 In the Physical Laboratory.
 In the Drawing Office.
 In the Museum of Geology.
 In the Metal Manufactory.
 In foreign travel.

VI.—THE FACULTY OF COMMERCE.

Pure Science.

Geography.
 Natural History.
 Ethnology.
 Political Economy.
 Doctrine of Probabilities.
 History.
 Languages.
 Ethics.
 Law.

Applied Science.

Construction and outfit of ships.
 Docks and Warehouses.
 Physical Geography.
 Political Geography.

Geography of Plants.
 Geography of Animals.
 Geography of Minerals.
 Weights and Measures of Nations.
 Moneys of Nations.
 Statistics and Wealth of Nations.
 Laws of Value.
 Laws of Insurance.
 Laws of Navigation.
 Principles of exchange.
 Theories of price.
 Interest and Banking.
 Laws of Commerce and shipping.

Practical Work.

In Natural History Collections.
 In Collection of Raw Materials.
 In counting-house and Warehouse.
 In Foreign Travel.

FOREIGN TRAVEL.

Foreign travel would be found to be one of the practical subjects set down for our Polytechnic University. What I intend is that a resort to foreign countries should not be necessary so far as School or University education is concerned. A good Polytechnic Institute worked here in the way I have proposed would, I am convinced, impart as much theoretical and practical knowledge as can be picked up in any of the foreign Scientific and Technical colleges, and it is only the select students who have learnt all that can be taught in this country, whom I reserve for being sent to travel abroad to see the working of the large factories and extensive workshops, not to be found except in Europe, and America. I expect that the adoption of this proposal will achieve better results than the sending of raw youths to pick up their entire education in Europe, and will also be more economical.

PROFESSORIAL STAFF FOR THE UNIVERSITY.

GENERAL PROFESSORSHIPS.

		Rupees from and to-p.m.
Professor of Mathematical sciences	.....	500 to 1000
Professor of Physical sciences	.....	500 „ 1000
Professor of Cosmological sciences	.....	500 „ 1000
Professor of Biological sciences	.....	500 „ 1000
Professor of Literature	.....	500 „ 1000
Professor of History and Philosophy	.....	500 „ 1000

SPECIAL TECHNICAL PROFESSORSHIPS.

		Rupees from and to-p.m.
Professor of Mechanical Technology	.....	500 to 1000
Professor of Chemical Technology	.....	500 „ 1000
Professor of Mining and Metallurgy	.....	500 „ 1000
Professor of Commerce	.....	500 „ 1000
Professor of Agriculture	.....	500 „ 1000
Professor of Engineering and Architecture	.....	500 „ 1000

In addition to the above mentioned Professors, Lecturers, Demonstrators and Superintendents, in all about one dozen more, on an average salary of from Rs. 200 to 500 will be required.

Here the question will naturally arise where we shall seek all these Professors. It is almost impossible to expect that many natives of India can be found to worthily fill all the higher chairs, but all the subordinate chairs together with some of the higher chairs can very well be occupied by distinguished Graduates of our Indian Universities. For the most of the dozen higher chairs, European scientists must be invited to conduct them for one generation at any rate. Among the Europeans very few best qualified Englishmen would come forward to take up these chairs as the salary proposed will not be a sufficient inducement to them to leave their Homes. The Continental standard of remunera-

tion is much lower than that of England, and so we shall be able to secure the services of superior scientists of Germany and other countries on these salaries. I shall, moreover, like to prefer Germans to Englishmen as the Professors of our University on several other grounds among which I may mention only one. The Germans and the Swiss have got the best Technical universities in the world established many years ago, and consequently they have a long and thorough experience of conducting such Technical institutions; while the English people have only lately made a substantial beginning in the matter of Technical education. England has even now got no Technical institutions which can be compared with the Zurich university. It is a well known fact that the students from all countries including England desirous of having systematic technical education flock to the German Universities and many German technical men have been employed by English capitalists to conduct large factories in England itself. Further I have heard that at present in Germany owing to its elaborate and fully developed systems of technical education, the supply of technical men has far exceeded the demand. Thus the Continental savants would best suit our University.

If our Technical University is to be successful, its Professorial staff must be of the highest kind available. Our Professors should be esteemed in repute equal to, if not greater than that of other responsible officers of the State and so they must have an income as large as that of a *Suba* or a *Judge*.

MATERIAL MECHANISM OF INSTRUCTION.

Museum of Geometry.—Geometry is looked upon as merely an abstract science in a literary University, but in a technical University it should be treated in quite a different manner. All the Geometrical forms should be presented to the view of the student in concrete form. Therefore this Museum should be furnished with “classified progressive illustrations of all the most beautiful, curious, and useful forms which human genius has created or which the geometry of Nature has

embodied in the works of Nature or enveloped in its laws." It should also contain all the varieties of solid forms, such as models of spherical geometry and their developments.

The Hall of Mechanics.—This should "contain a systematic development of every kind of tool the human mind has been able to invent or that the human hand is able to wield." It must next contain all the varieties of steam-engines, water-engines, fire-engines, gas-engines, magnetic-engines, and electric-engines, and also models, on a small scale of various departments of manufacturing machinery such as the oil-mill, spinning and weaving-mill, paper-mill, &c.

The Hall of Physical Science.—It should contain apparatus to demonstrate all the principle phenomena of Nature, including those of heat, light, sound, electricity, and magnetism as well as physical geography and meteorology.

The Hall of Chemistry.—In a technical University, none should be on a grander scale; for none can be more useful than this Hall of "The Modern Magician, the all-powerful Alchemist."

It should be furnished with all the appliances requisite for the principal chemical industries, e. g., Sulphuric Acid Manufacture, Alkali Trade, Dyeing, Bleaching and Calico-printing, &c.

Museum of Geology :—This should contain all varieties of crystals, shells and other specimens of Rocks as well as Paleontological series.

Museum of Raw Materials :—This should contain all specimens of Raw materials of vegetable, animal and mineral sources.

Botanical Gardens :—The site of our University should be as near to the Public Park as convenient so that all the living specimens of vegetable life may be familiarized to the eyes of the students. The University compound should also enclose a systematically organized Botanical Garden.

Meteorological Observatory:—A separate building should be erected at a convenient site in the garden of the University.

Zoological Collection:—This should be furnished with every species of animals available in this part of the country.

Anatomical Museum:—This should contain all prepared specimens of animal as well as human structure.

A Museum of Fine Art:—In addition to the above Museums and Halls, actual workshops and manufacturing Laboratories should be attached to the University. In a country like England teeming with manufactories and Mills, such workshops and Laboratories for the "Mimicry of work" would not be necessary but it would be indispensable in a country like India, where only a few industrial Establishments exist, to attach workshops and Laboratories for carrying on Industrial work on a small scale. Thus the following institutions for practical work are proposed to be established in connection with the University.

- 1 A Mechanical Workshop.
- 2 A Chemical Laboratory for Analytical work.
- 3 A Chemical Laboratory for Manufacturing Experiments.
- 4 A Drawing Office.

Lastly, I propose a *Library* to be established in connection with the University whose scope should be extensive and in due proportion to the development of the University and the ultimate aim should be to form a complete collection of all the important English, American, German and French works on Pure and Applied sciences.

DIPLOMAS.

It is desirable that our University should grant diplomas for completed studies, which should be of two kinds, the Associate-ship and the Fellow-ship. The Associate-ship should be awarded to students who shall have gone through the com-

plete course of instruction and have satisfactorily passed the examinations. The examinations will be held by College Professors at the end of each year, the last of which would be essentially practical in character. The fellowship would be conferred upon persons who, having obtained the Associateship, and spent at least three years in actual practice, should produce evidence of having done some original and valuable re-search work, or of having otherwise contributed to the advancement of the industry in which they are engaged by their work here or abroad.

THE BUILDING.

As for the building required for this Institution, I beg to propose that in the beginning, the present College building is the most suitable in all ways. The High-school may be located in some one of the unoccupied Palaces which could with a little cost and pains be converted to the uses of that school.

By the adoption of this measure great present outlay might be spared and immediate accommodation can be given to our University. In course of time, however, a new building may be built, the design for which should be taken from that of the Zurich University or the City and Guilds of London Institution.

GOVERNMENT AND WORKING.

The last subject I refer to is that of supplying the personal organization of the complicated system I have proposed. The duty of working this system should be left to a minister of education assisted by a Council of seven savants representing different branches of learning. The selection of the officer whom I term the minister of Education can never be too careful. He must be one who has himself received first Class education, and combines in himself administrative ability, zeal and tact. His business will be to study the educational needs of

the various classes of the population, devise schemes to satisfy them, and superintend the working of such schemes as may be adopted. The seven gentlemen intended to assist him should represent the Mechanical professions, the Fine Arts, Manufacture, Commerce, Agriculture, Literature and Philosophy.

This educational personnel is to act under the orders of the final authority, viz., His Highness the Maharaja Saheb, with whom as Chancellor of the University I have proposed will rest the granting of the diplomas.

FINANCE,

The ways and means of carrying out the above scheme are the most important matter, in the details of which I have not gone. I am prepared to supply them at any time I am called on to do so. I have not given them here because I felt it would be a waste of energy to note them before it is determined what portions of the Scheme are considered worth adoption. I might, however, mention generally that a reorganization on the above basis may not cost the State more than three times the present annual expenditure when the system is perfectly developed.

CONCLUSION.

I have given but a bare sketch of my ideas on the subject of National education. The vastness of the field traversed over made it impossible for me to have done anything, more in a short Note like the present. I am not so vain as to imagine that there will not be several deficiencies or errors in my views as above expressed. My object is to press on the attention of His Highness the Maharaja Saheb the extreme necessity of overhauling and reorganizing the present system of education. If I succeed in exciting thought and attention, no one will be more ready to accept necessary modification than I. I beg leave to conclude with a prayer and hope that His

Highness will realize that of all the blessings which an enlightened Prince like His Highness can bestow on his loving and devoted subjects none can be so lasting and really valuable as placing within their reach the means of practical education worthy of the name.

T. K. GAJJAR.