

C. E. I. 16.

LEAGUE OF NATIONS

ECONOMIC AND FINANCIAL SECTION

INTERNATIONAL ECONOMIC CONFERENCE

GENEVA, MAY 1927

DOCUMENTATION

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ELECTRICAL INDUSTRY

GENEVA 1927

Publications of the League of Nations

II. ECONOMIC AND FINANCIAL

1927. II. 7.

NOTE BY THE SECRETARIAT

At its first session in April 1926, the Preparatory Committee for the International Economic Conference decided that it was necessary to submit to the Conference a series of memoranda describing the present position in certain major industries, among them the electrical industry. The Committee at the same time outlined the general scheme on which these studies were to be carried out.

The Secretariat was instructed to prepare for the Committee's second session, in November 1926, memoranda on certain key industries. With regard to the other more important industries, among them the electrical industry, it was thought better to obtain memoranda from the competent organisations in certain countries. Consequently, at its second session, the Committee was placed in possession of a memorandum prepared by the Zentralverband der deutschen elektrotechnischen Industrie.

At its November session, the Committee decided that the memorandum from the above-mentioned German Association should be circulated by the Secretariat to members of the Committee for the observations of the competent organisations concerned in their countries.

Subsequently, such observations were received in the form of a monograph on the Electrical Industry by the British Electrical and Allied Manufacturers' Association (Inc.); a Note on the Electrical Industry by l'Union des syndicats de l'électricité (France); Notes on the Austrian Electrical Industry, by the Verband der Elektrizitätsindustrie Oesterreichs, on the Electrification of Italian Railways, communicated by H.E. M. de Stefani; and Statistics of the Electrification of French Railways on January 1st, 1927, by the Union des syndicats de l'électricité; also Observations on the German Memorandum from the competent organisations in Great Britain, France, Italy and Sweden.

At its meeting in Paris on February 23rd, 1927, the Documentation Committee of the Sub-Committee B of the Preparatory Committee for the International Economic Conference decided that the general Memorandum prepared by the Zentralverband der Deutschen Elektrotechnischen Industrie should be published together with the documents enumerated above, with the exception of those observations of which account has been taken in the form of corrections in or footnotes to the German Memorandum. A full list of the contents of the volume is printed on page 3.

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1.

THE ELECTRICAL INDUSTRY.

Memorandum prepared by the
**ZENTRALVERBAND DER DEUTSCHEN ELEKTROTECHNISCHEN
INDUSTRIE.**

Communicated by M. C. LAMMERS

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INTRODUCTION.

The following monograph for the use of the International Economic Conference is intended merely to serve as a basis for a comparative study of the position of the electrical industry. The incompleteness of the statistical material available made it necessary in the following memorandum to be content for some important points with estimates and with information from trade sources, which have been carefully sifted. The aim was, more especially, to find and to apply such methods as might furnish useful material for an international comparison. It is hoped that any criticisms made on the work will not only lead to valuable additions to the actual data, but also promote the general adoption of a uniform system of statistics of production.

The electrical industry occupies a special position in that to a great extent it is applied to services whose field of operation ranges far beyond national, and even continental, boundaries. This special character makes international technical collaboration in the domain of telegraphy and telephony imperative. But improvements in the generation and transmission of electrical power must also cause a greater degree of interdependence between nations, and here, too, increased international technical collaboration is required. Moreover, the economic interests of the countries importing electrical products demand technical standardisation of the goods, which is only attainable through technical collaboration among the exporting countries.

Hence, technical collaboration throughout the entire electrical industry becomes more and more an urgent international duty.

All the figures relating to the manufacture of electrical goods and to the labour employed in the industry show a marked upward tendency. From 1913 to 1925, the value of the output of electrical goods all over the world rose from about 4.1 milliard marks to about 12 milliard marks, and the number of workers employed in the electrical industry from about 450,000 to about 830,000. The volume of production and the quantities exported have approximately doubled.

Marketing prospects are favourable, as soon as normal economic conditions return, since the opening of new fields for electrical appliances depends on the general well-being.

The advances made in wireless and in television open up wide vistas in the domain of low-tension current. The increasing use of the telephone tends more and more to encourage new automatic devices.

As regards high-tension current, constant progress is being made both in the exploitation of sources of power and in distance of transmission. This holds out prospects of cheapening the prices of current — a *sine qua non* if the use of electricity is to become general. The figures for the generation of power have almost quadrupled since 1913. In spite of this increase, the electrification of many branches of industry is still only in its infancy. Only about 1 per cent. of the total length of the world's railways has been electrified. The use of electricity in agriculture and in the home is in most countries still in the initial stages of development.

The whole question to what extent and how rapidly the use of power for industrial and other purposes — and hence the demand for electrical goods — can be developed depends not only on a rise in purchasing power, but also on the supply of cheaper current. In this domain a great opportunity is offered to neighbouring nations to collaborate for the advancement of their industry and the prosperity of their people.

1. THE ESSENTIAL CONDITIONS GOVERNING THE DEVELOPMENT OF THE ELECTRICAL INDUSTRY.

To a great extent the electrical industry is applied to services whose field of operation is international. Both as regards technique and manufacture, therefore, international co-operation is required to an exceptional degree. In the following pages an attempt is made to indicate the essential tasks to which such co-operation should be directed.

A. — INTERNATIONAL TRANSMISSION OF MESSAGES, ETC.

1. *Telegraphy.* — The international importance of telegraphy as an important medium of intellectual and economic collaboration between nations was universally recognised from the outset. No effort was spared to place telegraphy at the service of all, irrespective of national frontiers. Hardly ten years after its introduction, a first — and for the moment unsuccessful — attempt was made in 1858 to lay a cable across the Atlantic Ocean. In 1866 an efficient working connection was established between the Old and the New World. Meanwhile telegraphic systems in both hemispheres, wherever the need for communication existed, grew and multiplied over land and sea. The great overland telegraph line from England to India was on the point of completion. The world cable system was steadily expanding. It was not until all the interested countries could be induced to collaborate and to agree on common rules for the construction and operation of the system that rapid communications for the whole of the civilised world could be accomplished and a close network of connections be provided to the most remote parts of the inhabited globe.

This agreement — a model of international co-operation — was successfully reached in 1875, and is embodied in the St. Petersburg Convention concluded in that year, which founded the Universal Telegraphic Union. Its organ is the Bureau of the Universal Telegraphic Union at Berne, whose business it is to execute the decisions of the Congress, which sits every five years, to maintain the necessary contact, and prepare for new sessions. It is thanks to the Universal Telegraphic Union that the international telegraph service, through the harmonious co-operation of all the countries concerned, has become the efficient instrument we know to-day. The Union was able to survive the war, and, as the last Congress in Paris in the autumn of 1925 showed, to resume its successful activities after the war. The new executive regulations framed in Paris for the international telegraph service testify to its vitality. The Universal Telegraphic Union has taken up the new task of settling the technical questions of telegraph service, and for this purpose a special committee (the International Advisory Committee on Telegraphic Communications) has been formed, which met for the first time in 1926.

2. *Telephony.* — The regulation of the international telephone service is another function of the Universal Telegraphic Union. The first provisions on

this matter are to be found in the Agreement concluded by the Universal Telegraphic Union Conference at Berlin in 1885; these were later supplemented at the following congresses — Paris, 1890; Budapest, 1896; London, 1903; and Lisbon, 1908. They were confined to a few working regulations, as international telephone communication was still quite undeveloped in 1908.

Before and during the war the position underwent a decided change. The invention of the amplifying valve as a telephone relay made it possible to extend telephonic communications from country to country in a manner not before dreamed of. In 1915 the United States of America constructed the overland telephone line from New York to San Francisco, a distance of 5,000 kilometres, and covered their country with a close network of long-distance telephone lines, so that in a few years telephonic communication was possible over almost the whole of its vast territory. Europe, as a whole, was unable to follow America's example at once — greatly as she needed such a telephone system with its unlimited facilities for communication — in view of the collapse of her economic systems and her disintegration into separate States. But all European countries made an attempt to pave the way for such a consummation by adapting their telephone systems, within their own frontiers, to the exigencies of a European system. Even before the Universal Telegraphic Union was able to resume its work after the war, the telephone engineers of all European countries of any importance from the point of view of telephone communications, combined to form a plan for a European telephone system. This task is far more difficult than the international regulation of telegraphic communications. In the case of telegraphy, technical questions have so far played a minor part, and the chief issues have been questions of transmission and rates, the solution of which, after fifty years of continuous co-operation, is comparatively simple. Telephonic communication presents a more difficult task, the central problem of which is technical. The question was, and still is, to reach, and to maintain permanently, an understanding on all the details of the complicated and constantly changing technique of long-distance telephony, for no efficient service is possible until the installations for transmission between the various countries are technically uniform and standardised in all their parts, and operated by rules which must be identical down to the minutest particulars. Further, as the telephone does not operate from office to office like the telegraph, but from speaker to speaker, and the same apparatus and a large proportion of the wires have to serve both for inland and international use, it follows that the necessary technical agreements for international communication will substantially affect the arrangements for inland communication, and accordingly, if our object is to be obtained, a radical standardisation of the entire European telephone system must be effected.

Thanks to the spirit of confidence existing between the Telegraph Departments of the countries concerned — a confidence arising from effective co-operation in the Universal Telegraphic Union, which, though shaken by the war, soon revived — the technicians have made a promising start in their work. After a

preliminary conference in 1923, the European telephone experts met in May 1924 in Paris at the invitation of the French telegraph administration, for the first session of the Advisory Technical Committee on Long-Distance Telephone Communications (Comité consultatif international des Communications téléphoniques à grande distance, abbreviated as C.C.I.). At this meeting the C.C.I. was constituted, and a first foundation laid for the institution of uniform rules of installation and operation for the European telephone service. It was decided to hold the meetings every year and, in addition to a general secretariat with provisional headquarters in Paris, to create a permanent Committee of representatives of the principal countries concerned (at present 11), whose duty it would be to study the questions upon which no decision had been taken during the sessions and to draft recommendations, so that the C.C.I. could adopt decisions at the plenary session. The second session of the C.C.I. took place in June 1925, and pursued its labours on the basis of the first resolutions, with the result that a serviceable book of rules has already been evolved embodying the technical provisions for the construction, operation and upkeep of long-distance telephone installations.

In connection with these technical regulations and in continuation of the previous work of individual countries — in particular, Germany, England, the Netherlands, Sweden and Switzerland, on whose experience the regulations are mainly based — a notable advance has been made in the last few years towards the association of European countries in a uniform telephone system: the cable systems in the above countries have been enlarged for international service and have been carried to the frontiers and coasts. The straits and seas between England and the Continent and between Germany on the one hand, and Denmark and Sweden on the other, have been spanned by maritime telephone cables. Other European countries — Belgium, France, Italy, Austria and others, are engaged on the construction of telephone cable installations to connect them with the adjacent countries. Thus, by the beginning of 1927, a coherent European telephone cable system will be available from the Baltic countries to Italy and from the British Isles to Austria, and so, in harmonious co-operation between European countries, a work will have been accomplished whose significance for the economic and intellectual needs of Europe cannot be too highly rated.

Meanwhile, the International Telegraphic Union, at the Paris Congress in September 1925, formally attached the C.C.I. to its organisation, the latter being now considered as a Committee within the Union but with the right to determine its own organisation and to pursue its work in the same way as before. The Committee is no longer limited to Europe, and henceforward every country represented in the International Telegraphic Union can take part in the deliberations and work of the C.C.I. In this way the door is opened for the transition from a European to a world telephone system. If the engineers succeed in linking up the existing wireless connection between England and America — which has already given most successful results in experimental working — with the telephone systems on both sides of the Atlantic and so create a universally available

medium of communication, and if the progress made in quite recent years in short-wave telephony makes it possible to increase the number of transoceanic connections in proportion to the need, long-distance telephone communications over land and sea will soon be just as indispensable as short- and medium-distance messages are to-day.

3. *Wireless*. — In wireless, the first beginnings of which date back to the turn of the century, international regulation was also very soon reached between the administrations and private companies concerned. Here international agreements are indispensable, as all messages from the transmitting station of any one country penetrate more or less, according to their range, into other countries and out to sea. The first branch to be regulated was maritime wireless, *i.e.*, communications between ships and between coast stations and ships. The first preparatory Wireless Conference met as early as 1903 in Berlin, and included representatives from the United States of America and the principal European countries (Germany, England, France, Italy, Austria-Hungary, Russia and Spain). The recommendations of the Conference, apart from questions of administration and the basis of the charges for maritime wireless messages, urged the introduction of Government supervision of the new means of communication and the recognition of the principle that the various wireless systems should be on an equal footing and pledged to reciprocal interchange. On the basis of these proposals, an international draft Wireless Convention was prepared, and submitted to the first General Conference, which met in 1906 at Berlin and at which thirty countries were represented. The Convention contained the fundamental provisions for maritime wireless (Government supervision, obligation imposed on all wireless stations to exchange messages, irrespective of the system used, means of preventing reciprocal interference, priority of S.O.S. calls from ships, etc.). The Convention came into force on June 1st, 1908, though with the proviso that the countries pledged to the Marconi system (chiefly America, England and Italy) would not, for the time being, accept the rule of co-operation with all other systems. This difficulty was overcome at the second International Wireless Conference in London in 1912. From that date, the maritime wireless service made rapid strides. In the meantime, wireless messages from country to country, between fixed transmitting and receiving stations, had become an important means of communication. Here, where no rules had already been imposed by the Universal Telegraphic Union, agreements were only reached from time to time between the administrations and the private companies directly concerned (see also Section 12). It was hoped that the third International Wireless Conference at Washington, which, by the London decisions, was planned for 1917, would provide universal regulations. But the war intervened. This Conference, however, is expected to take place in 1927. It will be a particularly important occasion, as the latest advances of wireless science are all to come under international regulation: wireless telephony, television and broadcasting, which last has developed rapidly within the last few years.

Wireless telephony has already made an auspicious beginning in the wireless telephonic connection between England and America already referred to. The successes quite recently obtained with short wave-lengths encourage the belief that wireless technique and telephone technique in conjunction will soon achieve useful results, so that wireless communication will be possible where telephone lines cannot be employed.

Television, by which it is possible to transmit exact reproductions of pictures and printed or written matter (photographs, newspaper prints, documents, cheques, etc.) with the rapidity of the telegraph over the greatest distances, is already far beyond the experimental stage. Its application will constitute a hitherto unforeseen enrichment of rapid international communication.

As regards broadcasting, which in most countries is not operated directly by State administration, but by private concerns, international regulation was provided for in 1925, when the International Union of Radio-Telephony was founded with its office in Geneva. This body has done valuable work in the short period of its existence, and has become an indispensable factor in international co-operation.

Having regard to the close relationship between the various branches of the international communication service, all forms of wireless undoubtedly fall within the purview of the International Telegraphic Union. The Wireless Conference at Berlin in 1906 therefore turned over to the International Telegraphic Bureau in Berne all business in connection with maritime wireless. The Wireless Conference at Washington will have to decide whether it intends to join up with the International Telegraphic Union, so that the several branches of international communication (telegraphy, telephony and "wireless" in all its forms) shall be united in a single organ.

It appears from the foregoing that international co-operation for the rapid communication of news is progressing in a most satisfactory way. Even the question of the standardisation of the electrical fittings of the apparatus is being investigated by the International Telegraphic Union.

The development of rapid communication will in fact provide a vast field of activity for the whole low-tension industry for some time to come.

The domain of wireless in particular, in view of the developments outlined above (television, introduction of short wave-lengths) presents considerable technical problems for the manufacturers.

In telephony the use of the automatic switch connection is making rapid progress. About 3.6 million telephones connected with public exchanges all over the world are now automatically operated. There is no doubt that the extraordinary advantages of automatic working will compel telephone administrations in all countries, particularly in the big towns, to introduce automatic connection. A survey of the development of telephony in all parts of the world is given in the following table:

POSITION AND DEVELOPMENT OF TELEPHONY THROUGHOUT THE WORLD
BY COUNTRIES (JANUARY 1ST, 1925).

Countries	Number of connections (000's)	Percentage of total connections	Connections per 100 inhabitants	Increase of connections in 1924 (000's)	Length of telephone wires in thousands of kilometres	Percentage of tele- phone wires of the world	Length of telephone wires per 100 inhabitants (km.)
<i>North America:</i>							
United States . . .	16,073	61.7	14.2	839	83,700	61.0	73.8
Canada	1,072	4.1	11.6	63	5,028	3.7	54.5
Other countries . .	155	0.6	—	10	705	0.5	—
Total	17,300	66.4	11.2	912	89,433	65.2	58.1
<i>South America:</i>							
Argentina	174	0.7	1.8	17	973	0.7	9.8
Other countries . .	200	0.8	—	11	803	0.6	—
Total	374	1.5	0.5	28	1,776	1.3	2.5
<i>Europe:</i>							
Germany	2,385	9.2	3.9	143	13,351	9.7	21.6
Great Britain and Northern Ireland	1,264	4.9	2.8	116	8,940	6.5	19.4
France	660	2.5	1.7	56	3,535	2.6	8.8
Sweden	418	1.6	6.9	16	1,659	1.2	27.5
Denmark	308	1.2	9.0	15	1,338	1.0	39.2
Netherlands . . .	203	0.8	2.8	10	752	0.5	10.3
Switzerland . . .	189	0.7	4.8	9	868	0.6	22.1
Russia (incl. Siberia)	150	0.6	0.1	20	810	0.6	0.5
Austria	145	0.6	2.2	9	673	0.5	10.0
Italy	173	0.7	0.4	20	990	0.7	2.3
Belgium	137	0.5	1.8	22	936	0.7	12.1
Czechoslovakia . .	116	0.4	0.8	12	367	0.3	2.7
Norway	169	0.6	6.1	1	739	0.5	26.8
Poland	120	0.5	0.4	10	748	0.6	2.7
Spain	105	0.4	0.5	15	378	0.3	1.6
Other countries . .	353	1.3	—	20	1,502	1.1	—
Total	6,895	26.5	1.4	494	37,586	27.4	7.6
<i>Asia:</i>							
China	112	0.4	0.03	11	299	0.2	0.07
Japan	544	2.1	0.9	72	2,767	2.0	4.7
Other countries . .	146	0.6	—	12	943	0.7	—
Total	802	3.1	0.1	95	4,009	2.9	0.4
<i>Africa:</i> Total	154	0.5	0.1	14	829	0.6	0.5
<i>Oceania:</i>							
Australia	318	1.2	5.5	37	2,280	1.7	39.2
New Zealand . . .	120	0.5	8.7	9	654	0.5	47.3
Other countries . .	76	0.3	—	2	523	0.4	—
Total	514	2.0	0.7	48	3,457	2.6	5.0
World total	26,039	100.0	1.4	1,591	137,090	100.0	7.4

B. — HIGH-TENSION CURRENT.

As regards supply, it should be the aim of all countries to produce electrical power as cheaply as possible, for advance in the use of electricity in industry is primarily a question of cheap current. Modern practice is seeking to solve the problem by the erection of high-power central stations on the actual site of the sources of power; these will cater for a great variety of forms of consumption and can thus be exploited to the fullest possible extent. From year to year co-operation between hydro-electric power stations and coal-fired power stations improves as a result of the increasingly high voltages used for transmission. With the wide range over which electricity can be conveyed by modern very high tension wires, high-tension current can nowadays cross frontiers, linking up and equalising the power sources of the several countries. In America, a transmission pressure of 110,000 volts was employed for the first time in 1908, and by 1921 the figure had risen to 220,000 volts. In Germany to-day still higher voltages are being used. The lines of 220,000 voltage now under construction to link the South-German water-power area with the Rhenish lignite area are so designed as to be used, later on, without any alteration, for a transmission pressure of as much as 380,000 volts. Hollow copper cables are being used which comply with the need of the high-tension alternating current for a conductor with large, slightly curved surfaces. With this transmission pressure of 380,000 volts, power ranging from several hundred thousand to 1,000,000 kilowatts can be transmitted over distances of 500 to 1,000 kilometres. Thus the idea of an international linking-up of water- and steam-produced electrical energy is advancing towards realisation, and wholly new vistas are opening for international co-operation in power generation. New technical ideas are being brought forward for discussion, such as the scheme for storing waste power in power reservoirs. These reservoirs are dams constructed at a high level, into which water is pumped by means of spare power so that, at periods of peak load, the maximum output can be obtained by means of this stored water-power. By this system the question of the world power supply' might perhaps be more economically solved than ever before. Whereas, hitherto, water-power and steam-power stations have been jointly employed for the continuous load, the peak load being obtained with the help of the steam plant — which involved a disproportionately high consumption of fuel for the short periods of the peak load and capital outlay not fully exploited — the scheme of international power supply as now conceived would be as follows:

Water-power plant and steam plant would operate continuously at full capacity, and during periods of light load would use their surplus output not absorbed by consumption for pumping water into the reservoirs referred to above; the peak load would no longer be obtained by recourse to increased steam-power, but by means of the power stored in the reservoirs. By such a system the vast water-power reserves of Bavaria, Austria, the Rhine and Switzerland could be

continuously applied and made to serve countries beyond their own frontiers, such as Northern Italy, the South of France, and the Succession States of Austria. Scandinavian water-power could be transmitted to Berlin and Central Germany.

These ideas for technical development are mentioned in order to show what an extraordinarily important field of economic international co-operation is opening up in this direction. An exchange of power of this kind already exists between Canada and the United States of America, between Switzerland and Germany and between Switzerland and France. The practical application of the suggestions outlined above would result in close connection between the electrical systems of many countries.

We have endeavoured to give in the Annex a short survey of world electrification, not only as regards the general supply of current but also as regards railways.

Technical Work for promoting International Exchange of Electrical Goods.

In all industrial countries there is the keenest desire to create uniform international rules and standards for electrical machines, appliances, lines, etc. Through standardisation, not only are manufacturing costs considerably cheapened, but also consumers in countries without an industry of their own have the advantage of being able to get electrical installations which are identical internationally as regards efficiency and safety, while at the same time their choice of contractors is not restricted. With this object in view, the International Electro-Technical Commission (I.E.C.) was founded in connection with the Chicago Exhibition of 1891. This Commission has since done extremely valuable work as regards technical nomenclature, power-voltages, standard regulations, etc. Efforts are now being made to institute an international standards committee.

In addition to the I.E.C., there are several associations more or less international in character which have set themselves to solve common problems connected with power current. But here, too, it should be the general object to guard against dispersed effort and to unite all the organisations in a single body as has been done in the International Telegraphic Union for the various branches of international rapid communication.

2 and 3. ACTUAL PRODUCTION AND CAPACITY OF PRODUCTION.

An idea of the extent to which the use of electricity is gaining ground throughout the world can best be formed by examining the consumption of electrical goods. Production represents the high-water mark of consumption.

Any attempt to give in figures the production of the electrical industry in the various countries must prove a hazardous undertaking, as we have to depend mainly on estimates, often without knowing to what extent semi-finished products

are comprised in the returns available. Only the United States, Canada and Sweden have official statistics which are a sure index to the progress made by the industry.

In venturing, with a full knowledge of all the reservations that must be made, to compile so comprehensive a table as the one given here, our object has been to provide some statistics of production, arranged according to a definite plan, so that each country can offer its criticisms and furnish more exact information. For the purpose of our calculations, we have used the published data available for drawing up statistics of production. The sources are indicated for each set of figures. Where estimates were made, they were drawn from the reports of undertakings, which often give indications of the volume of turnover.

A projected parallel between the production of electrical goods and the consumption of current in the several countries could not be carried out, as the data regarding the consumption of energy were so fragmentary, especially for the pre-war period, that the idea had to be abandoned.

The method of presentation used for the production figures given in the following table is discussed in detail in the notes thereto. It aims at providing the means for a quantitative comparison of values by establishing a uniform price basis. Allowing for the rise in prices as against the pre-war period, the actual increase of production since 1913 has been shown.

In the production returns, only total figures could be given. Division under the principal categories was unfortunately impossible. Detailed figures were available only for those countries that issue production statistics, viz., the United States, Japan and Sweden.

The following points emerge from a study of the table:

In absolute value, the world production of electrical goods amounted before the war to about 4 milliards and to-day amounts to about 12 milliard marks. Reducing these 12 milliards to the pre-war value, by the application of a uniform price coefficient, it appears that world production of electrical goods has doubled since 1913, a conclusion which is the more important in that previous literature on the subject only reports an increase of about 50 per cent. On a conservative estimate, the doubling of the consumption of electrical goods corresponds to a trebling or quadrupling of the production of current.

Production is distributed among the several countries, roughly, as follows:

The bulk is divided among three countries: the United States of America, Germany and Great Britain. The lead which Germany, with one-third of the total production, possessed before the war, has passed to the United States, to whom almost half the total production falls to-day. In the second place stands Germany with almost one-fourth of the total production. Great Britain follows with about one-eighth of the total production. France is fourth with only one-twentieth of the total production. Of the other countries mentioned, none represents more than 3 per cent of the total production.

The United States shows the greatest increase of production as against 1913. Relatively very substantial increases of production should be specially noted for France, Italy and Japan.

No figures can be given as to productive capacity. It is certain, however, that in several countries electrical works are not at present producing to their utmost capacity.

The export values given in the table will be dealt with in further detail in the later chapter on imports and exports. For these values the figures of the foreign trade returns have been adopted without alterations. We have not attempted to work out the ratio to production values, as it was impossible, for lack of data, to determine the import and export index numbers required for the establishment of a uniform price coefficient.

Table I.

VALUE OF TOTAL PRODUCTION OF THE ELECTRICAL INDUSTRY (IN MILLIONS OF REICHSMARKS)

COUNTRY	1913						1925						Difference between production for 1925 and 1913 Cf. 4 a and 9 b.	Coefficient of increased price in gold 1913=1	
	Production R. M. 000,000's	Coefficient	Uniform price basis		Number of workers 000's	Export R. M. 000,000's	Production R. M. 000,000's	Coefficient = 1.2 compared to 1913	Uniform price basis			Number of workers 000's			Export R. M. 000,000's
			Production R. M. 000,000's	Percentage of total production					Production		Percentage of total production				
									Present value	Pre-war value					
1	2	3	4a	4b	5	6	7	8	9a	9b	9c	10	11	12	13
Germany	1,300 ¹	1.0	1,300	34.9	140 ¹	330.6	2,100 ¹	1.0	2,100	1,750	23.3	190 ¹	356.5	1.35	1.2
United States of America	1,400 ¹	1.3	1,078	28.9	118 ¹	112.4	6,800 ¹	1.57	4,330	3,609	48.1	290 ¹	353.2	3.35	1.45
Canada	70 ¹	1.3	54	1.4	5 ¹	0.3	170 ¹	1.57	108	90	1.2	8 ¹	12.7	1.67	1.45
Great Britain	600 ¹⁰	1.0	600	16.0	75 ¹⁰	156.2	1,400 ¹⁰	1.35	1,037	864	11.5	135 ¹¹	352.2	1.44	1.62
France	150 ¹²	1.0	150	4.0	30 ¹²	30.2	420 ¹²	0.95	442	368	4.9	75 ¹²	78.3	2.45	1.14
Austria ¹³	120 ¹⁴	1.0	120	3.2	25 ¹¹	10.4	113 ¹⁴	1.0	113	94	1.3	23 ¹¹	34.7	0.78	1.2
Switzerland	45 ²⁰	1.0	45	1.2	— ¹⁵	24.7	110 ²¹	1.2	92	77	1.0	— ¹⁶	47.6	1.71	1.44
Italy	45 ²¹	1.0	45	1.2	— ¹⁵	8.3	150 ²¹	0.9	167	139	1.9	— ¹⁶	12.2	3.08	1.08
Japan	90 ²²	1.3	69	1.9	— ¹⁵	1.6	360 ²²	1.4	257	214	2.9	25 ²²	11.1	3.10	1.3
Sweden	40 ²³	1.0	40	1.1	6 ²³	14.1	80 ²³	1.3	62	52	0.7	7 ²³	40.1	1.30	1.56
Czechoslovakia ²⁷	20 ²⁴	1.0	20	0.5	— ¹⁵	—	60 ²⁴	1.2	50	42	0.6	— ¹⁶	4.6	2.1	1.44
Russia ²⁸	100 ²⁵	1.2	83	2.2	12 ²⁰	—	37 ²¹	3.5	11	9	0.1	6 ²¹	—	0.1	3.5
Other countries ²⁹	130 ²³	1.0	130	3.5	20	—	270 ²¹	1.2	225	188	2.5	— ¹⁶	—	1.45	1.44
Total	4,110		3,734	100	456	688.8	12,070		8,994	7,496	100	829	1,303.2	2.01	***1.38

¹ Estimated at 25,000.

¹⁰ Estimated at 70,000.

¹¹ Weighted average. See explanatory notes below.

¹² *Siemens-Zeitschrift* 1921, page 302.

¹³ Unofficial estimate.

¹⁴ Unofficial estimate according to the number of employed persons reported to the Zentralverband der Deutschen Elektrotechnischen Industrie. The number of salaried employees was deducted on the basis of a certain percentage ratio of salaried employees to wage-earners.

¹⁵ Refers to 1914, Census of Manufactures 1923.

¹⁶ Latest American estimate (September 1926). It is supported by statements in the *New York Times* of September 27th, 1926.

¹⁷ Estimated according to the figures of production and workmen for 1923 given in the Official Census.

¹⁸ Refers to 1915. *Canada Year-Book* 1916-1917, page 292.

¹⁹ Refers to 1915. *Canada Year-Book* 1916-1917, page 292. Only the total number of employed is given. The number of workmen is estimated on the basis of the percentage ratio of wage-earners and salaried employees who, in the 1921 and 1922 editions of the above-mentioned source, are shown separately.

²⁰ Refers to 1922. *Canada Year-Book* 1924, page 407.

²¹ According to the figures of the Economic and Statistical Department of the British Electrical and Allied Manufacturers' Association (September 1926).

²² *Ministry of Labour Gazette* 1926, No. 1, pages 22 and 23. The number of employees given in the figures contained in those pages has been deducted on the basis of a certain percentage ratio between salaried employees and wage-earners.

²³ Rapport général sur l'industrie française (Paris 1919).

²⁴ Estimated.

²⁵ Production figure for 1924 according to BEAMA: *The Electrical Industry in France* (London 1925, page 39) adjusted for 1925 in accordance with the available figures for the number of workmen for 1925 (75,000 as published by the Union des syndicats de l'électricité, Paris 1926, page 1275).

²⁶ Refers to present territory (Republic of Austria).

²⁷ Estimated from data supplied by the *Verband der Elektrizitäts-Industrie Oesterreichs*, Vienna.

²⁸ Estimated.

²⁹ According to data supplied by the *Verband der Elektrizitäts-Industrie Oesterreichs*, Vienna.

³⁰ See *Wirtschafts-statistisches Jahrbuch*, Vienna 1925.

³¹ *Siemens-Zeitschrift* 1921, page 302.

³² Unofficial estimate.

³³ *Siemens-Zeitschrift* 1921, page 302.

³⁴ Refers to 1924, *Japan Year-Book* 1926, page 502.

³⁵ Refers to 1924; estimated according to the number of workmen (23,870) given for 1923 in the Statistics of Agriculture, Industry and Commerce (Tokio 1925, page 107) and according to production figures given for 1923 and 1924 in the *Japan Year-Book*.

³⁶ *Sveriges Offiziella Statistik* (Industri) 1913.

³⁷ Refers to 1924, *Sveriges Offiziella Statistik* (Industri) 1924.

³⁸ Refers to present area of territory.

³⁹ Unofficial estimate.

⁴⁰ Refers to the present territory of Russia in Europe.

⁴¹ *Commercial Year-Book of the Soviet Union* 1925.

⁴² *Commercial Year-Book of the Soviet Union*. Estimate for 1924-25.

⁴³ Belgium 35 million marks

Denmark 15 " "

Netherlands 25 " "

Norway 10 " "

Spain 20 " "

Hungary¹ 25 " "

130 million marks.

⁴⁴ *Siemens-Zeitschrift* 1921, page 302.

⁴⁵ Estimated with the inclusion of other countries which in the meantime have developed small electrical industries, the individual production of each of which is less than that of the countries mentioned under 32.

¹ "Hungary's Trade and Industry in 1924" (Budapest 1925), page 118.

EXPLANATIONS.

I. Method employed in the Table.

The infinite variety of electrical manufactures makes it impossible to reproduce the total production quantitatively, and therefore the statistics only give values. These values, however, are not comparable with one another, because they are established on the basis of the home prices of the producing countries, whose price levels vary considerably for the most diverse reasons. The accompanying table is an attempt to obtain from the available figures for production values a basis of comparison for the volume of production which these values represent. In order to obtain this basis, therefore, the figures of values have been reduced to a uniform price basis — in the present case, the German.

II. Explanation of the Various Columns.

Columns 2 and 7 contain the production values of the different countries on the basis of home prices.

Columns 3 and 8: Coefficient for reducing values to a uniform price basis for the purposes of quantitative comparison. Thus, the coefficient expresses the relation between home prices in the different countries on the basis of which the comparative values are quantitatively estimated in columns 4a and 9a. For both periods the German price level=1 has been fixed, because the ratio to prices in other countries has been obtained from that figure. Accordingly, the coefficients for 1925 in column 8 do not show the increase of prices compared with 1913, which is first estimated in column 13 (for details see note below).

Columns 4a and 9a are the result of dividing the production values in columns 2 and 7 respectively by the coefficient in columns 3 and 8, the values being thus reduced to a uniform price basis. The figures thus estimated permit comparison between the percentage shares of the different countries in total production, which are shown in columns 4b and 9c.

Columns 6 and 11 show the export values in millions of Reichsmarks according to official statistics.

Column 9b "Pre-war Value" contains the production values reduced to a uniform price basis in column 9a and brought to the pre-war value by division by the 1.2 coefficient of increased prices compared with 1913, in order that a comparison may be made in column 12 between production in 1925 and in 1913 both in respect of individual countries and also as regards the totals. The coefficient in column 8 is 1.2 times the coefficient in 1913. This means that the German price level is on an average 20 per cent above the pre-war basis, in which connection it must be strongly emphasised that consideration has been taken of the increased output in weight and per unit due to technical improvements.

Column 13 gives the average coefficient of price increase for electrical manufactures in comparison with 1913. The figure has been reached by multiplying the coefficient for 1925 by 1.2, which is the price increase coefficient, and dividing the product by the unit coefficient for 1913. The mean value of 1.38, which represents the mean increase in the prices of world production, is not the arithmetical mean of the price increase coefficients of the different countries, but a weighted mean estimated on the basis of the percentage share of the different countries in total production.

Example: Since prices in the United States of North America in 1913 were on an average 1.3 times the German prices, the prices of electrical manufactures in the United States of North America have not increased by $1.57 \times 1.2 = 1.9$ times, but only by

$$\frac{1.57 \times 1.2}{1.3} = 1.45$$

Columns 5 and 10 show the number of workmen in thousands. These figures include only wage-earners, not salaried employees. Whenever the figures gave the total number of employed persons, employees were deducted on the basis of a certain percentage ratio between salaried employees and wage-earners. See special remarks in the individual notes accompanying this table.

4 and 5. NUMBER OF OCCUPIED WAGE-EARNERS AND OF UNEMPLOYED AND HOURS OF LABOUR.

In the table of the total production of the electrical industry, the number of workers for the countries under review is given in columns 5 and 10. As regards these figures, as the notes indicating their sources show, reliable data can only be obtained for the countries which issue official statistics on electrical production. The other figures are founded on estimates, partly made by the trade organisations of the countries concerned, and partly by other competent bodies or persons. It was particularly difficult to establish the number of wage-earners in countries which only give figures comprising the total number of persons employed. Here the number had to be estimated on the basis of a fixed percentage representing the ratio between wage-earners and salaried employees, and deducted from the total figure.

The proportion of the latter category varies according to the particular type of manufacture and the selling organisation of the undertaking. In "Series" production, the number of wage-earners in proportion to the number of salaried employees, etc., is relatively smaller than in undertakings with a self-contained production. In periods of temporary economic depression, the salaried employees will be relatively more numerous than the wage-earners, as the contracts of the latter are easier to terminate.

The total figure of occupied wage-earners in the electrical industry all over the world may be put at 800,000 to 900,000, so that the total number of persons employed is probably about 1.1 to 1.2 million.

NUMBER OF UNEMPLOYED.

No figures can be given as, with the exception of England, special unemployment returns were not available for the electrical industry.

Where subdivisions existed, these included the entire metal industry.

HOURS OF LABOUR.

The question of hours of labour is not dealt with in the present Report.

6. WAGES.

In attempting to group together for a comparative survey the wages paid in the electrical industry in the several countries, it was found that the available

figures, though comparatively abundant, were not adapted for comparison. The reason for this is the variety of the industrial branches comprised (metal industry, machine industry, electrical industry), the lack of uniformity in the classification of trades and groups of workers (skilled and unskilled workers in some cases lumped together, and in others shown separately), and finally, the lack of discrimination between areas with a different scale of wages (the large towns and the provinces). Moreover, the wage rates shown give no indication of the piece wages actually paid.

7. RAW MATERIALS USED.

The only raw material of which the electrical industry absorbs a high proportion, namely, 40 per cent of the total consumption, is copper. Its proportion in the consumption of other raw materials is relatively small.

8. IMPORTS AND EXPORTS.

A. — ELECTRICAL INDUSTRY AS A WHOLE.

The figures given for imports and exports are taken from the official trade statistics of the countries in question. The conversion of the values into Reichsmarks has been carried out for 1913 on the basis of the par of exchange, and for 1925 by establishing average values which allow for the fluctuations of the various exchanges in relation to the Reichsmark.

The following Table Ia of the world imports of electrical goods embraces about 90 per cent of the total figures. Europe and overseas countries¹ have changed places in the division of imports since 1913. In 1913 Europe took almost 55 per cent, and overseas countries over 45 per cent, whereas in 1925 Europe's proportion of imports was about 45 per cent and that of overseas countries about 55 per cent.

A survey of the world electrical exports (Table Ib, page 22) comprises over 95 per cent of the total figures. As in the case of production, three countries are principally concerned in the world's electrical trade, viz., Germany, Great Britain, and the United States of America, which together export 75 per cent. In the division of exports Europe still leads with about 75 per cent, while overseas countries, mainly represented by the United States, have increased their share in exports from 17 per cent to about 25 per cent.

In considering the total world trade in electrical goods, it must be remarked that the export figures given are not wholly represented in the imports. This is mainly due in the first place to the different statistical classification of the products in question in the different countries, and in the second place to the fact that some countries with a very small import trade, representing only a negligible percentage of the total imports, have not been taken into account.

¹ Oversea countries here means the countries of continents other than Europe.

A more detailed analysis of the relation of the volume of exports to the total production of electrical goods is impossible, as the values to be compared would have first to be reduced to uniformity by the application of a price coefficient. The attempt could be made in dealing with production, because certain commercial information as to the domestic prices of the producing countries was available, but there is no way of ascertaining the export prices, which adjust themselves according to the conditions of the market in the selling areas and the Customs barriers that encircle those areas.

With the doubling of the *volume* of production (see Chapter 2 and 3: Production) there has been a doubling of the *value* of exports. In reality, exports have probably also increased quantitatively in the same proportion as production, as excessive domestic prices cannot be maintained for export trade. Moreover, in countries with an unduly high protective duty and hence excessive internal prices, there is always the tendency to force the foreign market by means of particularly low prices.

Table I a.

IMPORTS OF ELECTRICAL GOODS INTO THE DIFFERENT COUNTRIES IN MILLIONS
OF REICHSMARKS.

Importing Country	1913		1924		1925	
	R. M. 000,000's	%	R. M. 000,000's	%	R. M. 000,000's	%
Germany.	14.5	2.9	9.4	1.0	21.9	1.9
France.	31.1	6.1	40.8	4.5	39.2	3.5
Belgium ¹	—	— ¹	—	—	36.6	3.3
Great Britain ²	54.2	10.7	77.6	8.6	102.8	9.2
Irish Free State	—	—	9.1	1.0	10.5	0.9
Italy.	26.0	5.1	32.7	3.6	43.5	3.9
Spain	34.6	6.8	29.4	3.3	42.3	3.8
Netherlands ¹	—	—	34.5	3.8	46.5	4.2
Switzerland.	8.7	1.7	14.7	1.6	18.1	1.6
Austria ³	29.4	5.8	14.8	1.6	17.2	1.5
Czechoslovakia	—	—	16.5	1.8	20.1	1.8
Poland.	—	—	23.2	2.6	28.5	2.6
Russia ⁴	38.2	7.5	13.4 ⁵⁻⁶	1.5 ⁵	23.5	2.1
Finland	5.5	1.1	9.9	1.1	10.5	0.9
Sweden.	11.6	2.3	28.5	3.2	27.0	2.4
Norway	8.4	1.7	14.3	1.6 ⁷	14.3	1.3
Denmark.	7.1	1.4	9.4	1.0 ⁷	9.4	0.8
Total Europe	269.3	53.1	378.2	41.8	501.9	45.7
United States of America ⁸	4.8	0.9	11.6	1.3	10.2	0.9
Canada ⁹	38.2	7.5	70.1	7.8	78.4	7.0
Argentine.	40.9	8.1	42.8	4.7	52.7	4.7
Brazil	29.2	5.7	37.2	4.1	37.2 ⁷	3.3
Chile.	5.5	1.1	17.1	1.9	17.1 ⁷	1.5
Japan	15.1	3.0	54.7	6.0	60.8	5.4
China	9.9	2.0	31.4	3.5	27.5	2.5
British India ¹⁰	18.2	3.6	53.5	5.9	68.4	6.1
Australia.	37.5	7.4	91.0 ¹¹	10.1	139.2 ¹¹	12.5
New Zealand	8.3	1.7	41.9	4.6	47.9	4.3
Egypt	4.2	0.8	9.2	1.0	13.1	1.2
Union of South Africa	26.0	5.1	65.8	7.3	54.8	4.9
Total Oversea.	237.8	46.9	526.3	58.2	607.3	54.3
Total	507.1	100	904.5	100	1,119.2	100

¹ No statistics available for the electro-technical industry.

² The import figures given in the statistics have been reduced by the amount of re-exports.

³ 1913: Austria-Hungary.

⁴ End of financial year June 30th, 1913.

⁵ End of financial year September 30th, 1924 (1925).

⁶ 1924: Pre-war value.

⁷ The data for 1925 were not available: value for 1925 determined according to 1924.

⁸ End of financial year June 30th, 1913.

⁹ End of financial year March 31st, 1913, 1925, and 1926.

¹⁰ End of financial year March 31st, 1914, 1925, and 1926.

¹¹ End of financial year June 30th, 1924 (1925).

The above table comprises about 90 per cent of the world's total import of electrical goods. The sections contained in the statistics under the heading of electrical goods have been amplified by adding the electrical manufactures entered under other sections (for example, artificial carbons, insulators, insulated wires); iron wire and non-insulated copper wire are not taken into account.

Table I b.

EXPORTS OF ELECTRICAL GOODS FROM THE DIFFERENT COUNTRIES IN MILLIONS OF REICHSMARKS.

Exporting Country	1913		1924		1925	
	R. M. 000,000's	%	R. M. 000,000's	%	R. M. 000,000's	%
Germany ¹	330.6	47.8	291.9	23.8	356.5	25.7
France	30.2	4.4	89.8	7.1	78.3	5.7
Belgium ²	—	—	—	—	17.8	1.3
Great Britain	156.2	22.8	296.6	24.1	352.2	25.4
Italy	8.3	1.2	11.0	0.9	12.2	0.9
Netherlands ³	—	—	52.3	4.3	52.8	3.8
Switzerland	24.7	3.6	41.6	3.4	47.6	3.5
Austria ⁴	10.4	1.5	38.5	3.1	34.7	2.5
Czechoslovakia	—	—	3.8	0.3	4.6	0.3
Hungary	—	—	14.8	1.2	11.6	0.8
Sweden	14.1	2.2	34.3	2.8	40.1	2.9
Total Europe	574.5	83.5	874.6	71.0	1,008.4	72.8
United States of America ⁵	112.4	16.3	332.3	27.0	353.1	25.5
Canada ⁶	0.3	—	15.5	1.3	12.7	0.9
Japan	1.6	0.2	8.8	0.7	11.1	0.8
Total Overseas	114.3	16.5	356.6	29.0	376.9	27.2
Total	688.8	100	1,231.2	100	1,385.3	100

The above table comprises more than 95 per cent of total electrical exports. The sections contained in the statistics under the heading of electrical goods have been amplified by adding the electrical manufactures entered under other headings

¹ 1924 and 1925 do not include reparations deliveries.

² No statistics available in 1913 and 1924 for the electrical industry.

³ No statistics available for the electrical industry in 1913.

⁴ 1913: Austria-Hungary.

⁵ 1913: end of financial year June 30th, 1913.

⁶ End of financial year March 31st, 1913 (1925, 1926).

(for example, artificial carbons, insulators, insulated wires). Iron wire and non-insulated copper wire are not taken into account.

B. — THE MOST IMPORTANT CATEGORIES OF GOODS.

The selection and classification of the groups of products indicated in the following tables, with a view to showing the total foreign trade of the electrical industry, follow the customary classification of official trade statistics generally.

It proved impossible to include electrical switch gear and installation material, because, in the available statistics, the products of this group were not in most cases shown separately. Nevertheless, the groups given represent in the case of imports as much as 70 per cent, and in the case of exports 65 per cent of the total trade.

I. For the share of different classes of goods in:

- (a) The total imports of the several countries; see Table II*a* below;
- (b) The total exports of the several countries: see Table II*b* below.

Table II*a*.

IMPORTS OF ELECTRICAL GOODS INTO THE COUNTRIES SHOWN IN TABLE IV*a*,
BY CATEGORIES.

Categories	1913		1925	
	Million Reichs-marks	Per cent	Million Reichs-marks	Per cent
Electrical machines	135.0	33.8	252.1	26.4
Cables and insulated wires	71.3	17.9	146.6	15.4
Measuring instruments and meters.	16.1	4.0	47.1	4.9
Telephony and telegraphy	27.2	6.8	146.8	15.3
Incandescent lamps	32.4	8.1	74.2	7.8
Total	282.0	70.6	666.8	69.8
Miscellaneous	117.0	29.4	289.3	30.2
Total Imports	399.0	100	956.1	100

The above table is based on the statistics of 20 countries which together in 1913 absorbed about 80 per cent and in 1925 about 86 per cent of the electrical imports considered in List I*a*, and hence over 75 per cent of the world imports of electrical goods.

Table IIb.

EXPORTS OF ELECTRICAL GOODS FROM THE COUNTRIES SHOWN IN TABLE IV *b*,
BY CATEGORIES.

Categories	1913		1925	
	Million Reichs-marks	Per cent	Million Reichs-marks	Per cent
Electrical machines	167.4	24.3	331.4	24.4
Cables and insulated wires	145.2	21.2	210.4	15.5
Measuring instruments and meters.	30.9	4.4	68.0	5.0
Telephony and telegraphy	34.6	5.0	197.2	14.5
Incandescent lamps	69.2	10.0	106.6	7.8
Total	447.3	64.9	913.6	67.2
Miscellaneous	241.2	35.2	447.9	32.8
Total Exports	688.5	100	1,361.5	100

The above table is based on the statistics of 12 countries which together comprise more than 95 per cent of the world exports of electrical goods.

The huge increase in exports as against 1913 shown in the above table must be attributed to the low-tension current branches, especially telephony and telegraphy, which have increased their percentage from 5 per cent to almost 15 per cent of the total exports.

II. For the proportion of the above categories in:

- (a) The imports of electrical goods of the several countries, see Annex, Table III*a*.
- (b) The exports of electrical goods of the several countries, see Annex, Table III*b*.

III. For the share of the various countries:

- (a) In the imports of the various categories, see Annex, Table IV*a*.
- (b) In the exports of the various categories, see Annex, Table IV*b*.

9. CUSTOMS TARIFFS AND IMPORT AND EXPORT PROHIBITIONS.

A. — CUSTOMS DUTIES.

The following table gives a survey of the approximate number of tariff items under the head of electrical goods in the Customs tariffs in different countries. It

will be seen that it is exactly in the chief protectionist countries that the classification is most detailed. By multiplying the items, it is sought to assimilate the specific duties to an *ad valorem* duty.

NUMBER OF CUSTOMS ITEMS FOR ELECTRICAL GOODS.

Countries	Number of items	Countries	Number of items
Argentina	90	Poland	95
Belgium	55	Russia	55
Germany	40	Sweden	60
France	71	Switzerland	45
Italy	110	Spain	51
Japan	110	Czechoslovakia	55
Austria	70	United States of America	15 ¹

For our investigation of the Customs charges, twenty of the principal electrical importing countries were taken, comprising about 85 per cent of world electrical imports. The same categories were considered as those previously taken in dealing with foreign trade. Including the category of apparatus and installation material, Europe accounts for about 75 per cent of the imports of the countries in question. In subdividing the categories according to weight, the classifications of the Customs tariffs were as far as possible observed.

Customs duties as a percentage on the value of the goods are shown in Table V of the Annex. The Customs charges are calculated for 1913 and 1926 on the basis of average values for the two periods; these are indicated in columns 2 *a* and *b* of the separate tables, and represent the average European prices. The specific duties for 1926 are converted into Reichsmarks at the rate of December 1st. For each of the countries the maximum and minimum rate that can be imposed is shown for each year under consideration.

From the Customs charges indicated for each group, averages have been calculated to serve as an index for the Customs charges of the group in question. These Customs indexes are summarised in Table VI of the Annex, under countries.

Table VI shows the amount of duty imposed by the various countries on imported goods, first where most-favoured-nation treatment is granted (minimum rates) and then where no treaty or agreement exists (maximum rates). From this may be seen the degree of protection with which the various countries safeguard each particular category of electrical goods, and what are the barriers due to the non-existence of preferential treaties in certain countries.

¹ The small number given for the United States is explained by the fact that there almost all electrical products are subject to an *ad valorem* duty.

In order to form an idea of the real Customs charge upon the imports actually effected it would be necessary to know:

- (1) The countries of origin, in order to establish a distribution of the imports under maximum, minimum or intermediate rates, according to the politico-commercial relations existing between the countries in question;
- (2) The import values, classified according to the categories upon which the inquiry is based.

Unfortunately, the available foreign trade statistics did not suffice to enable us to determine the countries of origin for the period in question, for in most statistics classification by countries is late in appearing. Generally, the duties show substantial increases as compared with the period before the war, and they often attain such rates as practically to prohibit import.

B. — IMPORT AND EXPORT PROHIBITIONS.

There exist in almost all countries import prohibitions and import restrictions which are imposed sometimes for reasons of public health or safety, or in application of fiscal policy or patents laws, or which are applied to war material and supplies or to commodities which are a Government monopoly. For instance, Hungary forbids the import of telephonic and telegraphic apparatus for use in war, and Bulgaria forbids the import of wireless apparatus, which is a monopoly of the Bulgarian postal administration.

Import prohibitions are issued also on purely protectionist grounds. As a rule, they are so manipulated as to allow exceptions by a system of licences, and in this way a sort of quota scheme is introduced.

In Czechoslovakia and Austria, almost all electrical imports are still subject to Government control. In Austria, for instance, such control extends to electrical machines, apparatus for telegraphs, telephones and wireless telegraphy, medical electrical apparatus, measuring instruments and meters, switch and contact appliances, heating and cooking apparatus and electric lamps. In Czechoslovakia import licences are compulsory for some of the above-mentioned goods, while for others mere notification is enough. A number of countries, *e.g.*, Switzerland and France, are allowed to import goods into Czechoslovakia within the limit of a quota, without licences or notification.

Russia has rigorously applied import and export prohibitions for all classes of electrical goods, as all trade with foreign countries is carried on through State organisations.

10. CONSUMPTION PER HEAD AND PER COUNTRY.

The *per capita* consumption of electrical goods was ascertained according to the absolute figures of production and of foreign trade on the basis of the following formula:

$$\text{Consumption} = \text{production} + \text{import} - \text{export}.$$

It is not possible from these figures to reach an accurate conclusion either as to the volume consumed or to the extent of electrification in the country concerned. The method of the Production Table (see Section 2 and 3, Production) could not be employed because there was no way by which the foreign trade figures which had to be taken in account here could be reduced to a uniform basis. Accordingly, the following table gives only the *per capita* expenditure on electrical products in the several countries.

PER CAPITA EXPENDITURE ON ELECTRICAL PRODUCTS.

Countries	1913	1925	Countries	1913	1925
	Reichsmarks			Reichsmarks	
Germany	14.70	28.20	Norway	7.30	11.30
France	3.80	9.70	Denmark	7.20	8.40
Belgium	4.60	10.60	United States of		
Great Britain	12.00	26.30	America	13.40	57.60
Italy	1.76	4.30	Canada	15.00	25.50
Spain	2.70	3.60	Argentina	5.10	5.40
Netherlands	4.00	5.30	Brazil	1.19	1.20
Switzerland	7.50	20.60	Chile	1.60	4.40
Austria	6.30	14.60	China	0.02	0.06
Czechoslovakia		5.60	Japan	1.95	6.90
Hungary		4.60	British India	0.06	0.20
Russia	1.27	0.60	Australia	7.70	23.70
Poland	—	0.97	New Zealand	7.20	34.70
Finland	1.70	8.20	Egypt	0.35	0.94
Sweden	6.70	11.10	British South Africa	4.40	7.60

11. PRICES.

As regards the prices in the electrical industry in the several countries, general indications have been given in the form of indices in Chapter 2 and 3.

As regards prices, it should be noted that as a result of the greater efficiency obtained by scientific utilisation of the material and improved methods of manufacture, there has been a fall in prices in many directions. A typical example is the price for incandescent lamps, which has come down to two-thirds of the pre-war price.

This reduction of prices is counteracted in many countries by excessively high Customs barriers, behind which the internal prices are maintained at an artificially high level.

12. INDUSTRIAL ORGANISATION.

The commercial agreements within the electrical industry are limited to a few products and are strictly national. A universal organisation and agreement exists only for wireless telegraphy and for incandescent lamps. Having regard to the importance of both agreements and their value as models, their history and tenor is given in detail.

A. — AGREEMENT IN WIRELESS TELEGRAPHY.

As early as 1912 the patents dispute between Marconi's Wireless Telegraph Company in London and the Telefunken-Gesellschaft in Berlin was terminated by means of an agreement providing for an exchange of patents all over the world on an absolutely equal basis.

This agreement became void on the outbreak of war. But only a year after the end of the war the parties came together again. This time the agreement underwent an extension, for the Telefunken-Gesellschaft entered the Société anonyme internationale de télégraphie sans fil (S.A.I.T.), which organises and controls the operation of wireless on all the merchant ships of Europe, with the exception of those countries in which national shipping wireless companies already existed, as in England, Germany and France. The French company, which had meanwhile become independent, joined the new international company at the same time, so that henceforward all questions in connection with shipping could be dealt with on a uniform basis. Moreover, the French company soon agreed to an exchange of patents between Germany and France, and this example was followed by the Radio Corporation of America. Thus in 1921 the relations between the four great world firms were on such a footing that each of the companies was entitled to use the patents of the others, an exclusive right subsisting only for the home State of the company in question. The effects of these agreements in the domain of wireless transmission were beyond all expectations. By combining all available forces, it was possible to create the organisation which to-day ensures a safe and rapid transmission of messages and news to every part of the globe. Moreover, the funds which hitherto had been used for litigation about patents could now be applied to technical improvements.

Once the foundations of international co-operation had thus been laid, foreign and extra-continental wireless connections developed very rapidly. Whereas until then the four great world firms had been obliged to build their long-distance wireless stations mainly with their own capital, and hence could only hope to operate profitably stations within their frontiers or in the colonies of their country, the international understanding between the four firms was extended by similar agreements for the exchange of patents on international lines of communication. It was not long before opposing political considerations were overcome, and

by means of agreements a basis could be created upon which it was possible to place inter-continental transmission on an economic footing. For this purpose some of the companies founded special undertakings, such as the Transradio A.G., for wireless overseas messages, in Germany, and the Radio-France in France. In America and England, the manufacturing companies still continued to operate their stations under their own management.

In countries outside the spheres of any of the four companies, the need was soon felt of erecting long-distance wireless stations to connect with the other already existing long-distance stations. Argentina, which has a very considerable volume of telegraphic communication with America, as well as Europe, was first in the field. By the end of the war each of the four companies had already obtained a concession for the construction of a long-distance station for communication with its own country. If each of the four companies had constructed a long-distance station in Argentina, the concerns in question could not possibly have paid, and would have been doomed in advance to speedy collapse. It was therefore agreed between the four that England, America and France should relinquish their concessions and that the Argentine station should be constructed, for communication with all countries, under the German concession, which had up to that time made the greatest progress.

The German Transradio Company, after obtaining its concession, had founded the Cia. Transradio Argentina, which now, in accordance with the agreement, was converted into a national company in which the four world firms participated equally. At the same time the Cia. Transradio Argentina changed its name to Transradio International. In 1923 the installation was completed, and ever since Argentina has been in continuous reciprocal connection with the American, French, German and British long-distance stations.

In founding the Argentine company, the four firms did not content themselves with merely establishing a settlement of their reciprocal relations *vis-à-vis* of Argentina, but they resolved also on future joint action with a view to developing wireless connections in the whole of South and Central America. This led to the constitution in 1921 of a joint committee, the Commercial Radio International Committee, with headquarters in Paris. Each of the four companies appointed two delegates to the Committee, who meet twice a year under the presidency of the chairman, in one of the four capitals, for a concerted examination of questions concerning South and Central American wireless communications. In this way, the Committee has been able to extend its valuable activities to other South American countries, and a long-distance station was built in Brazil, not only with capital furnished by the four companies, but also under their joint technical direction. Each of the companies participated in the construction of this station to the extent of one-quarter of the total capital outlay. This is the best proof that the expectations placed on the creation of the Committee have been fully and amply realised from the economic as well as the technical aspect. Another task which the Committee has set itself is to bring Chile into the world wireless system.

The evolution of these four companies, unimpeded by disputes about patents, has within a brief space of time so effectively promoted short wave-length transmission that to-day short-wave transmission is extensively used side by side with long-wave transmission and has a great future before it, especially in the field of wireless television.

B. — AGREEMENT IN THE INCANDESCENT LAMP INDUSTRY.

The International Incandescent Lamp Agreement, which is entitled "Agreement for the Development and Progress of the International Incandescent Lamp Industry" may be called a world convention, not only on account of the persons it comprises, but also because of its sphere of operation. The aim and object of this agreement is to ensure the co-operation of all the contracting parties with a view to a more profitable exploitation of their manufacturing capacity in lamp-making, to secure and maintain a uniform high quality, to secure the economic advantage of the division and allotment of markets, to enhance the efficiency of electric lighting and to increase its use to the advantage of the consumer.

By way of achieving this object, in the first place, regular interchange of inventions and experience is provided for. Thus, each member can use the inventions and experience of the others, while the party introducing the invention gets appropriate compensation. Each member has the right to go over any factory, note improvements and introduce them in his own premises. Fixed rules are drawn up for this interchange and an arbitral committee is provided for in case the amount of the compensation cannot be settled by agreement.

As a second means to the same end, the apportionment of the world trade is established. The share of each member is reckoned on the basis of the actual turnover in a given year; this proportion is guaranteed, together with a proportional share in any increase in the volume of world trade. Account is taken of the increasing volume of business in certain areas by fixing special quotas for the big manufacturing or consuming countries, or for groups of such countries, so that they may direct the expansion of trade in their area.

The proposal for a common sales organisation was vetoed, as it was held that the purpose of the agreement could be accomplished in freedom and that the individual should not be hampered more than was absolutely necessary in his business arrangements. The agreement is sufficiently elastic, however, to allow of arrangements for co-operative selling in particular economic areas if desired.

The fixing of prices is not made a condition of the agreement, nor an essential part of it, but is left to the organisations created for the several countries.

Stress is laid on supplying consumers all over the world with the best light at the cheapest prices. To this end efforts are being made towards standardisation and uniformity in the making of the various kinds of lamps.

Propaganda on the importance of light in national and household economy, as carried on, for example, by the Osram Company in Berlin, is also pursued on uniform lines by the participators in the agreement.

For making regulations and carrying out the agreement a special organisation has been created in the Phœbus Company at Geneva. All powers for the supervision and execution of the various provisions of the agreement are vested in this body.

ANNEX.

- 1. Supply of Current.**
 - 2. Electrification of Railways.**
 - 3. Tables III to VI.**
-

1. SUPPLY OF ELECTRIC CURRENT.

It was not possible, unfortunately, from the published figures, to gain a correct or even at all complete view of this. Official statistics are available only for comparatively few countries — in particular, the United States of America, Canada, France, Italy and Hungary¹. But even these statistics give no real idea of the consumption of current, as they comprise only the energy transmitted from public stations, and not privately produced current. For the other countries, estimates only are available, and these again are compiled from totally different aspects and with quite different classifications. But what is most of all lacking is any indication of the purpose for which the power is used.

Practically throughout, we encounter the following shortcomings:

- (1) No distinction is made between the utilisable power supplied from *all* power stations and that supplied from the public stations *only*.
- (2) By treating the total energy generated as identical with the total energy consumed the losses in distribution are ignored.

The result is a measure of inaccuracy which substantially impairs the absolute value of the figures established in the frequent enquiries into the *per capita* consumption of current, and puts any comparison between the different countries out of the question. As the sources of the figures are in most cases not indicated, verification is also impossible.

The institution for the whole world of a system of statistics of the consumption of electric power, compiled on uniform lines, is urgently needed. The statistics should include not only the power supplied from public stations, but also that produced by the consumer for his own use. The purpose for which the power was used should be separately indicated, in order to indicate the extent to which electricity is used in different spheres.

Keeping in mind all these aspects, such statistics might be arranged somewhat on the following plan:

I. *Generation of Current.*

- A — in public stations,
- B — on the consumers' own premises.

II. *Current transmitted for* ²:

A — light, B — power, C — heating:

1. For household purposes;
2. For industrial purposes (except agriculture):
 - (a) in the electro-chemical and electro-metallurgical industries,
 - (b) in other trades and industries:
 - large consumers on special contracts,
 - small consumers on fixed rates;
3. For agriculture;
4. For public purposes:
 - (a) public lighting,
 - (b) railways:
 - standard-gauge railways,
 - tramways and light railways;
5. Import and export of electric current.

¹ In the Hungarian statistics only the value of the energy consumed is given.

² Only power sold for a price can be included in statistics.

If the statistics of the supply of current were to include the capacity of the current generating plant, this would afford a most valuable indication for the electrical industry of the degree in which the existing plant is utilised.

There is given below a table showing the generation of electric energy throughout the world. This table considerably differs from that given on page 41 of the German edition of this Memorandum, as in the meantime more accurate and reliable data for recent years have been obtained. Our object in providing these figures has been to give an idea of the increase of current production in recent years over that of 1913. Unfortunately, only very few figures were available for 1913.

The main intention, however, in bringing this calculated total figure of about 164 milliiards of Kwh. is to provide an idea of the average minimum of generated electric energy throughout the world within the last years. The real figure of the total generation throughout the world certainly considerably exceeds 164 milliiards of Kwh., as for two of the main producing countries, viz., U.S.A. and Canada, the amount of energy generated for the consumer's own needs could not be calculated in the absence of available data.

In order to obtain an idea from the following figures of the position in regard to the generation of electrical energy throughout the world and the principal countries concerned, U.S.A. and Canada, for which only the production of public stations is known, cannot be considered. Also Poland and Holland, for which countries it was not possible to state which kind of stations were included, must be left out of consideration. ¹

¹ An Italian note points out that Italy possesses detailed and accurate statistics of the production of electrical energy.

The output is calculated:

(a) By the Ministry of Finance, through the agency of its technical departments;

(b) By the Associazione Esercenti Imprese Elettriche;

(c) And also, during recent years, by the Ministry of Public Works, through the agency of the Hydrographic Department.

The results of these returns are respectively published in the Annual *Statistica delle imposte*, in the Review *L'Impresa Elettrica* and in the special publications of M. Domenico Civita, the Director of the Associazione Imprese Elettriche, and again in a special volume published by the General Council of Public Works entitled *La produzione di energia elettrica in Italia nel 1925* (Government Publishing Department).

The last-named publication and that of M. Civita also contain sets of figures and calculations arrived at by inductive methods from specific data and giving an analysis of power consumption according to the uses to which it is put. (Information supplied direct.)

2. THE ELECTRIFICATION OF RAILWAYS (STANDARD GAUGE).

In the following table we have tried to show the position and development of the electric operation of railways (standard gauge only). Here, too, it was found that the statistics as to the mileage of electrically operated sections were quite inadequate, and we were consequently obliged, for several countries (see footnotes to the table), to resort to the estimates of experts.

The figures obtainable for the various countries show wide discrepancies. Often no distinction is made between electrically operated standard gauge lines and light railways. Moreover, sections still under construction are counted in with those already in operation.

The figures given in columns 2 and 3 of the following table — except in the case of Switzerland and the United States of America — probably vary very little from the pre-war figures, as during the war and in the years immediately following it work for the electrification of railways remained almost everywhere virtually at a standstill.

To sum up, in Europe in the years 1921 to 1922, in round figures, out of a total length of railway system amounting to 370,000 kilometres, 2,200 kilometres (equal to 0.6 per cent) were electrified, and in 1926 out of a total length of, roughly, 380,000 kilometres, about 6,000 kilometres (equal to 1.6 per cent) were electrified.

In America (North and South), in 1926, out of a total length of railway system of 598,600 kilometres, about 3,850 kilometres (= 0.7 per cent) were electrified.

POSITION AND DEVELOPMENT OF ELECTRIC RAILWAYS (STANDARD GAUGE)
(based on actual length of track)

Country	1921-22 kilometres	Percentage of total system	1926 kilometres	Percentage of total system	Type of current
Germany	439	0.7	ca. 961 ²	1.7	AC
Switzerland	543	10.0	896 ²	15.6	AC
Italy	510	2.5	ca. 1,000 ⁴	4.8	3 ph.
Sweden	398	2.6	926 ⁵	5.9	AC
France	—	0.3	ca. 1,060 ⁶	2.0	DC & AC
Austria	134	2.1	345 ⁷	5.2	AC
Holland	54	1.6	115 ¹	3.3	DC
England	104	0.3	130 ¹	0.3	DC & AC
Norway	—	—	205 ¹	5.9	AC
Spain	—	—	166 ¹	1.1	DC & AC
Hungary	—	—	143 ¹	1.5	DC
United States of America	1,536	0.4	3,127 ¹	0.8	DC & AC (85% DC)
Canada	—	—	301 ¹	0.5	DC & AC (85% DC)
Chile	—	—	255 ¹	2.9	DC
Brazil	—	—	64 ¹	0.2	DC
Cuba	—	—	52 ¹	0.9	DC
Mexico	—	—	48 ¹	0.2	DC
Japan	—	—	ca. 211 ⁸	1.0	DC

Explanations of abbreviations: AC = Single-phase alternating current; DC = Continuous current; 3 ph. = 3-phase alternating current.

¹ According to data furnished from private experts.
² *Elektrische Bahnen* (No. 1, 1926, page 1, and No. 4, 1926, page 111), including the suburban lines of Berlin about 80 kilometres, Hamburg 32 kilometres.
³ *Elektrotechnische Zeitschrift* of January 7th, 1926, page 16, with reference to the Swiss Federal Railways.
⁴ World Power Conference at Basle. *Elektrische Bahnen* (No. 10, 1926, page 360).
⁵ This figure includes 463 km. for the Stockholm-Göteborg line (including the line Stockholm-Hagalund), 448 km. for the line Svärton-Lulea-Riksgränsen, and 15 km. for the Lund-Ejarrad line. (Swedish note communicated direct.)
⁶ Publication of the "Union des syndicats de l'électricité" (Paris 1926), page 1293.
⁷ World Power Conference at Basle. Includes about 26 kilometres of the Wiener Stadtbahn. *Elektrische Bahnen* (No. 1, 1926, page 9).
⁸ World Power Conference at Basle.

Tableau IIIa.

PARTICIPATION DES CATÉGORIES D'ARTICLES PAR RAPPORT AUX IMPORTATIONS
D'ARTICLES DE L'INDUSTRIE ÉLECTROTECHNIQUE DES DIVERS PAYS.

CATÉGORIES	Allemagne Germany		France ¹		Belgique ² Belgium		Grande-Bretagne ³ Great Britain		Italie ⁴ Italy	
	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%
1913										
Machines dynamo-électriques . . .	3 564	24,7	7 333	23,6			25 426	46,9	9 537	36,7
Câbles et fils isolés	3 278	22,8	825	2,7			9 908	18,3	2 541	9,8
Instruments de mesure et comp- teurs	1 658	11,5	—	—			1 623	3,0	404	1,6
Téléphonie et télégraphie	614	4,3	8 100	26,0			3 093	5,7	2 020	7,7
Lampes à incandescence	1 026	7,1	2 125	6,8			3 195	5,8	7 365	28,3
Total	10 140	70,4	18 383	59,1			43 245	79,7	21 867	84,1
Divers	4 317	29,6	12 722	40,9			10 913	20,3	4 140	15,9
Total des importations . . .	14 457	100	31 105	100			54 158	100	26 007	100
1925										
Machines dynamo-électriques . . .	5 875	26,8	9 716	24,8	10 583	28,9	20 661	20,1	8 997	20,7
Câbles et fils isolés	2 612	11,9	1 564	4,0	3 571	9,8	15 633	15,2	715	1,6
Instruments de mesure et comp- teurs	5 302	24,2	—	—	2 194	6,0	4 205	4,1	4 534	10,4
Téléphonie et télégraphie	2 130	9,7	5 122	13,1	1 389	3,8	15 493	15,1	4 908	11,3
Lampes à incandescence	2 412	11,0	10 129	26,8	4 535	12,4	8 485	8,2	7 461	17,2
Total	18 331	83,6	26 531	68,7	22 272	60,9	64 477	62,7	26 615	61,2
Divers	3 567	16,4	12 624	31,3	14 377	39,1	38 338	37,3	16 853	38,8
Total des importations . . .	21 898	100	39 155	100	36 649	100	102 815	100	43 468	100

¹ Pour les instruments de mesure et les appareils servant à la téléphonie et à la télégraphie, sous la rubrique « Téléphonie et Télégraphie », la valeur est évaluée à 75 % environ de la position « Appareils à bobines ». Il est impossible de donner une statistique des compteurs électriques, car ceux-ci sont réunis dans la position 505 avec les compteurs à gaz et à eau.

² 1913: Les statistiques de l'industrie électrotechnique manquent.

³ Les réexportations sont déduites des importations. Machines électriques y compris les dispositifs de mise en marche pour machines.

1913: Instruments de mesure et compteurs évalués à 3 % des importations totales
1925: Instruments de mesure et compteurs évalués à 80 % des « instruments électriques autres que ceux qui servent à la téléphonie et à la télégraphie » (d'après la répartition de 1924).

⁴ 1913: Instruments de mesure et compteurs évalués à 10 %, téléphonie et télégraphie à 50 % de la position « Appareils ».

⁵ 1913: Instruments de mesure et compteurs évalués à 1 % des importations totales

⁶ 1913: Les statistiques relatives à l'industrie électrotechnique manquent.

1925: Instruments de mesure et compteurs évalués à 25 % de la position « Appareils ».

⁷ 1913: Autriche-Hongrie.

⁸ Lampes à incandescence évaluées à 85 % des importations de lampes électriques (d'après la répartition de 1924).

Table IIIa.

SHARE OF THE DIFFERENT CLASSES OF GOODS IN THE ELECTRICAL IMPORTS
OF THE DIFFERENT COUNTRIES

Espagne ^a Spain		Pays-Bas ^a Netherlands		Suisse Switzerland		Autriche ^b Austria		Tchécoslovaquie ^c Czechoslovakia		CLASS
1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	
1913										
22 830	66,2			1 250	14,5	8 628	29,3			Electrical machines. Cables and insulated wires. Measuring instruments and meters. Telephony and telegraphy. Incandescent lamps.
3 419	9,9			565	6,5	291	1,0			
345	1,0			868	10,0	5 198	17,7			
3 002	8,7			706	8,1	748	2,4			
4 309	12,5			1 729	19,9	4 026	13,7			
33 905	98,3			5 118	59,0	18 891	64,1			Total.
673	1,7			3 571	41,0	10 537	35,9			Miscellaneous.
34 578	100			8 689	100	29 428	100			Total Imports.
1925										
22 144	52,4	9 699	20,9	1 447	8,0	4 027	23,7	6 132	30,5	Electrical machines. Cables and insulated wires. Measuring instruments and meters. Telephony and telegraphy. Incandescent lamps.
3 013	7,1	15 261	32,8	1 872	10,3	351	2,1	117	0,6	
3 547	8,4	2 410	5,1	463	2,6	1 482	8,6	1 641	8,1	
5 318	12,6	10 412	22,4	4 798	26,5	2 379	13,8	5 231	26,0	
1 531	3,6	1 470	3,2	1 959	10,8	1 965	11,4	2 225	11,1	
35 553	84,1	39 252	84,4	10 539	58,2	10 207	59,6	15 346	76,3	Total.
6 741	15,9	7 240	15,6	7 602	41,8	6 967	40,4	4 786	23,7	Miscellaneous.
42 294	100	46 492	100	18 141	100	17 174	100	20 132	100	Total Imports.

^a Value of measuring instruments and telephonic and telegraphic apparatus under "telephony and telegraphy" estimated at about 75% of "apparatus with windings".

Meters not available, as they are included with gas and water meters under No. 505.

^b 1913: no figures available for the electrical industry.

^c Re-exports are deducted. Electrical machines, including starting gear for machines.

1913: measuring instruments and meters estimated at 3% of total imports.

1925: measuring instruments and meters estimated at 80% of "electrical instruments other than telephony and telegraphy" (based on the 1924 proportion).

^d 1913: measuring instruments and meters estimated at 10%, telephony and telegraphy at 50%, of the value of the articles included under the item "Apparatus".

^e 1913: measuring instruments and meters estimated at 1% of total imports.

^f 1913: no figures available for the electrical industry.

1925: measuring instruments and meters estimated at 25% of the value of the articles included under the item "Apparatus".

^g 1913: Austria-Hungary.

^h Incandescent lamps estimated at 85% of imported electric lamps (based on the 1924 proportion).

Tableau III a (suite et fin).

**PARTICIPATION DES CATÉGORIES D'ARTICLES PAR RAPPORT AUX IMPORTATIONS
D'ARTICLES DE L'INDUSTRIE ÉLECTROTECHNIQUE DES DIVERS PAYS.**

CATÉGORIES	Pologne Poland		Suède ¹ Sweden		Etats-Unis d'Amé- rique ² — U.S.A.		Canada ³		Argentine	
	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%
1913										
Machines dynamo-électriques . . .			1 701	14,7	—	—	6 653	17,4	4 941	12,1
Câbles et fils isolés			4 043	34,9	—	—	—	—	20 716	50,8
Instruments de mesure et comp- teurs			580	5,0	—	—	—	—	3 021	7,4
Téléphonie et télégraphie			199	1,7	—	—	—	—	806	2,0
Lampes à incandescence			1 413	12,2	2 100	43,8	—	—	2 005	5,0
Total			7 936	68,5	2 100	43,8	6 653	17,4	31 489	77,3
Divers			3 694	31,5	2 680	56,2	31 584	82,6	9 457	22,7
Total des importations . . .			11 630	100	4 780	100	38 237	100	40 946	100
1925										
Machines dynamo-électriques . . .	7 038	24,7	3 322	12,3	—	—	15 380	19,6	7 173	13,6
Câbles et fils isolés	6 317	22,2	2 359	8,7	—	—	2 079	2,7	21 569	40,9
Instruments de mesure et comp- teurs	1 723	6,0	2 527	9,0	—	—	1 180	1,5	3 444	6,5
Téléphonie et télégraphie	2 763	9,7	5 160	19,1	—	—	17 098	21,8	2 957	5,6
Lampes à incandescence	1 231	4,3	3 359	12,4	6 241	61,2	2 037	2,6	1 686	3,2
Total	19 072	66,9	16 727	61,5	6 241	61,2	37 774	48,2	36 829	69,8
Divers	9 440	33,1	10 267	38,5	3 978	38,8	40 651	51,8	15 890	30,2
Total des importations . . .	28 512	100	26 994	100	10 219	100	78 425	100	52 719	100

¹ Instruments de mesure et compteurs évalués à 90 % environ de la position « Appareils électriques spéciaux ».

² 1913 et 1925: Il n'existe d'indications détaillées que pour les lampes à incandescence.
1913: Exercice fiscal se terminant le 30 juin 1913.

³ Il n'existe d'indications détaillées que pour les machines. Exercices fiscaux se terminant le 31 mars 1913 et 1926 respectivement.

⁴ 1925: Pas de statistiques pour les lampes à incandescence qui sont comprises sous la rubrique « Lampes et articles pour lampes ».

⁵ Machines électriques y compris les dispositifs de mise en marche pour machines.
1913: Instruments de mesure et compteurs évalués à 5 % des importations totales. Exercices fiscaux se terminant le 31 mars 1914 et 1926 respectivement.

⁶ 1913: Les statistiques relatives à l'importation des instruments de mesure, des compteurs et des lampes électriques à incandescence manquent.
1925: Exercice fiscal se terminant le 30 juin 1925.

⁷ 1913: Il n'existe de statistique que pour les machines.

⁸ 1913: Lampes à incandescence évaluées à 5 %, instruments de mesure et compteurs à 2 % environ des importations.

Table IIIa (concluded).

**SHARE OF THE DIFFERENT CLASSES OF GOODS IN THE ELECTRICAL IMPORTS
OF THE DIFFERENT COUNTRIES.**

Japon * Japan		Inde britannique * British India		Australie * Australia		Nouv.-Zélande * New Zealand		Union de l'Afrique du Sud *— Union of South Africa		CLASS
1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	
1913										
9 009	60,0	7 038	38,7	9 425	25,2	8 119	98,2	9 506	36,5	Electrical machines. Cables and insulated wires. Measuring instruments and meters. Telephony and telegraphy. Incandescent lamps.
4 330	29,0	3 233	17,7	12 995	34,6	—	—	5 120	19,6	
987	6,1	900	5,0	—	—	—	—	500	1,8	
155	1,0	612	3,4	3 550	9,5	—	—	3 570	13,6	
596	3,9	1 244	6,8	—	—	—	—	1 300	5,0	
15 077	100	13 027	71,6	25 970	69,3	8 119	98,2	19 996	76,5	Total.
—	—	5 149	28,4	11 484	30,7	142	1,8	6 020	23,5	Miscellaneous.
15 077	100	18 176	100	37 454	100	8 262	100	26 010	100	Total Imports.
1925										
22 157	36,3	34 018	49,7	27 039	19,5	10 962	22,8	25 761	47,0	Electrical machines. Cables and insulated wires. Measuring instruments and meters. Telephony and telegraphy. Incandescent lamps.
4 250	7,0	11 783	17,2	26 958	19,4	12 444	26,0	14 149	25,7	
3 904	6,4	964	1,4	4 080	2,9	2 903	6,1	589	1,1	
29 109	47,7	1 178	1,7	20 645	14,7	4 060	8,4	6 618	11,4	
—	—	3 062	4,5	8 303	6,0	2 598	5,4	3 553	6,5	
59 420	97,4	51 005	74,5	87 025	62,5	32 967	68,7	50 670	92,4	Total.
1 397	2,6	17 433	25,5	52 164	37,5	14 961	31,3	4 160	7,6	Miscellaneous.
60 817	100	68 443	100	139 189	100	47 928	100	54 830	100	Total Imports.

* Measuring instruments and meters estimated at about 90 % of "special apparatus for electrical purposes".

* 1913 and 1925: Separate figures only available for incandescent lamps.

1913: Fiscal year ending June 30th, 1913.

* 1913: Separate figures only available for machines. Fiscal year ending March 31st, 1913 and 1926 respectively.

* 1925: Incandescent lamps not included, being contained under "lamps, lanterns and parts thereof".

* Electrical machines including starting apparatus for machines.

1913: Measuring instruments and meters estimated at 5 % of total imports. Financial years ending March 31st, 1914 and March 31st, 1926.

* 1913: Measuring instruments and meters and incandescent lamps: no information available.

1925: Financial year ending June 30th, 1925.

* 1913: Figures only available for machines.

* 1913: Incandescent lamps estimated at 5 % of imports, measuring instruments and meters at about 2 %.

Tableau III b.

**PARTICIPATION DES CATÉGORIES D'ARTICLES PAR RAPPORT AUX EXPORTATIONS
D'ARTICLES DE L'INDUSTRIE ÉLECTROTECHNIQUE DES DIVERS PAYS.**

CATÉGORIES	Allemagne ¹ Germany		France ²		Belgique ³ Belgium		Grande-Bretagne ⁴ Great Britain		Italie ⁵ Italy		Pays-Bas ⁶ Netherlands	
	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%
1913												
Machines dynamo-électriques.	64 400	19,5	3 334	11,0			46 296	29,6	2 012	24,2	—	—
Câbles et fils isolés	61 018	18,1	2 771	9,2			72 985	46,8	5 693	68,4	—	—
Instruments de mesure et compteurs	24 230	7,3	2 953	9,8			1 562	1,0	45	0,5	—	—
Téléphonie et télégraphie	11 246	3,4	2 953	9,8			5 922	3,8	46	0,5	—	—
Lampes à incandescence	48 114	14,5	1 806	6,0			3 110	2,0	143	1,7	8000	—
Total	209 008	63,1	13 817	45,8			129 875	83,2	7 939	95,3	—	—
Divers	121 553	36,9	16 360	54,2			26 301	16,8	394	4,7	—	—
Total des exportations	330 561	100	30 177	100			156 176	100	8 333	100	—	—
1925												
Machines dynamo-électriques.	51 803	14,6	14 627	18,6	2 202	12,3	116 966	33,2	4 466	36,6	4 827	9,1
Câbles et fils isolés	56 594	15,9	4 524	5,8	5 892	33,2	100 915	28,7	3 901	32,0	5 535	10,5
Instruments de mesure et compteurs	31 564	8,9	9 308	11,9	110	0,6	5 684	1,6	53	0,4	725	1,4
Téléphonie et télégraphie	47 997	13,5	9 308	11,9	4 854	27,3	57 477	16,3	522	4,3	2 383	4,5
Lampes à incandescence	26 786	7,5	6 914	8,8	828	4,6	10 363	2,9	66	0,6	37 314	70,8
Total	214 744	60,4	44 681	57,0	13 886	78,0	291 405	82,7	9 008	73,9	50 784	96,3
Divers	141 719	39,6	33 647	43,0	3 913	22,0	60 812	17,3	3 176	26,1	1 983	3,7
Total des exportations	356 463	100	78 328	100	17 799	100	352 217	100	12 184	100	52 767	100

¹ 1925: Non compris les livraisons au titre des réparations.

² Instruments de mesure, téléphonie et télégraphie, évalués respectivement à 1/3 de la position « Appareils avec et sans bobines ». Il est impossible de donner une statistique des compteurs électriques, car ceux-ci sont réunis dans la position 505 avec les compteurs à gaz et à eau.

³ 1913: Les statistiques de l'industrie électrotechnique manquent.

⁴ Machines électriques y compris les dispositifs de mise en marche pour machines.

1913: Instruments de mesure et compteurs évalués à 1% des exportations totales.

1925: Instruments de mesure et compteurs évalués à 80% des « Instruments électriques autres que ceux qui servent à la téléphonie et à la télégraphie », d'après la répartition de 1924.

⁵ 1913: Instruments de mesure, compteurs, téléphonie et télégraphie respectivement à 1/3 des exportations d'appareils.

⁶ 1913: Les statistiques relatives à l'industrie électrotechnique manquent. Les lampes à incandescence ont été évaluées à huit millions de marks, en prenant pour base la production du pays.

1925: Instruments de mesure et compteurs évalués à 25% environ des « appareils et instruments non spécialement désignés ».

⁷ 1913: Autriche-Hongrie.

⁸ Instruments de mesure et compteurs évalués à 3% des exportations totales. Lampes à incandescence évaluées à 90% des exportations totales de lampes (d'après la répartition de 1924).

⁹ Instruments de mesure et compteurs évalués à 90% environ de la position « Appareils électriques spéciaux ».

¹⁰ 1913: Les statistiques relatives aux câbles et fils isolés, aux instruments de mesure et compteurs manquent.

¹¹ 1913 et 1925: Il n'a pas été tenu compte des instruments de mesure et compteurs.

1913: Les statistiques pour les lampes à incandescence manquent

Table III b.

SHARE OF THE DIFFERENT CLASSES OF GOODS IN THE ELECTRICAL EXPORTS
OF THE DIFFERENT COUNTRIES.

Suisse Switzerland		Autriche † Austria		Tchécoslovaquie † Czechoslovakia		Suède † Sweden		Etats-Unis ¹⁰ d'Amérique † U.S.A.		Japon †† Japan		CLASS
1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	
1913												
16 435	66,7	1 264	12,2			5 051	35,8	27 598	24,6	987	61,2	Electrical machines. Cables and insulated wires Measuring instruments and meters. Telephony and telegraphy. Incandescent lamps
1 136	4,6	711	6,9			336	2,4	—	—	527	32,7	
1 869	7,6	108	1,1			141	1,0	—	—	—	—	
122	0,5	396	3,8			7 149	50,7	6 665	5,9	99	6,1	
722	2,9	4 544	43,8			117	0,8	2 617	2,3	—	—	
20 334	82,3	7 023	67,8			12 794	90,7	36 880	32,8	1 613	100	Total.
4 407	17,7	3 348	32,2			1 315	9,3	75 567	67,2	—	—	Miscellaneous.
24 741	100	10 371	100			14 109	100	112 447	100	1 613	100	Total exports.
1925												
22 742	47,7	6 595	19,0	1 314	28,8	23 654	59,1	78 506	22,2	3 667	32,9	Electrical machines. Cables and insulated wires. Measuring instruments and meters. Telephony and telegraphy Incandescent lamps.
2 207	4,6	3 757	10,8	633	13,9	2 765	6,9	20 580	5,8	3 051	27,3	
9 963	20,9	1 111	3,2	137	2,9	338	0,8	9 001	2,6	—	—	
471	1,0	5 610	16,2	—	—	8 683	21,7	59 304	16,8	609	5,5	
1 866	3,9	10 593	30,5	1 418	31,0	385	0,9	6 275	1,8	3 822	34,3	
37 249	78,1	27 666	79,7	3 502	76,6	35 825	89,4	173 666	49,2	11 149	100	Total.
10 399	21,9	7 023	20,3	1 068	23,4	4 277	10,6	179 508	50,8	—	—	Miscellaneous.
47 648	100	34 694	100	4 570	100	40 102	100	353 174	100	11 149	100	Total exports.

¹ 1925: Excluding reparations deliveries.

² Measuring instruments and telephony and telegraphy are estimated each at 1/4 of "apparatus with and without windings". Meters not available, being included among gas and water meters under No. 505.

³ 1913: No statistics available for the electrical industry.

⁴ Electrical machines, including starting gear. 1913: Measuring instruments and meters estimated at 1% of total exports.

⁵ 1925: Measuring instruments and meters estimated at 80% of all electrical instruments "other than telephony and telegraphy" (based on ratio for 1924).

⁶ 1913: Measuring instruments and meters and telephony and telegraphy estimated each at 1/3 of the exports of apparatus.

⁷ 1913: No statistics available for the electrical industry. Incandescent lamps estimated at 8 million marks on the basis of the home production.

⁸ 1925: Measuring instruments and meters estimated at about 25% of apparatus and instruments not specially mentioned.

[†] Austria-Hungary.

^{††} Measuring instruments and meters estimated at 3% of total exports. Incandescent lamps estimated at 90% of the total export of lamps (based on ratio for 1924).

^{†††} Measuring instruments and meters estimated at about 90% of special apparatus for electrical purposes.

¹⁰ 1913: No statistics available for cables and insulated wires, measuring instruments and meters.

¹¹ 1913 and 1925: Measuring instruments and meters not included.

1913: No figures for incandescent lamps.

Tableau IV a. — Table IV a.

PART REVENANT AUX PAYS DANS LES IMPORTATIONS DES DIVERSES CATEGORIES D'ARTICLES.
SHARE OF VARIOUS COUNTRIES IN THE IMPORTS OF THE DIFFERENT CLASSES OF GOODS.

Pays	Machines dynamo-électriques Electrical machines		Câbles et fils isolés Cables and insulated wires		Instruments de mesure et compteurs Measuring instruments and meters		Téléphonie et télégraphie ¹ Telephony and telegraphy		Lampes à incandescence Incandescent lamps		Countries
	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	
1913											
Allemagne	3 564	2,6	3 278	4,6	1 658	10,3	614	2,3	1 026	3,2	Germany.
France	7 333	5,4	825	1,2	—	—	8 100	29,8	2 125	6,6	France.
Belgique	—	—	—	—	—	—	—	—	—	—	Belgium.
Grande-Bretagne	25 426	18,8	9 908	13,9	1 623	10,1	3 093	11,4	3 195	9,9	Great Britain.
Italie	9 537	7,1	2 541	3,6	404	2,5	2 020	7,4	7 365	22,7	Italy.
Espagne	22 830	16,9	3 419	4,8	345	2,1	3 002	11,0	4 309	13,3	Spain.
Pays-Bas	—	—	—	—	—	—	—	—	—	—	Netherlands.
Suisse	1 250	0,9	565	0,8	868	5,4	706	2,6	1 729	5,3	Switzerland.
Autriche	8 628	6,4	291	0,4	5 198	32,3	748	2,8	4 026	12,4	Austria.
Suède	1 701	1,3	4 043	5,7	580	3,6	199	0,7	1 413	4,3	Sweden.
Etats-Unis d'Amérique	—	—	—	—	—	—	—	—	2 100	6,5	United States of America.
Canada	6 653	4,9	—	—	—	—	—	—	—	—	Canada.
Argentine	4 941	3,7	20 716	29,0	3 021	18,8	806	3,0	2 005	6,2	Argentina.
Japon	9 009	6,7	4 330	6,1	987	6,2	155	0,6	596	1,8	Japan.
Inde britannique	7 038	5,2	3 233	4,5	900	5,6	612	2,2	1 244	3,8	India.
Australie	9 425	7,0	12 995	18,2	—	—	3 550	13,1	—	—	Australia.
Nouvelle-Zélande	8 119	6,0	—	—	—	—	—	—	—	—	New Zealand.
Union de l'Afrique du Sud	9 506	7,1	5 120	7,2	500	3,1	3 570	13,1	1 300	4,0	Union of South Africa.
Total	134 960	100	71 264	100	16 084	100	27 175	100	32 433	100	Total.
1925											
Allemagne	5 875	2,3	2 612	1,8	5 302	11,3	2 130	1,5	2 412	3,2	Germany.
France	9 716	3,9	1 564	1,1	—	—	5 122	3,4	10 129	13,7	France.
Belgique	10 583	4,2	3 571	2,4	2 194	4,7	1 389	0,9	4 535	6,1	Belgium.
Grande-Bretagne	20 661	8,2	15 633	10,6	4 205	8,9	15 493	10,6	8 485	11,4	Great Britain.
Italie	8 997	3,6	715	0,6	4 534	9,2	4 908	3,3	7 461	10,1	Italy.
Espagne	22 144	8,8	3 013	2,1	3 547	7,5	5 318	3,6	1 531	2,1	Spain.
Pays-Bas	9 699	3,9	15 261	10,3	2 410	5,1	10 412	7,1	1 470	2,0	Netherlands.
Suisse	1 447	0,6	1 872	1,3	463	1,0	4 798	3,3	1 959	2,6	Switzerland.
Autriche	4 027	1,6	354	0,3	1 482	3,2	2 379	1,6	1 965	2,6	Austria.
Tchécoslovaquie	6 132	2,4	117	0,1	1 641	3,5	5 231	3,5	2 225	3,0	Czechoslovakia.
Pologne	7 038	2,8	6 317	4,3	1 723	3,7	2 763	1,9	1 231	1,7	Poland.
Suède	3 322	1,3	2 359	1,6	2 527	5,4	5 160	3,5	3 359	4,5	Sweden.
Etats-Unis d'Amérique	—	—	—	—	—	—	—	—	6 241	8,4	United States of America.
Canada	15 380	6,1	2 079	1,4	1 180	2,5	17 098	11,6	2 037	2,7	Canada.
Argentine	7 173	2,8	21 569	14,7	3 444	7,3	2 957	2,0	1 686	2,3	Argentina.
Japon	22 157	8,8	4 250	2,9	3 904	8,5	29 109	20,0	—	—	Japan.
Inde britannique	34 018	13,5	11 783	8,0	964	2,0	1 178	0,8	3 062	4,1	India.
Australie	27 039	10,7	26 958	18,4	4 080	8,7	20 645	14,0	8 303	11,2	Australia.
Nouvelle-Zélande	10 962	4,3	12 444	8,4	2 903	6,2	4 060	2,8	2 598	3,5	New Zealand.
Union de l'Afrique du Sud	25 761	10,2	14 149	9,7	589	1,3	6 618	4,6	3 553	4,8	Union of South Africa.
Total	252 131	100	146 620	100	47 092	100	146 768	100	74 242	100	Total.

¹ Téléphonie et télégraphie y compris la téléphonie et la télégraphie sans fil.

² Y compris les dispositifs de mise en marche pour machines; en conséquence, la valeur est un peu trop élevée par comparaison avec les autres pays.

Pour les remarques relatives aux pays, voir le tableau IIIa.

¹ Including wireless telephony and telegraphy.

² Including starting gear for machines: value therefore somewhat too high in comparison with the other countries. For notes on the countries see Table IIIa.

Tableau IV b. — Table IV b.

**PART REVENANT AUX PAYS DANS LES EXPORTATIONS DES DIVERSES CATÉGORIES D'ARTICLES.
SHARE OF VARIOUS COUNTRIES IN THE EXPORTS OF THE DIFFERENT CLASSES OF GOODS.**

Pays	Machines dynamo-électriques Electrical machines		Câbles et fils isolés Cables and insulated wires		Instruments de mesure et compteurs Measuring instruments and meters		Téléphonie et télégraphie ¹ Telephony and telegraphy		Lampes à incandescence Incandescent lamps		Countries
	RM. 1000	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	1000 RM.	%	
1913											
Allemagne	64 400	38,5	61 018	42,1	24 230	—	11 246	32,5	48 114	69,5	Germany.
France	3 334	2,0	2 771	1,9	2 953	—	2 953	8,5	1 806	2,6	France.
Belgique	—	—	—	—	—	—	—	—	—	—	Belgium.
Grande-Bretagne	46 296	27,6	72 985	50,3	1 562	—	5 922	17,1	3 110	4,5	Great Britain.
Italie	2 012	1,2	5 693	3,9	45	—	46	0,1	143	0,2	Italy.
Pays-Bas	—	—	—	—	—	—	—	—	8 000	11,5	Netherlands.
Suisse	16 485	9,8	1 136	0,8	1 869	—	122	0,4	722	1,0	Switzerland.
Autriche	1 264	0,8	711	0,5	108	—	396	1,1	4 544	6,7	Austria.
Suède	5 051	3,0	336	0,2	141	—	7 149	20,7	11 7	0,2	Sweden.
Etats-Unis d'Amérique	27 598	16,5	—	—	—	—	6 665	19,3	2 617	3,8	United States of America
Japon	987	0,6	527	0,3	—	—	99	0,3	—	—	Japan.
Total	167 427	100	145 177	100	30 908	—	34 598	100	69 173	100	Total.
1925											
Allemagne	51 803	15,7	56 594	26,9	31 564	46,4	47 997	24,4	26 786	25,1	Germany.
France	14 627	4,4	4 524	2,2	9 308	13,7	9 308	4,7	6 914	6,5	France.
Belgique	2 202	0,6	5 892	2,8	110	0,2	4 854	2,5	828	0,8	Belgium.
Grande-Bretagne	116 966	35,3	100 915	48,1	5 684	8,4	57 477	29,2	10 363	9,7	Great Britain.
Italie	4 466	1,3	3 901	1,8	53	0,1	522	0,2	66	0,1	Italy.
Pays-Bas	4 827	1,5	5 535	2,6	725	1,1	2 383	1,2	37 314	35,0	Netherlands.
Suisse	22 742	6,9	2 207	1,0	9 963	14,6	471	0,2	1 866	1,7	Switzerland.
Autriche	6 505	2,0	3 757	1,8	1 111	1,6	5 610	2,8	10 593	9,9	Austria.
Tchécoslovaquie	1 314	0,4	633	0,3	137	0,2	—	—	1 418	1,3	Czechoslovakia.
Suède	23 654	7,1	2 765	1,3	338	0,5	8 683	4,4	385	0,4	Sweden.
Etats-Unis d'Amérique	78 506	23,7	20 580	9,8	9 001	13,2	59 304	30,1	6 275	5,9	United States of America.
Japon	3 667	1,1	3 051	1,4	—	—	609	0,3	3 822	3,6	Japan.
Total	331 369	100	210 354	100	67 994	100	197 218	100	106 630	100	Total.

¹ Téléphonie et télégraphie y compris la téléphonie et la télégraphie sans fil.

² Nous nous sommes abstenus de calculer la part proportionnelle pour la catégorie des instruments de mesure et des compteurs, attendu que, dans les pays importants pour cette catégorie, nous ne possédons pas de statistiques et que, par conséquent, les pourcentages seraient de nature à induire en erreur.

³ Estimation d'après la production des maisons du pays.

⁴ Y compris les dispositifs de mise en marche pour machines; en conséquence, la valeur est un peu trop élevée par comparaison avec les autres pays.

Pour les remarques relatives aux pays, voir le tableau III b).

¹ Including wireless telephony and telegraphy.

² It was decided not to estimate the percentage share or "measuring instruments and meters", as data were lacking for important export countries, so that the percentage figures would have given a false idea.

³ Estimated on the basis of home production.

⁴ Including starting gear for machines; the value, therefore, is somewhat too high in comparison with other countries.

For notes on the countries, see Table III b.

Tableau V.

**POURCENTAGE DES DROITS DE DOUANE FRAPPANT LES PRODUITS DE L'INDUSTRIE
ÉLECTROTECHNIQUE.**

CATÉGORIES	Valeur moyenne par 100 kg. RM.		Allemagne Germany				France				Belgique - Belgium			
	Average value per 100 kgs Reichsmarks		1913		1926		1913		1926		1913		1926	
			maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum
	1913	1926												
1	2a	2b	3a	3b	3c	3d	4a	4b	4c	4d	5a	5b	5c	5d
Machines dynamo-électriques ¹:														
Poids max. 10 kgs.	700	800	1,3	1,3	10,0	5,0	17,3	12,2	53,3	13,3	1,4	1,4	24,0	8,0
» » 25 »	350	400	2,6	2,6	10,0	7,9	27,8	19,5	81,2	20,3	2,8	2,8	35,1	11,7
» » 50 »	270	310	3,3	3,3	7,4	7,4	36,0	24,0	104,8	26,2	3,6	3,6	45,3	15,1
» » 250 »	240	280	3,8	3,8	7,3	7,3	15,2	10,1	43,5	10,9	4,1	4,1	25,2	8,4
» » 500 »	220	250	4,1	4,1	7,2	7,2	16,6	11,0	48,8	12,2	4,4	4,4	28,2	9,4
» » 1.000 »	190	220	3,7	3,2	3,6	3,6	19,2	12,8	55,4	13,8	5,1	5,1	32,1	10,7
» » 5.000 »	165	190	3,9	3,3	4,0	4,0	14,7	8,7	42,7	10,6	5,8	5,8	26,1	8,7
Poids supérieur à 3.000 kgs	140	160	4,3	3,2	4,4	4,4	17,4	10,1	50,8	12,7	7,0	7,0	26,4	8,8
Moyenne			3,4	3,1	6,7	5,9	20,5	13,8	60,1	15,0	4,3	4,3	30,3	10,1
Appareils:														
Matériel d'installations	250	300	24,0	16,0	20,0	15,0 ²	48,6	25,9	104,8	26,2	3,9	3,9	75,3	25,1
Appareils de commutation et de coupure:														
Disjoncteurs dans l'huile: 200-300 kgs	160	200	37,5	5,0	30,0	22,5 ²	22,8	10,1	49,1	14,7	6,1	6,1	28,2	9,4
50-100 »	250	300	24,0	8,0	20,0	15,0 ²	38,9	13,0	57,3	13,1	3,9	3,9	28,2	9,4
Interrupteurs à levier 5-10	250	300	24,0	16,0	20,0	15,0 ²	48,6	25,9	104,8	26,2	3,9	3,9	56,1	18,7
Moyenne			27,4	11,3	22,5	16,9 ²	39,7	18,7	79,5	20,0	4,5	4,5	46,8	15,6
Câbles et fils isolés:														
Câbles pour courant à haute et basse tension	105	115	7,6	7,6	13,9	13,9	46,2	30,9	187,2	46,8	9,2	9,2	36,6	12,2
Fils isolés (NGA. 1,5-10 mm ³)	260	220	5,8	5,8	11,4	11,4	32,7	21,8	171,2	42,8	3,7	3,7	38,4	12,8
Moyenne			6,7	6,7	12,6	12,6	39,3	26,3	179,2	44,8	6,5	6,5	37,5	12,5
Instruments de mesure et compteurs:														
a) Instruments de mesure:														
Petits	1 600	2 000	3,8	2,5	6,0	5,0	7,6	5,6	17,1	4,5	0,6	0,6	28,2	9,4
Grands	1 100	1 400	5,5	3,6	8,6	7,1	11,0	8,1	24,5	6,4	0,8	0,8	40,2	13,4
Watt-mètre enregistreurs au-dessus de 20 kgs	2 000	2 500	3,0	1,5	4,8	4,0	4,1	3,2	8,2	2,6	0,5	0,5	22,5	7,5
Moyenne			4,1	2,5	6,5	5,4 ²	7,6	5,6	16,6	4,5	0,6	0,6	30,3	10,1
b) Compteurs:														
Compteurs de courant alternatif au-dessous de 5 kgs	1 200	1 500	5,0	3,3	8,0	6,7	6,8	5,1	56,4	14,1	0,8	0,8	28,2	9,4
Compteurs de courant alternatif au-dessus de 5 kgs	780	860	7,7	5,1	14,0	11,6	10,4	7,8	19,6	4,9	1,1	1,1	48,9	16,3
Moyenne			6,4	4,2	11,0	9,1 ²	8,6	6,5	38,0	9,5	1,0	1,0	38,6	12,8
Téléphonie et télégraphie:														
Appareils de téléphonie	1 150	1 600	5,2	5,2	7,5	7,5	10,6	7,4	21,4	5,3	8,4	8,4	26,4	8,8
Appareils de télégraphie	1 500	2 000	4,0	4,0	6,0	6,0	6,5	3,8	10,2	2,8	6,5	6,5	21,0	7,0
Moyenne			4,6	4,6	6,8	6,8	8,6	5,6	15,8	4,1	7,5	7,5	23,7	7,9
Lampes à incandescence:														
Lampes à filament métallique en atmosphère gazeuse	3 500	2 200	2,3	2,3	3,6	3,6	17,4	11,6	74,0	18,5	10	10	32,1	10,7
Lampes à filament métallique dans le vide	2 000	1 375	4,0	4,0	5,8	5,8	30,4	20,3	118,4	29,6	10	10	30,6	10,2
Moyenne			3,1	3,1	4,7	4,7	23,9	15,9	96,2	24,1	10	10	31,4	10,5

¹ Les transformateurs, en raison de leur faible valeur spécifique, sont frappés en moyenne de droits de 10 à 15% plus élevés excepté dans les pays dans lesquels il existe des taux spéciaux pour les transformateurs (par exemple, Italie et Autriche).

² Taux conventionnels pris dans le nouveau traité de commerce germano-suisse du 14 juillet 1926.

³ Turbo-générateurs.

Table V.

CUSTOMS DUTIES AS A PERCENTAGE ON THE VALUE OF ELECTRICAL MANUFACTURES

Italie Italy				Espagne Spain				Pays-Bas Netherlands				Suisse Switzerland				CATEGORIES	
1913		1926		1913		1926		1913		1926		1913		1926			
maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum		
6a	6b	6c	6d	7a	7b	7c	7d	8a	8b	8c	8d	9a	9b	9c	9d		
3,5	2,9	17,3	15,5	11,6	8,7	55,3	21,3	5	5	8	8	2,3	1,6	3,5	3,5	Electrical machines: ¹ Up to 10 kgs. » 25 » » 50 » » 250 » » 500 » » 1,000 » » 5,000 » Over 5,000 » Average.	
7,0	5,8	28,9	25,8	23,2	17,4	104,8	33,4	5	5	0	0	4,6	3,2	7,0	7,0		
9,0	7,5	37,2	33,3	30,0	22,5	126,3	45,1	5	5	0	0	6,0	4,2	9,1	9,1		
10,1	8,4	33,0	27,8	33,8	24,5	136,5	48,2	5	5	0	0	6,1	4,2	9,9	9,9		
11,0	9,2	26,2	23,3	27,6	19,9	149,0	52,2	5	5	0	0	5,9	4,1	9,7	9,7		
12,8	10,7	29,2	26,5	21,3	16,0	152,4	39,8	5	5	0	0	5,1	3,4	7,4	7,4		
14,7	7,9	25,0	22,2	24,5	16,5	90,9	23,6	5	5	0	0	5,4	3,5	8,0	8,0		
17,4	9,3	7,6 ²	27,3	24,3	29,0	11,6	78,6	18,2	5	5	0	0	5,2	3,2	8,8		8,8
10,7	7,6	28,0	24,8	25,1	17,1	111,7	35,8	5	5	1	1	5,1	3,4	7,9	7,9		
9,7	9,7	54,0	27,0	32,4	24,3	155,3	55,9	5	5	5	5	6,5	6,5	10,8	10,8		Apparatus: Installation material Switch gear: Oil switches 200-300 kgs. 50-100 » Knife switches 5-10 » Average.
15,2	12,7	36,6	18,3	50,6	38,0	116,4	32,4	5	5	5	5	10,1	10,1	16,2	16,2		
9,7	9,7	27,0	13,5	32,4	24,3	77,6	24,3	5	5	5	5	6,5	6,5	10,8	10,8		
9,7	9,7	35,1	17,6	32,4	24,3	77,6	24,3	5	5	5	5	6,5	6,5	10,8	10,8		
11,1	10,5	38,2	19,1	37,0	27,7	106,7	34,2	5	5	5	5	7,4	7,4	12,2	12,2		
23,1	21,5	42,3	42,3	46,3	33,1	199	72,9	5	5	5	5	11,6	9,4	22,0	22,0	Cables and insulated wires: Heavy and light current cables. Insulated wire (NGA. 1,5-10 mm ²) Average.	
18,7	15,6	37,0	31,0	46,7	31,2	243	84,7	5,8	5,8	5,8	5,8	9,3	5,6	14,1	14,1		
20,9	18,5	39,7	36,6	46,5	32,1	221	78,8	5,7	5,7	5,7	5,7	10,4	7,5	18,0	18,0		
1,5	1,5	14,6	8,1	15,2	10,1	60,5	23,3	5	5	5	5	1,3	1,0	3,2	3,2	(a) Measuring instruments: Small. Large. Recording wattmeters over 20 kgs. Average.	
2,2	2,2	20,8	11,6	22,1	14,7	86,5	33,3	5	5	5	5	1,8	1,5	4,6	4,6		
1,2	1,2	11,7	6,5	12,2	8,1	48,5	18,6	5	5	5	5	1,0	0,8	2,6	2,6		
1,0	1,6	15,7	8,7	16,5	11,0	65,2	25,1	5	5	5	5	1,4	1,1	3,5	3,5		
2,0	2,0	19,4	14,0	20,3	13,5	80,7	31,1	5	5	5	5	1,7	1,4	4,3	4,3	(b) Meters: Alternating current meters under 5 kgs. Alternating current meters over 5 kgs. Average.	
3,1	3,1	33,9	24,5	31,2	20,8	141,0	54,2	5	5	5	5	2,6	2,1	7,5	7,5		
2,6	2,6	26,7	19,3	25,8	17,2	110,9	42,7	5	5	5	5	2,2	1,8	5,9	5,9		
2,1	2,1	9,1	8,5	21,1	14,1	29,1	10,1	5	5	8	8	8,4	8,4	3,0	3,0	Telephony and telcgraphy: Telephone apparatus. Telegraph apparatus. Average.	
1,6	1,6	7,3	6,8	16,2	10,8	23,3	8,1	5	5	5	5	6,5	6,5	2,4	2,4		
1,9	1,9	8,2	7,7	13,6	12,4	26,2	9,1	5	5	6,5	6,5	7,4	7,4	2,7	2,7		
2,9	2,9	17,7	17,7	30,1	18,5	152,4	50,6	5	5	8	8	2,3	1,2	7,4	7,4	Incandescent lamps: Metal filament, gas-filled. Metal filament, vacuum. Average.	
4,7	4,7	28,3	28,3	52,7	32,4	244,0	81,3	5	5	8	8	4,0	2,0	11,8	11,8		
3,8	3,8	23,0	23,0	41,4	25,4	198,2	65,9	5	5	8	8	3,2	1,6	9,6	9,6		

¹ In consequence of their small specific value, transformers are taxed on an average 10 to 15 per cent. higher, except in countries which have special rates for transformers (e.g., Italy, Austria).

² Conventional duties of the new German-Swiss Commercial Treaty of July 14th, 1926.

³ Turbo-generators.

Tableau V (suite).

**POURCENTAGE DES DROITS DE DOUANE FRAPPANT LES PRODUITS DE L'INDUSTRIE
ÉLECTROTECHNIQUE.**

CATÉGORIES	Valeur moyenne par 100 kg. RM.		Autriche Austria				Tchécoslovaquie Czechoslovakia				Pologne Poland			
	Average value per 100 kg. Reichsmarks		1913		1926		1913		1926		1913		1926	
			maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum
	1913	1926												
1	2 a	2 b	3 a	3 b	3 c	3 d	4 a	4 b	4 c	4 d	5 a	5 b	5 c	5 d
Machines dynamo-électriques:¹														
Poids max. 10 kgs.	700	800	8,7	6,1	14,9	11,2	8,7	6,1	33,7	16,9	16,0	16,0	40,7	23,5
» » 25 »	350	400	17,5	12,2	29,8	19,2	17,5	12,2	67,5	33,8	32,0	32,0	53,5	48,1
» » 50 »	270	310	15,7	12,6	26,3	19,2	15,7	12,6	60,5	30,2	41,5	41,5	69,0	62,1
» » 250 »	240	280	17,7	12,7	25,9	19,2	17,7	12,7	67,0	33,5	46,7	46,7	67,2	60,5
» » 500 »	220	250	19,3	12,4	25,5	19,0	19,3	12,4	75,0	37,5	51,0	51,0	65,1	58,6
» » 1.000 »	190	220	19,2	12,1	24,7	17,4	19,2	12,1	73,3	40,2	59,0	59,0	50,7	45,6
» » 5.000 »	165	190	20,3	13,4	20,7	16,3	20,3	13,4	78,0	42,8	67,9	67,9	44,6	33,7
Poids supérieur à 5.000 kgs.	140	160	14,6	12,2	17,0	12,8	14,6	12,2	56,3	31,0	80,0	80,0	36,3	29,1
Moyenne			16,6	11,7	23,1	16,8	16,6	11,7	63,9	33,2	49,3	49,3	53,4	46,4
Appareils:														
Matériel d'installations	250	300	61,2	51,0	51,0	51,0	61,2	51,0	187,5	100	63,2	47,5	53,1	53,1
Appareils de commutation et de coupure:														
Disjoncteurs dans l'huile: 200-300 kgs	160	200	63,8	16,0	27,6	27,6	63,8	16,0	187,5	90	98,9	74,1	69,8	69,8
50-100 »	250	300	40,8	15,3	25,5	25,5	40,8	15,3	125,0	60	63,2	47,5	65,1	65,1
Interrupteurs à levier 5-10 »	250	300	40,8	40,8	34,0	34,0	40,8	40,8	125,0	90	63,2	47,5	93,0	93,0
Moyenne			51,7	30,8	34,5	34,5	51,7	30,8	156,3	85	72,1	54,2	70,3	70,3
Câbles et fils isolés:														
Câbles pour courant à haute et basse tension	105	115	39,0	39,0	26,6	26,6	39,0	39,0	104,3	65,2	84,1	84,1	42,2	42,2
Fils isolés (NGA. 1,5-10 mm ²)	260	220	31,2	22,9	42,5	38,6	31,2	22,9	108,0	56,8	82,1	82,1	56,0	50,0
Moyenne			35,1	30,9	34,5	32,6	35,1	30,9	106,1	61,0	83,1	83,1	49,1	49,1
Instruments de mesure et compteurs:														
a) Instruments de mesure:														
Petits	1 600	2 000	12,8	10,6	8,5	8,5	12,8	10,6	37,5	24,4	12,4	9,9	8,6	7,7
Grands	1 100	1 400	18,5	15,5	12,1	12,1	18,5	15,5	53,6	34,8	18,0	14,4	12,3	11,1
Watt-mètre enregistreurs au-dessus de 20 kgs	2 000	2 500	5,1	5,1	6,8	5,5	5,1	5,1	15,0	12,0	9,9	7,9	6,9	6,2
Moyenne			12,1	10,4	9,1	8,7	12,1	10,4	35,4	23,7	13,4	10,7	9,3	8,3
b) Compteurs:														
Compteurs de courant alternatif au-dessous de 5 kgs	1 200	1 500	17,0	14,2	11,3	11,3	17,0	14,2	50,0	32,5	16,5	13,2	11,5	10,3
Compteurs de courant alternatif au-dessus de 5 kgs	780	860	13,1	13,1	19,8	14,8	13,1	13,1	43,6	34,9	25,3	20,3	20,0	18,0
Moyenne			15,1	13,7	10,6	13,1	15,1	13,7	46,8	33,7	20,9	16,8	15,8	14,2
Téléphonie et télégraphie:														
Appareils de téléphonie	1 150	1 600	13,3	9,6	8,0	8,0	13,3	9,6	35,1	23,4	13,8	10,3	20,3	17,4
Appareils de télégraphie	1 500	2 000	6,8	6,8	6,4	6,4	6,8	6,8	18,8	15,0	10,5	7,9	14,2	14,2
Moyenne			10,0	8,2	7,2	7,2	10,0	8,2	26,9	19,2	12,2	9,1	17,3	15,8
Lampes à incandescence:														
Lampes à filament métallique en atmosphère gazeuse	3 500	2 200	4,9	4,9	7,7	7,7	4,9	4,9	22,7	14,8	11,3	11,3	29,6	29,6
Lampes à filament métallique dans le vide	2 000	1 375	8,5	8,5	12,4	12,4	8,5	8,5	36,4	23,6	19,8	19,8	47,4	47,4
Moyenne			6,7	6,7	10,0	10,0	6,7	6,7	29,5	19,2	15,6	15,6	38,5	38,5

¹ Les transformateurs, en raison de leur faible valeur spécifique, sont frappés en moyenne de droits de 10 à 15 % plus élevés, excepté dans les pays dans lesquels il existe des taux spéciaux pour les transformateurs (par exemple, Italie et Autriche.)

Table V (continued)

CUSTOMS DUTIES AS A PERCENTAGE ON THE VALUE OF ELECTRICAL MANUFACTURES

Suède Sweden				Etats-Unis d'Amérique U.S.A.				Canada				CATEGORIES		
1913		1926		1913		1926		1913		1926				
maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum p ^r Grande- Bretagne For Great Britain	maximum	minimum			
6a	6b	6c	6d	7a	7b	7c	7d	8a	8b	8c	8d	9		
8,8	8,8	7,7	7,7	20	20	30	30	27,5	25	15	27,5	22,5	15	Electrical machines ¹ :
17,7	17,7	15,5	15,5	20	20	30	30	27,5	25	15	27,5	22,5	15	Up to 10 kgs.
22,9	22,9	20,0	20,0	20	20	30	30	27,5	25	15	27,5	22,5	15	» 25 »
15,4	15,4	13,3	13,3	20	20	30	30	27,5	25	15	27,5	22,5	15	» 50 »
15,2	15,2	12,6	12,6	20	20	30	30	27,5	25	15	27,5	22,5	15	» 250 »
13,0	13,0	11,3	11,3	20	20	30	30	27,5	25	15	27,5	22,5	15	» 500 »
12,6	12,6	10,9	10,9	20	20	30	30	27,5	25	15	27,5	22,5	15	» 1,000 »
12,1	12,1	10,5	10,5	20	20	30	30	27,5	25	15	27,5	22,5	15	» 5,000 »
14,8	14,8	12,7	12,7	20	20	30	30	27,5	25	15	27,5	22,5	15	Average.
24,8	24,8	20,6	20,6	—	—	—	—	27,5	25	15	27,5	22,5	15	Apparatus:
38,6	38,6	30,9	30,9	—	—	—	—	27,5	25	15	27,5	22,5	15	Installation material
24,8	24,8	11,3	11,3	—	—	—	—	27,5	25	15	27,5	22,5	15	Switch gear:
22,7	22,7	18,8	18,8	—	—	—	—	27,5	25	15	27,5	22,5	15	Oil switches 200-300 kgs
27,7	27,7	20,4	20,4	—	—	—	—	27,5	25	15	27,5	22,5	15	Knife switches 5-10 »
26,8	26,8	24,4	24,4	15	15	35	35	30	27,5	20	30	24,75	20	Average.
13,0	13,0	15,3	15,3	15	15	35	35	30	27,5	20	30	24,75	20	Cables and insulated wire:
19,9	19,9	19,8	19,8	15	15	35	35	30	27,5	20	30	24,75	20	Heavy and light current cables.
														Insulated wire (NGA. 1,5-10 mm).
														Average.
10,0	10,0	10,0	10,0	20	20	45	45	27,5	25	15	27,5	22,5	15	Measuring instruments and meters:
10,0	10,0	10,0	10,0	20	20	45	45	27,5	25	15	27,5	22,5	15	(a) Measuring instruments:
10,0	10,0	10,0	10,0	20	20	45	45	27,5	25	15	27,5	22,5	15	Small.
10,0	10,0	10,0	10,0	20	20	45	45	27,5	25	15	27,5	22,5	15	Large.
														Recording wattmeters over 20 kgs.
														Average.
10,0	10,0	10,0	10,0	20	20	45	45	27,5	25	15	27,5	22,5	15	(b) Meters:
10,0	10,0	10,0	10,0	20	20	45	45	27,5	25	15	27,5	22,5	15	Alternating current meters under 5 kgs.
10,0	10,0	10,0	10,0	20	20	45	45	27,5	25	15	27,5	22,5	15	Alternating current meters over 5 kgs.
														Average.
11,2	11,2	8,1	8,1	20	20	40	40	27,5	25	15	27,5	22,5	15	Telephony and telegraphy:
11,3	11,3	8,4	8,4	20	20	40	40	27,5	25	15	27,5	22,5	15	Telephone apparatus.
11,3	11,3	8,3	8,3	20	20	40	40	27,5	25	15	27,5	22,5	15	Telegraph apparatus.
														Average.
12,9	12,9	20,5	20,5	30	30	20	20	30	27,5	20	30	27,5	20	Incandescent lamps:
22,5	22,5	32,8	32,8	30	30	20	20	30	27,5	20	30	27,5	20	Metal filament lamps, gas-filled.
17,7	17,7	26,6	26,6	30	30	20	20	30	27,5	20	30	27,5	20	Metal filament lamps, vacuum.
														Average.

¹ In consequence of their small specific value, transformers are taxed on an average 10 to 15 per cent. higher, except in countries which have special duties on transformers (e. g., Italy, Austria).

Tableau V (suite et fin).

**POURCENTAGE DES DROITS DE DOUANE FRAPPANT LES PRODUITS DE L'INDUSTRIE
ÉLECTROTECHNIQUE.**

CATÉGORIES	Valeur moyenne par 100 kg. R.M.		Argentine				Japon Japan				Inde britannique British India			
	Average value per 100 kg. Reichsmarks		1913		1926		1913		1926		1913		1926	
			maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum
	1913	1926	3 a	3 b	3 c	3 d	4 a	4 b	4 c	4 d	5 a	5 b	5 c	5 d
1	2 a	2 b	3 a	3 b	3 c	3 d	4 a	4 b	4 c	4 d	5 a	5 b	5 c	5 d
Machines dynamo-électriques:														
Poids max. 10 kgs.	700	800	0,9	0,9	2,0	2,0	13,0	13,0	18,0	18,0	0	0	2,5	2,5
» » 25 »	350	400	1,7	1,7	4,0	4,0	26,0	26,0	36,0	36,0	0	0	2,5	2,5
» » 50 »	270	310	2,2	2,2	5,1	5,1	20,7	20,7	27,3	27,3	0	0	2,5	2,5
» » 250 »	240	280	2,5	2,5	5,7	5,7	19,7	19,7	26,6	26,6	0	0	2,5	2,5
» » 500 »	220	250	2,8	2,8	6,4	6,4	19,1	19,1	28,0	28,0	0	0	2,5	2,5
» » 1.000 »	190	220	3,2	3,2	7,3	7,3	18,4	18,4	27,4	27,4	0	0	2,5	2,5
» » 5.000 »	165	190	3,7	3,7	8,4	8,4	19,1	19,1	29,0	29,0	0	0	2,5	2,5
Poids supérieur à 5.000 kgs	140	160	4,3	4,3	10,0	10,0	17,5	17,5	33,6	33,6	0	0	2,5	2,5
Moyenne			2,6	2,6	6,1	6,1	19,2	19,2	28,2	28,2	0	0	2,5	2,5
Appareils:														
Matériel d'installation	250	300	22,3	22,3	36,6	36,6	40	40	35	35	—	—	15	15
Appareils de commutation et de coupure:														
Disjoncteurs dans l'huile: 200-300 kgs.	160	200	57,0	57,0	89,9	89,9	20	20	20	20	—	—	15	15
50-100 »	250	300	36,5	36,5	59,9	59,9	20	20	20	20	—	—	15	15
Interrupteurs à levier 5-10 »	250	300	36,5	36,5	59,9	59,9	20	20	20	20	—	—	15	15
Moyenne			38,1	38,1	61,6	61,6	25	25	23,8	23,8	—	—	15	15
Câbles et fils isolés:														
Câbles pour courant à haute et basse tension	105	115	9,6	9,6	13,5	13,5	18,3	18,3	16,3	16,3	5	5	2,5	2,5
Fils isolés (NGA. 1,5-10 mm ²)	260	220	26,5	26,5	67,4	67,4	19,5	19,5	40,2	40,2	5	5	15,0	15,0
Moyenne			18,0	18,0	40,4	40,4	18,9	18,9	28,2	28,2	5	5	8,7	8,7
Instruments de mesure et compteurs:														
a) Instruments de mesure:														
Petits	1 600	2 000	32,0	32,0	50,0	50,0	13,7	13,7	25,2	25,2	5	5	15	15
Grands	1 100	1 400	23,0	23,0	36,0	36,0	19,9	19,9	36,0	36,0	5	5	15	15
Watt-mètre enregistreurs au-dessus de 20 kgs	2 000	2 500	1,2	1,2	1,9	1,9	10,9	10,9	20,1	20,1	5	5	15	15
Moyenne			18,7	18,7	29,3	29,3	14,8	14,8	27,1	27,1	5	5	15	15
b) Compteurs:														
Compteurs de courant alternatif au-dessous de 5 kgs	1 200	1 500	68,0	68,0	120,0	120,0	11,6	11,6	14,8	14,8	5	5	15	15
Compteurs de courant alternatif au-dessus de 5 kgs	780	860	27,0	27,0	49,0	49,0	17,9	17,9	22,8	22,8	5	5	15	15
Moyenne			47,5	47,5	84,5	84,5	14,8	14,8	18,8	18,8	5	5	15	15
Téléphonie et télégraphie:														
Appareils de téléphonie	1 150	1 600	20,5	20,5	24,0	24,0	20,0	20,0	20,0	20,0	5	5	15	15
Appareils de télégraphie	1 500	2 000	16,0	16,0	18,0	18,0	20,0	20,0	20,0	20,0	5	5	15 ¹	15 ¹ 10
Moyenne			18,3	18,3	21,0	21,0	20,0	20,0	20,0	20,0	5	5	13,7	13,7
Lampes à incandescence														
Lampes à filament métallique en atmosphère gazeuse	3 500	2 200	2,3	2,3	7,1	7,1	40,0	40,0	23,7	23,7	5	5	15	15
Lampes à filament métallique dans le vide	2 000	1 375	4,1	4,1	11,6	11,6	40,0	40,0	43,5	43,5	5	5	15	15
Moyenne			3,2	3,2	9,4	9,4	40,0	40,0	33,6	33,6	5	5	15	15

¹ Importés pour les compagnies de chemins de fer.

Table V (concluded)

CUSTOMS DUTIES AS A PERCENTAGE ON THE VALUE OF ELECTRICAL MANUFACTURES

Australie Australia				Nouvelle-Zélande ¹ New Zealand				Union de l'Afrique du Sud Union of South Africa				CATEGORIES
1913		1926		1913		1926		1913		1926		
maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	
6 a	6 b	6 c	6 d	7 a	7 b	7 c	7 d	8 a	8 b	8 c	8 d	
25	25 20	60,0	55,0 45	15	15 10	10	10 0	3	0	5	0	Electrical machines: Up to 10 kgs. » 25 » » 50 » » 250 » » 500 » » 1,000 » » 5,000 » Over 5,000 » Average.
25	25 20	60,0	55,0 45	15	15 10	10	10 0	3	0	5	0	
25	25 20	60,0	55,0 45	15	15 10	10	10 0	3	0	5	0	
25	25 20	60,0	55,0 45	15	15 10	10	10 0	3	0	5	0	
25	25 20	60,0	55,0 45	15	15 10	10	10 0	3	0	5	0	
25	25 20	60,0	55,0 45	15	15 10	10	10 0	3	0	5	0	
17,5	17,5 12,5	55,0	50,0 40	15	15 10	10	10 0	3	0	5	0	
17,5	17,5 12,5	55,0	50,0 40	15	15 10	10	10 0	3	0	5	0	
23,1	23,1 18,1	58,7	53,8 42,5	15	15 10	10	10 0	3	0	5	0	
0	0 0	50	45 35	30	30 20	10	10 0	3	0	5	0	
0	0 0	50	45 35	30	30 20	10	10 0	3	0	5	0	
0	0 0	50	45 35	30	30 20	10	10 0	3	0	5	0	
0	0 0	50	45 35	30	30 20	10	10 0	3	0	5	0	
0	0 0	50	45 35	30	30 20	10	10 0	3	0	5	0	
5	5 0	15-45	22,5 15	0	0 0	10	10 0	15	12	20	20	Cables and insulated wires: Heavy and light current cables. Insulated wire (NGA. 1,5-10 mm). Average.
5	5 0	15	5 0	0	0 0	10	10 0	15	12	20	20	
5	5 0	22,5	13,8 7,5	0	0 0	10	10 0	15	12	20	20	
5	5 0	15	5 0	30	30 20	35	30 20	15	12	20	20	Measuring instruments and meters: (a) Measuring instruments: Small. Large. Recording wattmeters over 20 kgs. Average. (b) Meters: Alternating current meters under 5 kgs. Alternating current meters over 5 kgs. Average.
5	5 0	15	5 0	30	30 20	35	30 20	15	12	20	20	
5	5 0	15	5 0	30	30 30	35	30 20	15	12	20	20	
5	5 0	15	5 0	30	30 20	35	30 20	15	12	20	20	
5	5 0	75	62,5 50	0	0 0	35	30 20	15	12	12,8	0	
5	5 0	45	40,0 35	30	30 20	35	30 20	15	12	5,1	0	
5	5 0	60	51,3 42,5	15	15 10	35	30 20	15	12	8,8	0	
0	0 0	10	5 0	30	30 20	10	10 0	3	0	3	0	
17,5	17,5 10	40	35 27,5	30	30 20	10	10 0	3	0	3	0	
8,7	8,7 5	25	20 13,8	30	30 20	10	10 0	3	0	3	0	
17,5	17,5 10	30	20 10	15	15 10	45,0	33,8 22,5	3	0	5,7	0	Incandescent lamps: Metal filament lamps, gas-filled. Metal filament lamps, vacuum. Average.
17,5	17,5 10	48	32 16	15	15 10	80,4	60,3 40,2	3	0	5,8	0	
17,5	17, 10	39	26 13	15	15 10	62,7	47,1 31,4	3	0	5,8	0	

¹ Imported for railway companies.

Tableau VI.

POURCENTAGE DES DROITS DE DOUANE FRAPPANT LES PRODUITS DE L'INDUSTRIE
ÉLECTROTECHNIQUE.

RELEVÉ DES VALEURS MOYENNES DES CATÉGORIES.

CUSTOMS DUTIES AS A PERCENTAGE ON THE VALUES OF ELECTRICAL MANUFACTURES.
SUMMARY OF THE AVERAGE FOR DIFFERENT GROUPS OF GOODS.

Pays	Machines dynamo-électriques Electrical machines				Appareils Apparatus				Câbles et fils isolés Cables and insulated wires			
	1913		1926		1913		1926		1913		1926	
	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum
Allemagne	3,4	3,1	6,7	5,9	27,4	11,3	22,5	16,9 ¹	6,7	6,7	12,6	12,6
France	20,5	13,8	60,1	15,0	39,7	18,7	79,5	20,0	39,3	26,3	179,2	44,8
Belgique	4,3	4,3	30,3	10,1	4,5	4,5	46,8	15,6	6,5	6,5	37,5	12,5
Grande-Bretagne	0	0	0	0	0	0	0	0	0	0	0	0
Italie	10,7	7,6	28,0	24,8	11,1	10,5	38,2	19,1	20,9	18,5	39,7	36,6
Espagne	25,1	17,1	111,7	35,8	37,0	27,7	106,7	32,4	46,5	32,1	221	78,8
Pays-Bas	5	5	1	1	5	5	5	5	5,7	5,7	5,7	5,7
Suisse	5,1	3,4	7,9	7,9	7,4	7,4	12,2	12,2	10,4	7,5	18,0	18,0
Autriche	16,6	11,7	23,1	16,8	51,7	30,8	34,5	34,5	35,1	30,9	34,5	32,6
Tchécoslovaquie	16,6	11,7	63,9	33,2	51,7	30,8	156,3	85,0	35,1	30,9	106,1	61,0
Pologne	49,3	49,3	53,4	46,4	72,1	54,2	70,3	70,3	83,1	83,1	49,1	49,1
Suède	14,8	14,8	12,7	12,7	27,7	27,7	20,4	20,4	19,9	19,9	19,8	19,8
Etats-Unis d'Amérique	20	20	30	30	—	—	—	—	15	15	35	35
Canada ²	27,5	25	27,5	22,5	27,5	25	27,5	22,5	30	27,5	30	24,75
		(15)		(15)		(15)		(15)		(20)		(20)
Argentine	2,6	2,6	0	0	38,1	38,1	61,6	61,6	18,0	18,0	40,4	40,4
Japon	19,2	19,2	28,2	28,2	25	25	23,8	23,8	18,9	18,9	28,2	28,2
Inde britannique	0	0	2,5	2,5	—	—	15	15	5	5	8,7	8,7
Australie ²	23,1	23,1	58,7	53,8	0	0	50	45	5	5	22,5	13,8
		(18 1)		(42,5)		(0)		(35)		(0)		(7,5)
Nouvelle-Zélande ²	15	15	10	10	30	30	10	10	0	0	10	10
		(10)		(0)		(20)		(0)		(0)		(0)
Union de l'Afrique du Sud	3	0	5	0	3	0	5	0	15	12	20	20

¹ Taux conventionnels pris dans le nouveau traité de commerce germano-suisse du 14 juillet 1926
² Les tarifs préférentiels accordés à la Grande-Bretagne sont indiqués, entre parenthèses, dans la colonne « minimum ».

Table VI.

POURCENTAGE DES DROITS DE DOUANE FRAPPANT LES PRODUITS DE L'INDUSTRIE ÉLECTROTECHNIQUE.

CUSTOMS DUTIES AS A PERCENTAGE ON THE VALUES OF ELECTRICAL MANUFACTURES. SUMMARY OF THE AVERAGE FOR THE DIFFERENT CLASSES OF GOODS.

Instruments de mesure et compteurs Measuring instruments and meters				Compteurs Meters				Téléphonie et télégraphie Telephony and telegraphy				Lampes à incandescence Incandescent lamps				Country
1913		1926		1913		1926		1913		1926		1913		1926		
maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum	minimum	
4,1	2,5	6,5	5,4 ¹	6,4	4,2	11,0	9,1 ¹	4,6	4,6	6,8	6,8	3,1	3,1	4,7	4,7	Germany.
7,6	5,6	16,6	4,5	8,6	6,5	38,0	9,5	8,6	5,6	15,8	4,1	23,9	15,9	96,2	24,1	France.
0,6	0,6	30,3	10,1	1,0	1,0	38,6	12,8	7,5	7,5	23,7	7,9	10	10	31,4	10,5	Belgium.
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Great Britain.
1,6	1,6	15,7	8,7	2,6	2,6	26,7	19,3	1,9	1,9	8,2	7,7	3,8	3,8	23,0	23,0	Italy.
16,5	11,0	65,2	25,1	25,8	17,2	110,9	42,7	18,6	12,4	26,2	9,1	11,4	25,4	198,2	65,9	Spain.
5	5	5	5	5	5	5	5	5	5	6,5	6,5	5	5	8	8	Netherlands.
1,4	1,1	3,5	3,5	2,2	1,8	5,9	5,9	7,4	7,4	2,7	2,7	3,2	1,6	3,6	9,6	Switzerland.
12,1	10,4	9,1	8,7	15,1	13,7	10,6	13,1	10,0	8,2	7,2	7,2	6,7	6,7	10,0	10,0	Austria.
12,1	10,4	35,4	23,7	15,1	13,7	46,8	33,7	10,0	8,2	26,9	19,2	6,7	6,7	29,5	19,2	Czechoslovakia.
13,4	10,7	9,3	8,3	20,9	16,8	15,8	14,2	12,2	9,1	17,3	15,8	15,6	15,6	38,5	38,5	Poland.
10	10	10	10	10	10	10	10	11,3	11,3	8,3	8,3	17,7	17,7	26,6	26,6	Sweden.
20	20	45	40	20	20	45	45	20	20	40	40	30	30	20	20	United States of America.
27,5	25	27,5	22,5	27,5	25	27,5	22,5	27,5	25	27,5	22,5	30	27,5	30	27,5	Canada. ²
	(15)		(15)	(15)	(15)	(15)	(15)	(15)	(15)	(15)	(15)	(20)	(20)	(20)	(20)	
18,7	18,7	29,3	29,3	47,5	47,5	84,5	84,5	18,3	18,3	21,0	21,0	3,2	3,2	9,4	9,4	Argentina.
14,8	14,8	27,1	27,1	14,8	14,8	18,8	18,8	20,0	20,0	20,0	20,0	40,0	40,0	33,6	33,6	Japan.
5	5	15	15	5	5	15	15	5	5	13,7	13,7	5	5	15	15	India.
5	5	15	5	5	5	60	51,3	8,7	8,7	25	20	17,5	17,5	39	26	Australia. ²
	(0)		(0)	(0)	(0)	(42,5)	(42,5)	(5)	(5)	(13,8)	(13,8)	(10)	(10)	(13)	(13)	
30	30	35	30	15	15	35	30	30	30	10	10	15	15	62,7	47,1	New Zealand. ²
	(20)		(20)	(10)	(10)	(20)	(20)	(20)	(20)	(0)	(0)	(10)	(10)	(31,4)	(31,4)	
15	12	20	20	15	12	8,8	0	3	0	3	0	3	0	5,8	0	Union of South Africa.

¹ Conventional rates of the new German-Swiss Commercial Treaty of July 14th, 1926.

² The preference rates accorded to Great Britain are shown in parentheses in the "minimum" column.

2.

OBSERVATIONS

on the

German Memorandum on the Electrical Industry.

Submitted by the

**BRITISH ELECTRICAL AND ALLIED MANUFACTURERS'
ASSOCIATION.**

Communicated by Sir Arthur BALFOUR.

**OBSERVATIONS SUBMITTED BY THE
BRITISH ELECTRICAL AND ALLIED MANUFACTURERS'
ASSOCIATION (INC.).**

1. While the monograph does not pretend to be as complete as the terms of reference would desire, and allowance must be made for the fact that reliable statistical data are still very difficult to obtain, there are omissions in it which appear to be rather important. The report gives no information about:

- Labour conditions;
- Wages;
- Consumption of raw materials, other than copper;
- Hours of labour;
- Industrial organisations, other than wireless and lamps;
- Prices;
- Remuneration of capital;
- Finance;
- Industrial research.

It is very strong on the tariff side and on the wireless side, and gives a fairly correct analysis of the international situation regarding communications. As far, however, as the electrical manufacturing industry as a whole is concerned, the report gives singularly little information. Our Association, for example, supplied information direct to the Zentralverband regarding wages, labour conditions, output and electrical development in this country, as well as some indication of the progress we were making in research and industrial organisation. None of this information has been incorporated in the monograph, and German conditions have not been described even in passing. It appears, therefore, that the monograph is not calculated to give a proper survey of the present international situation.

2. It is impossible for us to deal with the statistics in any detail, since the work of verification and amplification would be enormous. Examination of the table of production, however, discloses certain weaknesses:

(a) The number of employees given for Great Britain in 1925, namely, 135,000, is an under-estimate by about 30,000.

(b) The number of employees given for Germany is also an under-estimate by about 70,000. The three main electrical firms, the A.E.G., Siemens-Schuckert and Siemens und Halske, employ between them over 180,000 men. The 1925 census for the city of Berlin alone gives the total number

of employees in the electrical manufacturing industry at 181,233. The census for Bavaria, Württemberg, Baden, Saxony and East Prussia gives the total number of 181,196 employees in the electrical manufacturing, fine instruments and optical industries. Assuming that one-third of this total is employed in electrical manufacturing, we get the figure of 250,000. To this total should also be added the number of employees in electrical firms in the Ruhr, which is fairly considerable; even allowing for the fact that some part of the number given in the census is employed on contracting and retailing business, the lowest figure one could assume for Germany would be 250,000 men. The effect of such an under-estimate is, of course, to raise the output per employee in Germany to about £505, compared with about £457 for Britain, an indication of superior efficiency in Germany which does not exist.

(c) Similarly, the latest official figures for Canada, namely, 1924, give the Canadian output of electrical machinery and apparatus at 56.49 million dollars, while we can estimate the 1925 figure at 62 million dollars, 90 million marks higher than the figure given by the Zentralverband.

(d) The German official figures of exports for 1925 are about 322 million marks, including everything that can be termed electrical, and not 356 million marks as listed.

3. It is obvious, in view of the criticisms we have levied against the production figures, that the number of employees for the whole world, as given by the Zentralverband, must be increased by at least 100,000, while the total value of output in 1925, as far as we can judge, is considerably in excess of £603,000,000. Holland, which has an annual output of at least £8,000,000, as well as Spain, Hungary, Norway and a number of smaller countries have been omitted. The Swiss Statistical Society, in an examination of Swiss production published in October of this year, estimated the percentage of the total output of electrical machinery and apparatus exported at 69 per cent. Applying this percentage to the total export figures, namely, £2,380,000 in 1925, we get a total value of output of about £3,508,000, and not the £5,500,000 given by the Zentralverband.

January 1927.

3.

MONOGRAPH ON THE ELECTRICAL INDUSTRY

Prepared by

**THE BRITISH ELECTRICAL AND ALLIED MANUFACTURERS'
ASSOCIATION (INC.).**

Communicated by Sir Arthur BALFOUR.

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MONOGRAPH ON THE ELECTRICAL INDUSTRY.

FOREWORD.

A study of international developments in the electrical industry, if it could be carried out with accuracy, both on the technical and economic sides, would have very great importance at the present time when the whole industry is in a state of flux, preparatory to embarking on a period of rapid expansion. A number of international conferences held every year and the technical Press itself afford sufficient information to define the more outstanding technical changes that are taking place, and ensure a certain uniformity of development, but economic changes have still to be discovered and studied. In the belief, therefore, that even a partial survey devoted to the latter would justify itself and prepare the way for more complete and more accurate investigation, the British Electrical and allied Manufacturers' Association has assembled all the relevant data available, and carried out an international census bearing on the production of electrical goods, the world market, actual and potential, for such products, and the distribution of production costs and prices.

In many cases, estimates have necessarily been made which are based on experience of manufacturing conditions as much as on direct statistical data, and they differ materially, at times, from similar estimates made by the Zentralverband der deutschen elektrotechnischen Industrie in their Memorandum on the Electrical Industry. Where a radically different estimate has been made, however, its retention has been justified, in the opinion of this Association, through a number of factors apparently ignored by the authors of the German Memorandum. The present survey should be read, therefore, in conjunction with the Memorandum of the Zentralverband, which deals with certain additional aspects, namely, telegraphic and telephonic communications and tariffs.

The lack of statistics, of even the most elementary kind, bearing on production and manufacturing conditions must be regretted, while the adoption of a uniform classification would do much to remove the confusion that exists in foreign trade returns. An international comparison of exports and imports is rendered excessively difficult by the failure to define clearly the leading classes of manufacture and draw a line of demarcation between what is and what is not electrical. The differences existing between the foreign trade statistics submitted by this Association and similar statistics grouped by the Zentralverband der deutschen elektrotechnischen Industrie must be attributed to varying interpretations of the classifications given in official trade returns. We have tried to make comparisons bear on the same products. In the expression of general principles, there is fairly close agreement between the German Monograph and our own survey.

D. N. DUNLOP,
Director.

I.

DEVELOPMENTS IN ORGANISATION AND TECHNIQUE.

The electrical manufacturing industry falls into the category of the newer industries, since it is less than fifty years old and is only now entering on its first great period of expansion. In its early years, it owed much of its technical development to British engineers, but the rapidity with which industry adopted electricity for manufacturing processes in Germany and the United States, as apart from lighting and traction, made it possible for German and American manufacturers to undertake large-scale production much sooner than British, and obtain sufficient financial resources to embark on a policy of expansion. The American and German preference for large administrative units, for concentration of production, was illustrated, in the electrical industry, by the formation of a limited number of very large manufacturing companies, such as the General Electric and Westinghouse Companies in the United States and the A.E.G. and the Siemens & Halske Company in Germany. The policy adopted both in Germany and the United States for opening up the home market lay in the creation of power supply companies either directly by the manufacturing companies or with financial encouragement from the latter, and we are justified in attributing to this the great predominance of the power supply company, as distinguished from local authorities and municipalities, in the generation and distribution of electricity in Germany and the United States. It is still true that, through this policy, electrical manufacturers in these countries have enjoyed a market which was, even without protection, a closed preserve.

In Britain, such developments, owing to legislation and the limited range of the home market, were impossible, and Britain itself was regarded as undeveloped territory prior to the war; the great American and German firms had established manufacturing subsidiaries in Britain as well as in France, Italy, Austria and Russia. During the war, however, the situation became clarified largely owing to the increased resources of the British firms, and something like a united industry with a common policy and a definite programme of expansion emerged in 1919. At that time an effort was made to link up French, Swiss, Italian, British and American interests through one group of firms, and it might have been successful if the tariff war had not been initiated in Europe, and currency depreciation, with its consequences in disturbance of trade conditions, had not set in. Now, however, beyond certain arrangements governing lamp production necessitated by the patent situation, international agreement on a large scale does not exist in the electrical industry. The leading American and German

firms have come into contact again for exchange of research data and manufacturing experience, but no international control either over production or price has yet been attempted.

ADMINISTRATIVE TENDENCIES.

To define the principal factors that are now operating in electrical manufacture, a distinction must be drawn between the administrative and the purely technical aspects. In administration, four developments of more than temporary significance should be noted:

(a) The electrical manufacturer (if we limit attention to the largest firms) has concentrated, perhaps more thoroughly than any other manufacturer, on finance and the extension of control over his market through financial interests. In the United States, Germany, Switzerland, Italy, France, and, to some extent, Britain, the manufacturer has been able to secure some measure of control in the management of a number of the leading power supply companies, which constitute perhaps the most important source of demand for generating plant. Such interests not only cover countries themselves directly interested, but may extend to certain important markets; American interests in Japan, for example, German interests in South America, Swiss interests in Italy have been developed through this policy.

In addition to this, a number of holding companies, very similar to investment trusts, have been created, largely as part of a policy for ensuring a continuous demand for the products of one particular firm or group of firms. This investment trust financed power companies in the home market as well as in foreign countries, but it was primarily constituted to develop foreign trade. In Germany there are at least three large power investment companies with widespread interests covering the leading markets for electrical plant; in Switzerland, at least three companies; in France, three companies; in Belgium, one company of recent formation; and in Britain, two companies active in the financing of power supply. The main markets affected are South America, Japan, Canada, Italy, Spain, Mexico, South Africa.

(b) The rapid advance of power development on a large scale throughout the world has rendered necessary the formation of special financial organisations, capable of financing large power schemes. This must be regarded as a comparatively recent development, due very largely to the fact that many schemes for the construction of generating plant and distribution systems have now reached the stage where the financial resources of the individual manufacturer are unable to cope with them. Specialisation has therefore been introduced, as far as large contracts are concerned, in production and finance. This has been an important development in Britain since the conclusion of the war, and has undoubtedly been a contributive factor to the

great increase in exports that has taken place, even during the period of trade depression. Financial co-operation, as such, combines, in a great number of cases, technical advice regarding power schemes with the organisation of finance and the realisation of credit; it performs, therefore, a function outside the range of the usual financial institution, and has been an important factor in the advancement of electrical power development in many countries which would otherwise have remained untapped.

(c) The fiscal policy of many important markets since the conclusion of the war has been aimed at encouragement of home production and at exclusion of the products of industrial firms located in countries which once constituted the main source of supply. This has been very markedly the case in electrical manufacture, with the result that many of the electrical engineering firms have been forced to establish subsidiaries in certain markets to retain their hold on demand. Thus Swiss firms have established manufacturing subsidiaries in Austria, Italy, Germany, France and the United States; German firms in China, Italy, Spain, Austria, Czechoslovakia, Russia and the Irish Free State; American firms in Japan, Canada, Spain, Holland, Czechoslovakia, Austria and France; British firms in Spain and the Dominions generally. It is doubtful, of course, whether, with future expansion, the manufacturing subsidiaries as such will ever be strong enough to become independent of the parent firm.

The technical advances realised in the generation and transmission of electricity have brought into being increasing capacities, increasing pressures and wider distribution systems, with a demand that the contracting firm should be in a position to handle the entire contract. This means that a manufacturing firm, to be fully competitive, must be prepared to handle contracts totalling in some cases well over a million pounds, and, in the majority of cases, over £200,000. Special contracts require manufacturing equipment representing a capital expenditure of many millions of pounds, which can only be fully productive if the home market, in which the company is located, can provide it with sufficient orders, or if it can develop an export trade strong enough to make good the deficiency in the home market. There are few countries where the position is favourable to the success of such a firm; the United States, Britain, Germany, Italy, France, and, to some extent, Switzerland and Canada, are the only countries which could maintain an electrical manufacturing industry capable of dealing with the largest contracts. This has been, undoubtedly, a factor in neutralising the effect of tariffs.

(d) The electrical manufacturing industry, owing to rapid scientific and technical changes in the design and construction of electrical machinery and apparatus, has been committed, to a greater extent than almost any other industry, to a progressive research policy, and the principal firms now maintain important research laboratories and development departments

whose main purpose is to carry out experiments and to study scientific phenomena and technical principles which may have a bearing on the future of the industry. In addition to this, the fact that electrical development is still not universal has led to the creation of fairly strong sales organisations, destined to cover wide territories. The main manufacturing countries, at present, are the United States, Britain, Germany, France, Sweden and Switzerland, and, in each case, they have developed a strong export trade. The growth of national production has now reached the stage where it can threaten the export trade of those countries, while many new markets await development.

TECHNICAL CHANGES.

It is impossible to follow the technical changes that have occurred in electrical manufacture even during the seven years that have elapsed since the conclusion of the war. The growth of telegraphic and telephonic communications, the introduction of radio-telephony and wireless transmission on a large scale, with further developments along the line of television, the steady prosecution of research into the constitution of the atom as well as into the electro-physical and electro-chemical constitution of matter, the acquisition of knowledge regarding the properties of light and colour and the nature of illumination, are all factors which have contributed to a transformation of an important part of the industry. In the generating plant and industrial equipment branches, developments, although less spectacular in nature, have been no less remarkable.

We may possibly distinguish three main channels of progress:

(a) The high cost of materials and of fuel has served to place a premium on any methods which would lead to economies of a lasting nature. In the electrical industry they have been directed towards the realisation of increased output for a given consumption of coal in generating stations, for example, and of reduction in the weight of copper used (in transmission and distribution systems). The tendency has been for generating plant, turbo-alternators, transformers, rotary converters, control and switchgear to assume higher capacities and higher efficiencies per unit; steam pressures have risen and, with them, steam temperatures, while speeds have increased.

A few years ago a steam turbo-alternator set of 10,000 kilowatts, revolving at 3,000 r.p.m., would have been considered as the limit of manufacturing design, but now turbo-alternators of 30,000 kilowatts have been constructed to run at this speed, and there is no guarantee that even higher capacities will not be specified. Similarly, generating sets of 50,000 kilowatts, destined to run at lower speeds, have been constructed; sets of 100,000 kilowatts have been ordered; and there are indications that even this figure will be exceeded. The effect of such changes on coal consumption in a power station

may be judged from the fact that, in a short time, 1 lb. of coal will be sufficient to generate one unit of electricity in a steam-power station equipped with turbo-alternators of the most recent design, compared with 2.5 to 3 lb. a decade ago.

Similarly, transmission voltages have increased; underground power cables have been constructed now for 66,000 volts, and will probably soon exceed 100,000 volts; overhead main transmission lines are operating in several countries now at 220,000 volts, and may well reach 400,000 volts. The effect of such high voltages is to reduce enormously the amount of copper required for power transmission, extend the range of supply from a central generating station, and make it possible to develop a load sufficient to justify the construction of super-power stations with generating sets of the largest capacities. The transforming, converting and control apparatus have been affected in the same way; their capacities have gone up and, with them, a greater development of automatic adjustment and control. In water-power systems, parallel changes have occurred.

The main tendency is towards the creation and operation of larger productive units, the realisation of higher standards of efficiency with reduction in operating costs and centralisation of sources of supply. The super-power station and the super-power zone have been introduced into the leading electrical countries of the world. In railway electrification as well the same direction of progress can be seen; electric locomotives are being designed for power outputs higher than at any previous time, and now exceed in capacity the most powerful type of steam locomotive. The electrical industry is committed to a period of construction of large units.

(b) The movement towards such capacities has been a consequence of prolonged and accurate research into the nature and strength of the principal materials used in electrical manufacture, since steam temperatures and pressures and transmission voltages are only limited by the resistance of the materials. Test laboratories, equipped with apparatus representing a heavy capital expenditure, have become absolutely necessary to the electrical manufacturer, while the production of plant of the capacity now demanded has tended to limit the range of competition. Only a few firms, at most twenty-four to thirty, in the world can handle effectively turbo-alternators of 25,000 kilowatts and above, to quote a definite example, while the number capable of supplying control and transmission apparatus to deal with 150,000 volts and above is much less still.

The industry, as far as the generation, transmission and distribution of electricity is concerned, is moving rapidly out of the position where it could fear the competition of new firms established behind a high tariff, merely for the purpose of developing national production. International competition has been, therefore, keenest in the branches of the industry where those conditions of large-scale production do not obtain — in the manufacture of

industrial motors and control equipment, instruments, meters, telegraphic and telephonic apparatus, batteries and lamps.

(c) There has been a tendency towards specialisation in the production of electrical machinery and apparatus, largely owing to the fact that mass-production methods and standard materials and processes cannot be economically adopted for contracts of the type already mentioned, where capacities are rising steadily and materials changing. In the sections devoted to industrial motors, instruments and meters, small transformers and switch-gear, telegraphic and telephonic apparatus, including wireless accessories, fans and domestic appliances generally, mass production is a condition of success in competition, and separate companies or departments dealing with them have come into existence to ensure maximum reduction of overhead expenditure and efficiency in production.

Thus, in the heavy sections of the industry, competition is gradually dying down, owing to the limited number of producers, and the effects of tariffs on the expansion of the world market are less directly felt; but, in the special sections, competition is intense, with the growth of national production aided by high tariffs, an important factor in reducing the market available.

II.

WORLD PRODUCTION OF ELECTRICAL GOODS.

Any estimate made of the world production of electrical machinery and apparatus must be very tentative, since few statistics bearing on output in individual countries are available, and, even where statistics are given of manufacturing output, there is no guarantee that the classification adopted has been such as to cover all the branches of the industry. We have made an estimate for a number of the leading countries based partly on official returns, partly on statistics collected by various associations and partly on our own knowledge of manufacturing conditions in the countries in question. Table I illustrates the position with reference to production, numbers of employees, foreign trade and consumption in thirteen countries. In the case of Russia, the official figures have been taken, although we doubt that they are too high, while the Dutch and Swedish statistics err in all probability on the conservative side.

It is not correct, of course, to bring production, exports and imports into line as simultaneous in time with a standard method of assessment of values: exports always lag behind production, while, in many countries, import values are given c.i.f. and exports f.o.b., which tends to give too high an assessment for imports. The value of the comparison is not wholly invalidated even by these possibilities of error, since little marked fluctuation in foreign trade takes place from year to year. The consumption estimates indicate the state of the home market in each of the countries listed.

TABLE I.

PRODUCTION, FOREIGN TRADE AND ESTIMATED CONSUMPTION
OF ELECTRICAL GOODS IN THIRTEEN COUNTRIES.

(1925)

(Thousands of £ Sterling)

Country	Pro- duction	Per Cent of Total	Number of Em- ployees	Exports	Imports	Balance of Exports	Con- sumption
¹ United States . . .	£295,000	52.0	340,000	£16,300	£510	£15,790	£279,210
² Germany	105,000	18.5	280,000	15,900	1,008	14,892	90,108
Great Britain	70,000	12.3	160,000	17,564	5,179	12,385	57,615
³ France	21,000	3.7	75,000	4,000	1,900	2,100	18,900
⁴ Japan	17,500	3.4	37,000	510	3,730	- 3,220	20,720
⁵ Canada	12,800	2.2	15,000	367	3,400	- 3,033	15,833
⁶ Italy	12,500	2.2	31,000	610	2,175	- 1,565	14,065
⁷ Russia	9,700	1.7	21,822	—	1,175	- 1,175	10,875
⁸ Switzerland	6,850	1.1	14,000	2,120	580	1,540	5,310
⁹ Austria	5,650	1.0	18,000	1,700	840	860	4,790
¹⁰ Holland	5,000	0.8	12,400	2,220	2,170	50	4,950
¹¹ Sweden	4,000	0.7	10,000	1,970	1,340	630	3,370
¹² Hungary	3,000	0.4	14,000	570	218	352	2,648
	£568,000	100.0	1,028,222	£63,831	£24,225	£39,606	£528,394

- ¹ Based on 1923 census and on sales by ten firms representing 50 per cent. of national production.
- ² The employees based on 1925 census, and output on the Memorandum by the *Zentralverband der deutschen elektrotechnischen Industrie*.
- ³ *Union des syndicats de l'électricité* and foreign trade statistics.
- ⁴ Department of Commerce census for 1923.
- ⁵ Based on returns for 1924 issued by Dominion Bureau of Statistics; employees estimated from wages roll.
- ⁶ Based on 1922 Enquiry into Engineering Trades.
- ⁷ Soviet Union Year-Book, 1926.
- ⁸ Based on estimates made by Dr. A. Reichlin ("Zeitschrift für schweizerische Statistik," No. 3, 1926).
- ⁹ Memorandum by the *Zentralverband der deutschen elektrotechnischen Industrie* for output, and balance-sheets of manufacturing companies for employees.
- ¹⁰ Based on questionnaire covering 38 firms additional to principal lamp manufacturers.
- ¹¹ Official returns for 1924.
- ¹² Based on official Census of Manufacturers in the Engineering Industry (1925).

VALUE OF WORLD PRODUCTION.

If allowance is made for the output of manufacturing companies or subsidiaries located in Belgium, Czechoslovakia, Norway, Spain, Denmark, Kingdom of the Serbs, Croats and Slovenes, Australia, New Zealand and other less important countries, the total value of the world production of electrical goods in 1925 may be given as £595,000,000 to £600,000,000, and the number of employees at 1,100,000 to 1,200,000. The United States are responsible for almost 50 per cent. of the world's output and about 47 per cent. of the world's consumption.

The most remarkable features to be noted in the table are: the immense range of the United States home market and the small percentage of production represented by exports, the small part played by foreign trade generally in the industry (only 11.5 per cent. being exported of the total output), the heavy imports

by countries which enter into the free trade group, such as Great Britain, Holland and Sweden, and the almost complete elimination of imports into the United States due to their tariff policy.

It is impossible to reduce the 1925 values to a 1913 basis, for reasons given in the final section of this memorandum, and statistics of output in 1913 of a reliable nature are available only for six countries, Great Britain, United States, Germany, France, Sweden and Russia, responsible for about 85 per cent. of the world total. Table II shows the increase that has taken place since 1913 in these countries, the general average being 182 per cent., with the United States highest at 325 per cent. Applying the percentage increase of 182 per cent. to the world as a whole, we may estimate the 1913 output at £200,000,000 to £210,000,000.

TABLE II.
PRODUCTION OF ELECTRICAL MACHINERY AND APPARATUS
IN SIX COUNTRIES.
(1913 and 1925)
(Sterling)

Country	1913	1925	Increase Per cent.
United States	£69,000,000	£295,000,000	325
Germany	65,000,000	105,000,000	62
Britain	30,000,000	70,000,000	133
France	7,700,000	21,000,000	173
Sweden	1,800,000	4,000,000	123
Russia	4,760,000	9,700,000	104
Total	£178,260,000	£504,700,000	182

An important factor in the situation has been the growth of national production in countries like Japan, Canada, Italy, Spain and Czechoslovakia, under high tariff protection, and there are indications that the process will be accelerated in the future. It is clear, however, that trade activity in electrical goods, as far as imports and exports are concerned, will scarcely be affected for some time to come by such a development, the five main exporters, Great Britain, United States, Germany, France and Switzerland, still controlling between them over 87 per cent. of the world's exports, and the first three countries over 77 per cent.

DEVELOPMENT OF FOREIGN TRADE.

In Table I, foreign trade returns have been given for thirteen countries in 1925, but it is difficult to establish corresponding figures for 1913, owing

to the fact that classifications have changed in some cases and, in other cases, separate returns for electrical goods were made only after the war. By using the statistics for the five main countries, as given in Table III, where a comparison with 1913 can be made with some degree of accuracy, the 1913 position might be determined for the world generally. Exports from those countries totalled £32,758,000 in 1913, £55,884,000 in 1925, and £59,154,000 in 1926, so that we can fix the world's exports in 1913 at £37,500,000, equivalent to 17.5 per cent. of the total production. The corresponding figure for 1925 was, as already noted, 11.5 per cent. The growth of the world market as such has been less rapid than the growth of electrical power consumption in the main producing countries themselves — a condition inseparable from a new industry — and a static position has obviously

TABLE III.
EXPORTS OF ELECTRICAL MACHINERY AND APPARATUS
FROM FIVE COUNTRIES.
(1913, 1924, 1925, 1926)
(Sterling)

Country exporting	1913	Per cent. of Total	1924	Per cent. of Total	1925	Per cent. of Total	1926	Per cent. of Total
Great Britain	£7,655,700	23.4	£16,229,000	30.4	£17,564,000	31.4	£18,194,000	30.8
United States	5,790,000	17.7	16,500,000	30.9	16,300,000	29.2	17,600,000	29.7
Germany . .	15,887,700	48.5	14,246,000	26.7	15,900,000	28.5	17,300,000	29.3
France . . .	2,185,000	6.7	4,400,000	8.2	4,000,000	7.2	3,880,000	6.5
Switzerland .	1,240,000	3.7	2,100,000	3.8	2,120,000	3.7	2,180,000	3.7
Total	£32,758,400	100.0	£53,475,000	100.0	£55,884,000	100.0	£59,154,000	100.0

not yet been reached; in Germany, the United States, and, to some extent, in Britain, the electrical industry is finding an increasing demand in the home market, due to intensive electrical development.

Examination of exports from Germany, the United States and Britain, as carried out in Table IV over the main products, shows that, while Great Britain has maintained its position as the leading supplier, it has not achieved this result over the entire range of its products. In electrical machinery, Germany and Britain are practically on the same level and slightly higher than the United States; in insulated wires and cables, Britain is superior, accounting for 60 per cent. of the total exports, while, in telegraphic and telephonic apparatus, it is still highest of all three, though yielding ground in wireless. Germany stands pre-eminent in the supply of meters, lamps and electro-medical apparatus, while the United States occupies first place in batteries and electrical specialities connected with domestic appliances and industrial heating apparatus. Specialisation has taken

TABLE IV.
EXPORTS OF ELECTRICAL MACHINERY AND APPARATUS FROM
GREAT BRITAIN, UNITED STATES AND GERMANY
(1924, 1925, 1926)
(Thousands of £ Sterling)

1924.			
Classification	Britain	Germany	U.S.A.
Electrical machinery (motors, generators, transformers, control and switchgear, choke coils)	5,353.1	5,547.9	5,935.0
Batteries and accumulators	742.1	593.7	1,040.0
Wires and cables	4,476.6	1,076.3	970.0
Telegraphic and telephonic apparatus	2,659.2	1,581.4	1,910.0
Meters	446.2	1,528.3	451.0
Lamps	351.8	1,103.9	242.0
Heating and cooking apparatus	not specified	269.9	250.0
Electro-medical apparatus	not specified	579.1	240.0
Carbons and electrodes	27.4	414.3	—
N.E.1	2,172.6	1,550.8	5,462.0
Total	16,229.0	14,245.6	16,500.0
1925.			
Classification	Britain	Germany	U. S. A.
Electrical machinery (motors, generators, transformers, control and switchgear, choke coils)	5,761.9	5,272.9	5,067.0
Batteries and accumulators	973.1	840.3	1,050.0
Wires and cables	4,970.2	1,798.5	1,065.0
Telegraphic and telephonic apparatus	2,831.4	2,377.3	2,440.0
Meters	351.1	1,782.0	464.0
Lamps	526.8	1,273.5	283.0
Heating and cooking apparatus	not specified	231.7	276.0
Electro-medical apparatus	not specified	467.4	284.0
Carbons and electrodes	23.4	not specified	—
N.E.1	2,126.1	1,856.4	5,371.0
Total	17,564.0	15,900.0	16,300.0
1926.			
Classification	Britain	Germany *	U. S. A. **
Electrical machinery (motors, generators, transformers, control and switchgear, choke coils)	5,817.1	5,900.0	5,450.0
Batteries and accumulators	1,014.5	510.0	1,415.0
Wires and cables	4,999.6	2,840.0	1,070.0
Telegraphic and telephonic apparatus	3,126.7	2,960.0	2,960.0
Meters	388.8	1,490.0	530.0
Lamps	510.3	1,090.0	386.7
Heating and cooking apparatus	not specified	250.0	344.0
Electro-medical apparatus	not specified	530.0	300.0
Carbons and electrodes	18.3	not specified	not specified
N.E.1	2,319.0	1,730.0	5,144.3
Total	18,194.0	17,300.0	17,600.0

* Based on first 11 months.

** Based on first 10 months.

place to some extent, therefore, in each of the three countries. Table V summarises the position over the three years 1924, 1925 and 1926.

TABLE V.
EXPORTS OF ELECTRICAL MACHINERY AND APPARATUS FROM
GREAT BRITAIN, UNITED STATES AND GERMANY
(1924-1926)

(Thousands of £ sterling)

Classification	Total Exports from Three Countries			Percentage represented by								
				Britain			Germany			U. S. A.		
	1924	1925	1926	1924	1925	1926	1924	1925	1926	1924	1925	1926
Electrical machinery (motors, generators, transformers, control and switchgear, choke coils)	16,836.0	16,101.8	17,167.1	31.8	35.8	33.9	33.0	32.8	34.4	35.2	31.4	31.7
Batteries and accumulators	2,375.8	2,863.4	2,939.5	31.3	34.0	34.3	25.0	29.2	17.4	43.7	36.8	48.3
Wires and cables.	6,522.9	7,833.7	8,909.6	68.5	63.5	56.0	16.5	23.0	31.8	15.0	13.5	12.2
Telegraphic and telephonic apparatus	6,150.6	7,648.7	9,046.7	43.2	37.1	34.6	25.8	31.1	32.8	31.0	31.8	32.6
Meters	2,425.5	2,597.1	2,408.8	18.2	13.6	16.1	63.4	68.5	62.0	18.4	17.9	21.9
Lamps	1,697.7	2,083.3	1,987.0	20.8	25.2	25.7	65.0	61.0	54.9	14.2	13.8	19.4
Heating and cooking apparatus.	519.9	507.7	594.0	—	—	—	52.0	45.6	42.0	48.0	44.4	58.0
Electro - medical apparatus	819.1	751.4	830.0	—	—	—	71.0	62.0	64.0	29.0	38.0	36.0
Total of all goods	46,974.6	49,764.0	53,094.0	34.6	35.2	34.2	30.4	31.8	32.8	35.0	33.0	33.0

Developing the comparison further, as in Tables VI, VII and VIII, where exports to thirty markets from Great Britain, U.S.A. and Germany during 1924 and 1925 are given, we can trace a similar specialisation in markets. Great Britain predominates in the Dominions (except Canada), Argentine, China, France and Russia, while it is fairly active in Spain, Japan, Brazil, Chile and Italy; Germany has almost a monopoly of the European market, and is active in Egypt, Dutch East Indies, Brazil, Argentine and Japan; the United States find their main sources of demand in Canada, Japan, Australia, Brazil, Argentine, Mexico, Central and South America. Table IX should be compared with Tables VII and VIII as affording some indication of the relation between these main exporting countries and the markets available to them. The principal importers are: Australia, Great Britain, Japan, Canada, British India, South Africa, Argentine, New Zealand, Italy and Brazil. In all of these countries, with the exception of Britain, the market is comparatively new and great expansion of demand dates only from the conclusion of the war. It is evident, however, that the nineteen markets mentioned are only capable of absorbing 71 per cent. of the total exports of the main producers, the

TABLE VI.
EXPORTS OF ELECTRICAL MACHINERY AND APPARATUS FROM
GREAT BRITAIN, UNITED STATES AND GERMANY.

(1924)
(Thousands of £ Sterling)

Country	Britain	Germany	U.S.A.
Britain	—	1,374.2	995.0
Germany	33.5	—	56.0
U.S.A.	868.1	261.4	—
India	1,975.3	not available	236.0
Australia	3,469.0	»	1,180.0
South Africa	1,983.0	»	316.0
New Zealand	1,204.6	»	289.0
Canada and Newfoundland	330.7	»	2,941.0
France	409.5	43.3	509.0
Spain	223.8	346.4	341.0
Norway	41.4	501.2	606.0
Italy	68.8	781.9	156.0
Holland	146.5	1,158.1	123.6
Sweden	226.0	801.0	60.6
Belgium	111.1	208.8	—
Denmark	66.7	296.1	60.4
Switzerland	not available	441.8	25.0
Austria	»	454.3	—
Finland	»	332.0	—
Poland	»	344.5	—
Czechoslovakia	»	168.2	—
Russia	47.6	335.1	13.6
Latvia	not available	18.4	—
Roumania	»	70.9	—
Hungary	»	12.9	—
Portugal	51.1	not available	—
Argentine	684.6	760.9	575.0
Brazil	275.5	403.4	690.0
Chile	180.2	211.3	390.0
Mexico	20.8	55.0	1,230.0
Japan	898.5	409.9	2,715.0
China	218.9	277.1	193.0
Dutch East Indies	10.5	58.3	78.0
Egypt	52.9	not available	—
Total to all countries	16,229	14,245.6	16,500.0

TABLE VII.
EXPORTS OF ELECTRICAL MACHINERY AND APPARATUS FROM
GREAT BRITAIN, UNITED STATES AND GERMANY
(1925)
(Thousands of £ Sterling)

Country	Britain	Germany	U.S.A.
Britain	—	1,405.0	1,100.0
Germany	33.0	—	74.7
U.S.A.	572.8	392.8	—
India	1,420.1	142.6	339.0
Australia	3,550.6	40.0	1,050.0
South Africa	1,642.9	117.1	224.3
New Zealand	1,146.2	not available	298.0
Canada and Newfoundland	366.2	10.3	2,500.0
France	403.1	184.3	281.0
Spain	305.2	540.7	442.0
Norway	58.2	579.1	50.0
Italy	940.6	1,050.9	144.5
Holland	215.1	1,693.2	103.3
Sweden	88.6	880.2	77.9
Belgium	146.1	319.7	129.5
Denmark	24.7	507.2	36.4
Switzerland	120.0	510.0	22.6
Austria	not available	644.4	4.8
Finland	»	282.1	6.9
Poland	»	654.4	3.8
Czechoslovakia	»	521.0	22.5
Russia	403.8	614.2	89.0
Latvia	not available	157.8	—
Roumania	»	504.9	3.1
Hungary	»	148.8	3.1
Portugal	31.5	84.4	15.9
Argentina	805.4	711.2	775.0
Brazil	297.4	339.6	824.0
Chile	141.7	not available	358.0
Mexico	5.8	»	917.0
Japan	941.9	842.7	2,090.0
China	326.3	260.7	178.0
Dutch East Indies	not available	74.4	73.8
Egypt	46.1	105.1	14.6
Total to all countries	17,564.0	15,900.0	16,300.0

TABLE VIII.

EXPORTS OF ELECTRICAL MACHINERY AND APPARATUS FROM
GREAT BRITAIN, UNITED STATES AND GERMANY.

(1925)

(Thousands of £ Sterling)

Market	Total Values of Exports from Three Countries	Percentage represented by		
		Great Britain	Germany	U.S.A.
Great Britain	2,505.0	—	56.0	44.0
Germany	107.7	30.6	—	69.4
U.S.A.	965.6	59.0	41.0	—
India	1,901.7	74.7	7.5	17.8
Australia	4,640.6	76.7	0.7	22.6
South Africa	1,984.3	82.8	5.9	11.3
New Zealand	1,444.2	79.3	—	20.7
Canada	2,876.5	12.7	0.3	87.0
France	868.4	46.5	21.2	32.3
Spain	1,287.9	23.8	42.0	34.2
Norway	687.3	8.5	84.0	7.5
Italy	2,136.0	44.3	49.4	7.3
Holland	2,011.6	10.7	84.5	4.8
Sweden	1,046.7	8.5	84.5	7.0
Belgium	595.3	24.6	53.9	21.5
Denmark	568.3	4.3	89.2	6.5
Switzerland	652.6	18.1	78.3	3.6
Austria	649.2	—	99.0	1.0
Finland	289.0	—	97.5	2.5
Poland	658.2	—	99.5	0.5
Czechoslovakia	543.5	—	96.0	4.0
Russia	1,106.0	36.4	55.5	8.1
Latvia	157.8	—	100.0	—
Roumania	508.0	—	99.0	1.0
Hungary	151.9	—	98.5	1.5
Portugal	131.8	24.0	64.5	11.5
Argentina	2,291.6	35.2	31.1	33.8
Brazil	1,461.0	20.3	23.2	56.5
Chile	499.7	23.4	—	66.6
Mexico	922.8	1.0	—	99.0
Japan	3,874.6	24.4	21.8	53.8
China	765.0	42.6	34.0	23.4
Dutch East Indies	148.2	—	50.0	50.0
Egypt	165.8	27.9	63.5	8.6
Total to all countries	49,764.0	35.2	31.8	33.0

TABLE IX.

FOREIGN TRADE IN ELECTRICAL GOODS — TWENTY-EIGHT COUNTRIES.

(1925)

A. *Exporting Countries.*

(Sterling)

Country	Imports	Exports	Balance of Exports
Great Britain	£5,179,000	£17,564,000	£12,385,000
United States	510,000	16,300,000	15,996,000
Germany	1,008,000	15,900,000	14,892,000
France	1,900,000	4,000,000	2,100,000
Switzerland	580,000	2,120,000	1,540,000
Austria	840,000	1,700,000	860,000
Sweden	1,340,000	1,970,000	630,000
Hungary	218,000	570,000	352,000
Holland	2,170,000	2,220,000	50,000
Total	£13,745,000	£62,344,000	£48,599,000

B. *Importing Countries.*

Country	Imports	Exports	Balance of Imports
Australia	£6,277,000	—	£6,277,000
British India	3,350,000	—	3,350,000
*Japan	3,730,000	510,000	3,220,000
Canada	3,400,000	367,000	3,033,000
South Africa	2,894,500	—	2,894,500
Argentina	2,760,000	—	2,760,000
New Zealand	2,343,000	—	2,343,000
Italy	2,175,000	610,000	1,565,000
Brazil	1,860,000	—	1,860,000
Egypt	1,358,000	—	1,358,000
Russia	1,175,000	—	1,175,000
Belgium	1,760,000	835,000	925,000
Finland	1,430,000	—	1,430,000
*Peru	565,000	—	565,000
Malaya	555,000	—	555,000
*Chile	495,000	—	495,000
Greece	354,000	—	354,000
*Java	294,000	—	294,000
Denmark	635,000	565,000	70,000
Total	£37,410,500	£2,869,000	£34,541,500

* 1924.

remaining 29 per cent. being spread over a large number of countries not included in the table, such as Norway, China, the French Colonies, Belgian Congo, Mexico, the smaller South American Republics, Persia, Palestine, Kingdom of the Serbs, Croats and Slovenes, the Baltic States and Czechoslovakia.

CONSUMPTION OF ELECTRICAL GOODS.

On the basis of the statistics given in Tables I-VII, an estimate of consumption per head of population can be made. Table X illustrates the position in 1925:

TABLE X.
THE CONSUMPTION OF ELECTRICAL GOODS IN 1925.
(Per Head of Population)

Country	Population (Millions)	Estimated Expenditure on Electrical Goods	Expenditure per Hundred of Population
U.S.A.	105.7	£279,210,000	£264.0
Germany	62.5	90,108,000	144.0
Great Britain	42.8	57,615,000	134.2
Canada	8.8	£15,833,000	£180.0
New Zealand	1.3	2,343,000	180.5
Australia	5.4	6,277,000	116.2
South Africa	7.2	2,894,000	40.1
India	318.9	3,350,000	1.5
Switzerland	3.9	£5,310,000	£133.0
Austria	6.1	4,790,000	78.5
Holland	7.1	4,950,000	69.7
Norway	2.6	1,500,000	57.9
Sweden	6.0	3,370,000	56.2
Finland	3.1	1,500,000	48.5
France	39.2	18,900,000	48.4
Belgium	7.6	3,000,000	39.5
Italy	38.5	14,065,000	36.6
Hungary	8.2	2,648,000	32.3
Spain	21.8	2,400,000	11.0
Russia	103.0	10,875,000	10.5
Argentine	9.5	£3,000,000	£31.6
Chile	3.9	600,000	15.4
Mexico	15.1	1,200,000	7.5
Brazil	30.6	2,100,000	6.9
Japan	60.7	£20,720,000	£34.1
Egypt	13.9	1,358,000	9.8
Dutch East Indies	35.0	400,000	1.5
China	448.1	1,700,000	0.4
Total	1,416.5	£562,016,000	£40.0
Total (omitting India and China).	649.5	£556,966,000	£86.0

The census figures adopted for population date from 1921 in almost every case, and were taken on that basis in order to establish some uniformity of comparison. The United States give the highest expenditure per head of population, followed at a fairly wide interval by New Zealand and Canada, new countries with great natural resources, especially in water-power. Germany comes fourth, Britain fifth, and Switzerland sixth — all on much the same plane of development. Australia stands in the seventh place, while the principal European countries, other than Germany and Switzerland, are ranged between £78.5 per hundred of population and £3.26. India and China are almost wholly virgin territory.

III.

WORLD MARKET FOR ELECTRICAL GOODS.

The main sources of demand for the products of the electrical manufacturing industry, omitting illumination, which, of course, is common to all industrial and economic activities and cannot be classified under any one heading, are the generating stations, transmission and distribution systems owned or operated by public or private supply undertakings, industrial manufacturing processes, transport and communications, including telegraphic and telephonic equipment, and domestic services. The generating station must be regarded as the hub of the entire scheme of electrical progress in any country; it supplies the energy required in industry, transport and the household, and forms, as far as our calculations go, about 40 per cent. of the market open to the electrical manufacturer, industry accounting for about 30 per cent. and all other sources for the remainder.

It may generally be assumed that the consuming apparatus and machinery attached to any network supplied by generating stations have a much greater horse-power capacity than that of the generating plant actually installed in the station, and, to estimate exactly the real range of the market in power-producing and power-consuming plant alone, it is necessary to multiply the capacity of the generating plant installed by a factor ranging between 2.5 and 3. It is essential, therefore, to begin with statistics of generating plant installed in the principal countries of the world, and Table XI gives the latest returns available for eighteen countries.

INDUSTRIAL DEMAND FOR ELECTRICAL POWER.

It should be noted, first of all, that, in addition to the power stations owned by public supply undertakings, industrial firms may generate power for their own purposes, quite apart from the supplies available from the public power undertakings. In certain countries, notably France, Belgium and Italy, industrial generating stations have been included with those owned by the public supply undertakings, since it was quite impossible to establish a clear line of demarcation;

TABLE XI.
PRODUCTION OF ELECTRICITY IN EIGHTEEN COUNTRIES.
(1925)

Country	Capacity of Generating Plant (Kilowatts)	Output of Electricity (Millions of Units)	Percentage of Total
¹ United States	22,000,000	65,801	46.0
² Germany	5,938,400	11,521	8.2
³ Canada	2,590,000	10,480	7.6
⁴ Great Britain	5,050,000	8,320	5.9
⁵ France	4,519,000	9,700	6.9
⁶ Japan	2,600,000	6,400	4.6
⁷ Italy	2,369,000	7,600	5.5
⁸ Switzerland	1,380,000	4,190	2.9
⁹ Norway	1,350,000	4,200	3.0
¹⁰ Sweden	1,200,000	3,500	2.6
¹¹ Belgium	1,261,000	3,214	2.4
¹² Austria	938,000	1,600	1.2
¹³ Poland	618,000	1,300	0.9
¹⁴ Russia	464,000	1,130	0.8
¹⁵ Holland	508,000	896	0.6
¹⁶ Mexico	146,000	561	0.4
¹⁷ Hungary	296,000	480	0.3
¹⁸ Denmark	162,000	223	0.2
Total	53,389,400	141,116	100.0

- ¹ U.S. Geological Survey.
- ² *Vereinigung der Elektrizitätswerke.*
- ³ Based on 1924 official figures.
- ⁴ Including output of British Aluminium Company.
- ⁵ Based on 1923 official returns.
- ⁶ Based on 1924 statistics.
- ⁷ D. Civita.
- ⁸ 1924 statistics and estimate made by *Société de Banque Suisse.*
- ⁹ and ¹⁰ Based on reports to the 1926 Conference of the International Association of Power Producers and Distributors.
- ¹¹ Includes industrial stations.
- ¹², ¹³, ¹⁵, and ¹⁴ Statistics cover 1924 only.
- ¹³ Official statistics of Electrical Trust.
- ¹⁶ Mexican Light and Power Company only.
- ¹⁷ Based on 1925 Census of Manufacturers.

in other countries, chief among them the United States, Canada, Switzerland, Norway and Sweden, there has been a marked tendency for the private industrial power station to be absorbed by the public supply undertaking, with the result that the figures given represent over 80 per cent. of the output of energy from all sources; in other countries again, such as Britain, Germany, Austria and Poland, it is doubtful whether the statistics given cover more than 50 per cent. of the entire national output, including the industrial power station.

On the other hand, industry itself accounts for over 90 per cent. of the load on public generating stations in Italy, Belgium, Canada, Sweden and Norway; in Germany, France, Switzerland and Austria, for over 80 per cent.; and in the United States, Britain, Japan and Holland, for over 65 per cent. It is evident,

therefore, that industry in some shape or form accounts for at least 80 per cent. of the demand for generating plant in the leading countries of the world.

WORLD PRODUCTION OF ELECTRICITY.

If we make allowance for the Dominions (over 3,000,000,000 units), the South American States, Czechoslovakia, Kingdom of the Serbs, Croats and Slovenes, Finland and the Baltic States, Spain, Greece, Portugal and other European countries, China, Persia, Iraq, Palestine, Belgian Congo and the French Colonies, we can estimate the total output of electrical energy in 1925 in the world at 160-170,000,000,000 units, the capacity of generating plant lying between 65 and 70 million kilowatts. To this total should be added an estimate of the plant installed in private industrial power stations, which would bring the capacity of all generating plant up to at least 100,000,000 kilowatts. These estimates are purely tentative, since we have no data available to determine with absolute accuracy the output of electrical energy in every country, or even the sources of output, but they suffice to illustrate the very great expansion that has taken place in the production and consumption of electrical power during the last forty years. Comparison of statistics of output by various countries would lead us to believe that the annual rate of growth at the present moment lies in the vicinity of 11 per cent. to 15 per cent., equivalent to an increment of at least 10,000,000 kilowatts of generating plant.

It is impossible to discover reliable statistics of output in 1913 for all the eighteen countries in question. Taking, however, the four main countries, the United States, Britain, Germany and Italy, which generated, in 1913, a total of 23,000,000,000 units, and, in 1925, 93,000,000,000 units, an increase of 305 per cent., we can estimate very approximately the 1913 output of the eighteen countries noted in Table XI at 35,000,000,000 units.

The capital expenditure on the generation, transmission and distribution of electricity fluctuates from country to country as an average per kilowatt of generating plant installed; in the United States it is equivalent to £60 per kilowatt installed, in Canada to £61 per kilowatt, in Britain to £53, in Switzerland to £50, and in Italy to about £35, so that a fair average would be, for all countries, about £50. Applying this figure to the total capacity of generating plant as recorded in Table XI, we obtain a capital expenditure of £2,600,000,000, and we can assume with a certain amount of justice that the total capital expenditure on the supply of electricity in the world is not far short of £3,000,000,000.

One authority has stated that, even in the most advanced countries of Europe, less than 20 per cent. of the potential electrical development has been reached, and it is clear from the statistics quoted above that, even to reach a 50 per cent. development ratio, a capital expenditure on power development, generation, transmission and distribution alone would represent an enormous sum paralleled only by that already expended on railway transport.

TABLE XII 1.

INDEX OF PRODUCTION OF ELECTRICITY IN GREAT BRITAIN.
(Monthly Average : 1923-24=100)

Date	Britain, excluding London and Wales	Coal Mining, Iron and Steel, Ship- building, Heavy En- gineering	General Engineer- ing and Automobile Construc- tion	Chemicals	Marine Transport, Docks, etc.	Textiles, Cotton and Wool.
1924.						
January	121	139	123	111	119	104
February	123	134	122	123	116	110
March	121	134	115	122	117	106
April	107	120	104	112	95	103
May	107	118	105	134	96	95
June	104	113	98	136	100	91
July	99	103	97	128	97	89
August	99	110	88	118	95	87
September	108	114	107	123	114	95
October	117	116	119	146	119	108
November	131	135	137	183	135	122
December	127	128	122	153	134	117
1925.						
January	129	130	139	151	128	119
February	135	140	139	145	132	122
March	131	135	137	160	134	122
April	113	118	117	135	107	105
May	113	121	124	146	110	106
June	102	105	110	134	106	91
July	102	105	118	136	108	92
August	103	109	104	142	109	93
September	116	117	129	146	129	106
October	126	125	139	157	135	110
November	145	143	159	180	151	138
December	142	140	151	178	156	134
1926.						
January	139	138	162	184	155	135
February	141	153	161	192	150	134
March	135	136	155	161	139	131
April	119	121	128	153	127	114
May	93	88	103	145	99	90
June	100	88	119	157	114	105
July	91	77	123	147	110	97
August	96	84	112	149	110	101
September	105	88	132	163	127	112
October	125	110	148	149	148	131
November	136	119	159	167	161	145
December	148	141	157	183	163	148
<i>Monthly Averages :</i>						
1924	114	122	111	132	112	102
1925	121	124	130	151	126	111
1926	119	100	138	162	134	120
<i>Quarterly Averages :</i>						
Jan.-Mar. { 1925	132	135	138	152	131	121
{ 1926	138	142	159	179	148	133
Apr.-June { 1925	107	115	117	138	108	101
{ 1926	104	99	117	152	113	103
July-Sept. { 1925	107	110	117	141	115	97
{ 1926	97	83	122	153	116	103
Oct.-Dec. { 1925	138	136	150	172	147	127
{ 1926	136	123	155	166	157	141
<i>Strike Months of 1926 compared with 1925</i>						
May-Nov. { 1925	115	118	126	149	121	105
{ 1926	107	93	128	154	124	112

ELECTRICITY AS A TRADE INDICATOR.

An effort has been made in four countries, namely, the United States, Canada, Germany and Britain, to publish monthly statistics of electrical power production, since they act as an indication not merely of the growth of the industry but also of industrial activity, because the fact that industry represents over 70 per cent. of the total demand must render the output of electricity fairly representative of fluctuations in industrial activity. Table XII gives the monthly statistics of power production in Britain, and Table XIII similar statistics for the four countries mentioned above, since 1924. In the case of the United States, Germany and Canada, the return is representative of the entire output of the country, but, in the case of Britain, only those areas have been taken for the compilation of the power production figure which were predominantly industrial. London and the surrounding districts, as well as the South of England generally and Wales, were omitted, while non-statutory undertakings, devoted very largely to the generation of electricity for traction purposes, have not been considered. The index of output as given is, on the whole, more representative of industry than the other three indices. It is now being recognised that electrical energy, granted a fairly high state of development in the country in question, does represent a fairly important indication of the state of trade.

ELECTRICAL POWER IN INDUSTRY.

We have dealt above to some extent with industrial demand, and it is unnecessary to go into much greater detail. The possibility of electricity being adopted as a motive power in industry, to the exclusion of all other means of power, may not be ruled out of consideration. According to the calculations made by the *Electrical World*, industry in the United States is already electrified to the extent of 65 per cent., which means that 65 per cent. of the motive power required for manufacturing processes is represented by electricity, and that 65 per cent. of the capacity of the machinery used in industry is electrical. In Britain, Belgium, Czechoslovakia, Hungary and other countries, the degree of electrification is much less. In Germany, as far as it is possible to estimate from the 1925 census, industry is electrified to the extent of 70 per cent.; in Belgium the capacity of steam prime movers in 1924 was 1,266,000 kilowatts, and of this total we can estimate about 56 per cent. to be electrical; in France the capacity of steam prime movers in 1922 was 4,830,000 kilowatts; and in Britain, as far as we can estimate for 1925, the corresponding figure is in excess of 10,000,000 kilowatts. It is doubtful whether more than 40 per cent. of these totals was devoted to the generation of electrical energy. In Czechoslovakia and in Hungary, where the capacity of prime movers in 1925 was 1,330,000 kilowatts and 635,000 kilowatts respectively, a much lower percentage than even in the case of Britain and France can be recorded. It is obvious, therefore, that in the industrial sphere alone the possibilities of expansion are very great.

TABLE XIII.
INDEX OF PRODUCTION OF ELECTRICITY IN FOUR COUNTRIES.
(1924-1926)
(Daily Average : 1925 = 100)

Date	Great Britain ¹	United States ²	Germany ³	Canada ⁴
1924				
January	98	94	—	91
February	98	93	—	92
March	94	89	—	89
April	86	86	—	91
May	87	85	—	90
June	79	83	—	85
July	82	83	—	84
August	77	84	—	86
September	86	88	—	90
October	95	94	—	91
November	99	92	—	98
December	103	99	—	102
1925				
January	101	100	103	100
February	105	95	99	100
March	101	96	98	97
April	90	94	97	97
May	89	94	95	96
June	81	95	92	93
July	84	96	92	93
August	79	98	99	93
September	93	101	101	103
October	102	104	102	105
November	109	106	114	106
December	116	110	117	115
1926				
January	108	110	108	115
February	113	111	101	120
March	109	110	96	115
April	95	106	93	112
May	72	101	93	112
June	80	108	86	116
July	75	104	87	112
August	76	110	95	—
September	84	113	101	—
October	96	122	109	—
November	108	—	119	—
December	121	—	—	—

¹ Economic and Statistical Department of the British Electrical and Allied Manufacturers' Association and the *Economist*.

² U.S. Department of Commerce.

³ Statistisches Reichsamt.

⁴ Royal Bank of Canada.

ELECTRICAL POWER IN TRANSPORT.

A third great source of potential demand for electrical goods is railway transport. Although the horse-power represented by railway locomotives of all types is generally considerably in excess of the total horse-power installed in industry, and although it may not be possible, at least in the immediate future, to undertake complete electrification of transport, there is no doubt that railway electrification has before it a period of very great expansion. According to a report of the American Railways Association, quoted in the *Journal of the American Institution of Electrical Engineers* (June 1925), 2,351 electric locomotives, with a total capacity of 4,259,148 h.p., were in operation in the world on July 1st, 1924. Of this total, 1,446 locomotives, aggregating 2,780,692 h.p., were designed to operate with alternating current, and 905, aggregating 1,478,456 h.p., with direct current. In the United States, 465 locomotives, totalling 862,000 h.p., were in operation; in Italy, 504 electric locomotives with 1,209,000 h.p.; in France, 366 locomotives with 384,000 h.p.; in Germany, 304 locomotives with 519,000 h.p.; in Switzerland, 215 locomotives aggregating 384,000 h.p. The average capacity, therefore, per locomotive, taking the world total, was 1,800 h.p.

The statistics in our possession would lead us to believe that, as far as France, Italy and Germany are concerned, these figures are exaggerated, while the Swiss totals are about 40 per cent. under-estimated. No notice has been taken of motor coaches, which would serve to swell very considerably the total horse-power represented by electric traction on the railways. The total length of track electrified in Switzerland up to 1925 was 2,680 kilometres, equivalent to 45 per cent. of the entire network; in France, 1,060 kilometres, equivalent to 1.85 per cent. of the entire network; in Germany, 939 kilometres, equivalent to 1.75 per cent.; in Great Britain, 720 kilometres, including suburban railways, equivalent to 1.83 per cent.; in Sweden,¹ 729 kilometres, equivalent to 4.8 per cent.; in Austria, 320 kilometres, equivalent to 5 per cent.; in British South Africa (main line only), 280 kilometres. The most conservative estimate would place the percentage of railways electrified in the world at less than 1 per cent., so that there is an enormous potential demand for electrical machinery in this branch alone.

It is unnecessary to deal here with communications as far as telegraphy and telephony are concerned, since they constitute in themselves a subject of great intricacy and have been treated in close detail, with reference to international development, by Dr. W. H. Eccles in his Presidential Address to the Institution of Electrical Engineers².

In the domestic sphere lies perhaps the greatest potential demand both for electricity and electrical appliances. The only countries where electricity is used on a moderate scale in the household for heating, cooking and other domestic services, in addition to lighting, are the United States, Canada, Norway, Sweden,

¹ See note on p. 41 of the German Memorandum (*Note by the Secretariat*).

² *Journal I.E.E.*, Vol. 65, No. 360, December 1926.

Switzerland and Holland; in all other countries, even including Germany, France and Britain, this vast field of expansion remains practically uncultivated, and it has been estimated that, even under partial development, power needs for domestic purposes should exceed those already needed for industrial production. The growth of population, granted a sufficient level of prosperity and a reasonably high standard of living, should mean a constant annual increase in this market, translated directly into demand, but, under present conditions, rapid electrification of domestic services can scarcely be expected.

The electrical industry must depend, for many years to come, on power generation and supply, industry generally, transport and communications for the disposal of its output, but it is clear, from the statistics quoted above, that, in these three sources alone, the future affords every prospect of great expansion.

IV.

DISTRIBUTION OF PRODUCTION COSTS.

In a highly complex industry like electrical manufacture, it is difficult to determine with any degree of accuracy the distribution and incidence of production costs. One important section devoted to the manufacture of turbo-alternators of the highest capacities will consume different materials and different weights of similar materials from those consumed by a section producing transforming and converting plant; cable production entails the employment of less skilled labour than the manufacture of instruments and meters. In the departments engaged on transformers and heavy generating plant, materials may account for 49 per cent. to 80 per cent. of the total factory costs, while, in instruments and meters, the percentage may be less than 40 per cent. It is important to notice these distinctions, since they serve to explain why, in almost every leading industrial country, electrical manufacture should have been spread over a large number of producers, even when 70 per cent. to 80 per cent. of the total output, as in Germany, the United States and Britain, should still be concentrated in the hands of a few firms. Within limits, the electrical industry lends itself to specialisation to an extraordinary degree, and such specialisation leads to more successful results than in many other industries.

If the industry is taken as a whole, however, some estimate may be made of the distribution of production costs on the basis of data available. In Britain, as a result of an investigation carried out by the *British Electrical and Allied Manufacturers' Association*, the distribution of production costs was in 1923 — materials, 43 per cent.; labour, 28.5 per cent.; factory and commercial expenses, 24 per cent., and taxation, 4.5 per cent. (based on total value of output); in Canada (1924), the corresponding figures were 43 per cent. for materials, 28.6 per cent. for labour and 28.4 per cent. for factory and commercial expenses, including

taxation; in the United States (1921), 41 per cent. for materials, 37 per cent. for labour, 16.7 per cent. for factory and commercial expenses, and 5.3 per cent. for rents, rates and taxation; in Sweden (general engineering only), 39.2 per cent. for materials, 33.2 per cent. for labour, and 27.2 per cent. for factory and commercial expenses, including taxation; in Italy and Germany, the percentage represented by materials has been given as between 42 per cent. and 45 per cent. It is clear from the above that materials constitute much the same percentage in every country manufacturing electrical goods on a fairly large scale, namely, 43 per cent., that labour costs fluctuate between 29 per cent. and 37 per cent., and other costs between 20 per cent. and 28 per cent.

CONSUMPTION OF MATERIALS.

Further, an examination of the consumption of raw materials in Britain, with comparison of similar data in Canada and the United States, showed that pig-iron accounted for 4.8 per cent. of the total weight of materials used, iron and steel products for about 22 per cent., copper for 12.3 per cent., lead for 5 per cent., aluminium for 1.5 per cent. and zinc for 0.4 per cent., the remaining 54 per cent. being accounted for by an enormous number of materials, chief among them mica, rubber, tin, textiles, paper, glass, porcelain and varnish. In addition to raw materials as such, manufactured goods, such as machine parts and special castings, as well as electrical supplies, enter into consideration. Among the materials should also be noted fuel and power, as constituting a factor of some importance in the costs of production. A comparison of prices of materials in Britain, U.S.A., Germany and France, weighted to correspond with the statistics given above, was sufficient to prove that no real difference existed in the prices of materials as a factor in production costs: Britain stood at 100, Germany at 100.08, the United States at 100.2 and France at 100.07.

LABOUR COSTS.

It is necessary, therefore, to look elsewhere for any factors which may determine the competitive position. Labour costs, however, showed a very great divergence between the various countries, if average rates of wages paid for similar work are taken as a base. In Britain, in 1925, the average wage paid per hour in the electrical industry was 1.25 shillings; in Germany, as far as our information goes, 0.89 shilling; in France, 0.80 shilling, and in the United States, 2.66 shillings. Applying these figures to the total of production costs, assuming materials and other expenses to be the same in each country, we can construct the following table:

TABLE XIV.

DISTRIBUTION OF PRODUCTION COSTS.

(1925)

Factors	Great Britain	U. S. A.	Germany	France
Materials	43.0	43.0	43.0	43.0
Labour	28.5	54.5	18.1	16.2
Factory and commercial expenses *	24.0	24.0	24.0	24.0
Taxation *	4.5	4.5	4.5	4.5
Total	100.0	126.0	89.6	87.7

* Assuming that these items form the same percentage in each country.

In Italy the average wage earned was about 0.75 gold lira per hour or 0.6 shilling, while in Switzerland it stood at 1.40 francs or 1.14 shillings. In Italy and Switzerland the higher cost of materials sufficed to reduce their competitive efficiency, particularly so in Italy, but there is still a gap between the British costs and the costs of the leading European countries.

MARKET POSITION.

Several conclusions of importance emerge from consideration of the statistics given above, which may now be given, before discussion of prices is begun:

(a) The electrical industry is peculiar in that its essential raw materials, copper, lead, tin, zinc, aluminium, mica, rubber, are subject to international price control or equalisation, so that no advantage accrues to any nation. In the heavy plant side of the industry, where iron and steel products play a greater part, the price element is important, since the leading Continental producers can obtain their iron and steel at lower rates than the British. The question of process specifications and standard materials, as well as the rapid technical advances made by the industry, tend, however, to create some form of equalisation.

(b) The relative position of the electrical industry in Britain, for example, *vis-à-vis* any other competing country, depends almost wholly on manufacturing efficiency, labour costs and taxation. Materials represent a stable factor, and competition revolves, therefore, round the 57 per cent. represented by other costs. The industry may advance in one country, with high labour and taxation costs, through higher manufacturing efficiency with its result in reduced factory expenditure, higher quality of product and better design, or it may derive advantage through lower rates of wages and a low standard of taxation. At the most, however, the reduction in production costs represented by the latter may not exceed 15 per cent., even under the most favourable conditions of labour efficiency.

(c) The success of the United States and Britain in maintaining their export position intact must be attributed to the fact that their equipment for production is good, their labour efficiency high and the quality of their product sound. There is no guarantee, of course, that labour efficiency in Germany and France will not improve sufficiently to establish a privileged position for them and that equipment for production will not become at least as good as in Britain and the United States, but the tendency is for wages and overhead expenditure to reflect at once an upward movement in efficiency of output.

(d) It is clear, however, that, with equalisation in competitive conditions as established at present, the effect of tariffs must be to close out the British manufacturer from the Italian market, the Italian manufacturer from the French market, and so on, concentrate competition on countries which do not manufacture electrical equipment, and encourage a system of dumping in every country where the nature of the goods renders this possible.

(e) The course of production in every country is steadily upwards, due to the fact that electrical development is only in its very early stages, and intensity of competition consequent on a surplus of manufacturing equipment has not yet arisen to any great extent. It is clear, however, that labour costs and taxation determine the situation, especially on the profit-earning side, and the danger of reduction in labour conditions through adoption of a policy of low wages in the competing countries is still very real.

V.

SIGNIFICANCE OF PRICES.

It is impossible to determine with any degree of accuracy the increase in prices of electrical manufactures that has taken place since 1913. The technical development of the industry has been such that any calculations based either on weight or on value, or on a combination of both, must be erroneous. The study of economy in materials has been perhaps more directly productive of results in electrical manufacture than in any other branch of engineering; calculated on a tonnage basis, generating plant may show an increase of more than 100 per cent. in price over 1913, while a calculation on a kilowatt basis would probably show no increase at all.

In addition to this, there have been very great developments in the utilisation of electrical machinery, so that even a kilowatt basis would not be entirely representative of the increased value of output from the consumer's point of view. In the same way, whole sections of the industry have revolutionised their methods of production; switchgear, as far as large units are concerned, has been changed almost beyond recognition, and, from many points of view, the electrical

manufacturing industry in its present state of development has few characteristics in common with the industry in its 1913 position. In certain lines of manufacture, however, such as small industrial motors, small transformers, meters and cables of standard capacity, it may be possible to institute some comparison, but it would be inaccurate to segregate these products and apply any percentages obtained to consideration of the industry as a whole.

PRICE CHANGES.

Examination of export and import prices per ton of electrical machinery over the years 1923, 1924, 1925, 1926 may serve to show how impossible it is to base any calculations on tonnages. In Britain, as Table XV shows, import prices now stand at 133 per cent. above 1913 and are steadily rising, while export prices stand at 97 per cent. above; in Switzerland, where labour conditions are approximately the same, the import prices index shows an increase of 130 per cent. and export prices 41 per cent., while in Germany import prices were 13 per cent. below and export prices 50 per cent. above the 1913 basis.

TABLE XV.
IMPORT AND EXPORT PRICES OF ELECTRICAL MACHINERY.
(In the National Currency)

A. — ACTUAL PRICES.

Year	Great Britain (£ per Ton.)		Germany (Marks per Ton M.)		France (G. Francs per Ton M.)		Switzerland (Francs per Ton M.)	
	Import.	Export.	Import.	Export.	Import.	Export.	Import.	Export.
1913	116	86	2,450	1,530	4,000	2,240	2,060	2,500
1923	243	188	—	—	3,850	3,790	2,160	4,140
1924	254	167	1,980	1,890	4,900	3,950	4,800	3,980
1925	252	173	1,950	2,060	3,560	3,900	4,840	3,870
1926	270	170	2,180	2,300	—	3,280	4,750	3,520

B. — INDEX FIGURES.

1913	100	100	100	100	100	100	100	100
1923	210	218	—	—	96	169	105	166
1924	219	194	81	123	122	176	232	159
1925	219	200	80	134	89	174	234	155
1926	233	197	89	150	—	145	230	141

In France, export prices were about 45 per cent. above the 1913 level, calculated on a gold basis. These increases, as Table III shows, do not correspond at all to the competitive position, and merely represent movements within certain classes of machinery which are not standard for each country. Thus, British exports are generally high-quality machinery with a high capital value, while German and French

exports are composed of machinery of a lower manufacturing cost — in the case of Germany, mass-production materials such as industrial motors and transformers. The only conclusion of any value whatever that could be drawn from these figures is that there is a steady downward movement in export prices per ton in France and Switzerland, with an equally steady upward movement in Germany towards equalisation.

PRODUCTION COSTS AND PRICES.

The second method of approach lies in comparison of production costs, substituting, as far as possible, 1913 values. In a previous section it was stated that materials as a factor in production costs give practically the same value in each of the main competing countries. As far as metals were concerned, the increase in the prices of materials was about 20 per cent. at the beginning of 1926 over 1913, the low figure being caused by copper, which has shown no increase at all. In other materials the increase lay in the vicinity of 45 per cent., so that, spread over this section of production costs, we can give the 1926 increase at about 33 per cent. Now, as a result of the rise in prices of iron and steel and coal, the increase may be fixed at 35-37 per cent. Wages in Britain are now 110 per cent. above 1913, measured on an hourly basis, while taxation, imperial and local, shows an increase of about 220 per cent. Making allowance for these factors, the total increase in the cost of production in Britain lies in the vicinity of 70 per cent. In Germany, wages are only about 30 per cent. above the 1913 level; in France there is practically no increase; in Italy an increase of about 40 per cent., and in Switzerland about 88 per cent.; while, in taxation, Britain has quite easily the highest percentage, the only country approximating to it being Switzerland.

It is clear from the foregoing that any effort to establish a 1913 basis of comparison must lead to serious inaccuracies. As a general rule, however, an estimate may be made that, allowing for the increased efficiency of plant manufacture in industry and for changes in design, the actual increase now over 1913, in Britain at least, cannot be more than 35-40 per cent., while in Germany, France and Italy, due to lower rates of wages coupled with inflation, a somewhat lower figure may be recorded. Against the latter, however, should be placed the decreased efficiency of manufacture, which tends to restore the balance in international competition between most of the countries involved.

4.

NOTE ON THE ELECTRICAL INDUSTRY

prepared by the

UNION DES SYNDICATS DE L'ÉLECTRICITÉ DE FRANCE

Communicated by M. DE PEYERIMHOFF DE FONTENELLE.

NOTE ON THE ELECTRICAL INDUSTRY

GENERAL OBSERVATIONS.

The questions concerning the electrical industry which will probably be discussed at Geneva by the International Economic Conference formed the subject of a monograph prepared by the Central Federation of the German Electro-Technical Industry and communicated by M. Lammers. This monograph deals with a number of questions which may be grouped as follows:

- (1) Telephony and telegraphy and wireless telephony and telegraphy;
- (2) The production and distribution of electric power;
- (3) The construction of electrical material.

The questions concerning the construction of electrical material should perhaps claim the special attention of the Conference.

On the one hand, the big international questions concerning electric or radio-electric communications can only be usefully and fully examined at conferences which include representatives of Government administrations, many of which are responsible for running communications of this kind; the Transit and Communications Section of the League of Nations has already worked on these lines, even taking the initiative in the matter of special international conferences.

On the other hand, questions concerning the production and distribution of electric power are national rather than international in character. Under present European conditions, exchanges of power between one country and another are unlikely to develop to such an extent as to necessitate the establishment of any joint plan in the matter, and while the suggestions submitted in the German report are of interest from the technical point of view, they do not appear to be ripe for discussion at the forthcoming Conference.

Problems concerning the industry for the construction of electrical material, however, might form the subject of useful discussion, since, although the position of these industries is not the same in the different producing countries, it is obvious at first sight that important progress would probably result from a joint study of the problems which the directors of these industries have to settle at the present time.

Is there a crisis in the industry for the construction of electric material? Does this crisis present the same characteristics in the different producing countries? Is it possible to determine the principal causes of the evil? Is it possible to discover a future remedy for the present situation if this is not satisfactory?

Such are the questions calling for discussion and, if possible, for solution.

In attempting to judge the situation, too much reliance must not be placed upon statistics; the compilation of really accurate and comparable statistics is an important task which should be undertaken as soon as possible, but which cannot lead to immediate results, and, while statistics are necessary in order to define a situation accurately, it may perhaps still be possible to make out the main lines of the problem without reference to figures.

In France the manufacture of electrical material is distributed between a fairly large number of companies. The extent to which, in the spheres both of industry and of commerce, there is a dispersal of effort is very striking. Any impartial observer will perhaps marvel that such successful technical results have nevertheless been realised — for the material manufactured in France is recognised as of first-class quality. Owing to the present economic circumstances, the cost of production is not too high and permits of competitive export, but in this respect it is essential to consolidate and to extend the results already obtained. Opinion is rapidly moving towards the idea of industrial concentration, and in the near future this idea may make swift progress.

The situation is quite different in Germany, where certain undertakings for the construction of electrical material have made immense progress and considerable industrial concentration has been attained. As a result, the conditions of German industry are very satisfactory, despite the relatively high wages. The German industry appears, however, to be in search of new outlets, which it will find in future in the development of the home market and is at present seeking in the form of increased exports.

In England — we shall mention these three countries only, interesting as it would be to include all the producing countries — the situation lies midway between that of France and that of Germany, industrial concentration being less advanced than in Germany and conditions of competition better regulated than in France. England, like France and Germany, is endeavouring to develop her exports.

This survey of the present situation, which may even contain inaccuracies, is in any case too rapid and too summary. The importance of developing it is at once apparent, and this should be the first task. When this has been done, it will be possible to see the main lines for the future organisation of the industry for the construction of electric material in Europe; the basis of a coherent programme will have been established, which would take duly into account the legitimate ambitions of the different national industries and would at all events be free from inconsistencies.

Only one practical procedure appears calculated to give an exact picture of the present situation: representatives of the electrical industry in the different countries should be entrusted by the International Economic Conference with the task of drawing up a joint general report defining the present situation of the industry in the different countries and its future prospects. It seems impossible to obtain useful results until this preliminary step has been taken.

Annex I.

WIRELESS TELEGRAPHY AND TELEPHONY.

Questions concerning telegraphy and telephony, wireless or otherwise, are not exclusively or even primarily industrial questions.

Electrical and radio-electrical communications are, indeed, governed in many countries by strict administrative regulations. In many cases they are actually conducted as monopolies.

The international conferences which study and regulate their development and working are thus necessarily, as they have always been, conferences in which national administrations play an essential part. Although the Universal Telegraphic Union (of which, incidentally, the United States is not a member) also includes private companies, it is primarily an organ of State administrations.

We fully recognise the advantages of the private agreements concluded in the international sphere by the principal wireless companies, the results thus obtained being most gratifying. Nevertheless, we must recognise the fact that, for the moment, the great international questions concerning electric or radio-electric communications can only be usefully and fully examined at conferences which also include representatives of State administrations, many of which themselves work such services.

This is, indeed, the spirit in which the Transit and Communications Section of the League of Nations has already been working, even to the extent of taking the initiative in convoking special international conferences.

Besides this, a great international wireless conference is to be held next autumn in Washington for the purpose of working out not only regulations for wireless telegraphy but also the new convention which is to link up the States participating. All the private companies will be represented there. The drafts have already been drawn up and distributed to the parties concerned, a great number of whom are now concerting together in various semi-official meetings.

It is therefore not possible to propose another general meeting for the immediate future.

For the above reasons, we think that questions relating to industries connected with communications, etc., should be omitted from the proceedings of the forthcoming International Economic Conference, though without in any way minimising the importance of the part which they play in international economic life.

As regards the disturbances on international telephonic lines which high-tension lines may possibly cause, these fall within the province of the International Advisory Committee on Long-Distance Telephony, an official international body to whose discussions the industry for the distribution of electrical power is admitted.

Annex II.

PRODUCTION AND DISTRIBUTION OF ELECTRIC POWER.

The German monograph deals with certain questions concerning the production and distribution of electric power.

It is perhaps doubtful whether the introduction of these questions was intended by the Preparatory Committee for the Economic Conference. Reference to Committee B's report, as approved by the Preparatory Committee, shows that Committee B decided that special papers should be prepared on a number of key industries, including certain industries which have been particularly affected by the crisis — coal, iron and steel, mechanical engineering, shipbuilding, cotton — and certain industries which are of particular interest in view of the situation and international economic relations: wool, chemical products (particularly potash), electrical engineering, silk and artificial silk, and petroleum.

Thus the only part of the electrical industry under consideration was electrical engineering; further, the industry was only to be considered in so far as it was specially affected by the crisis.

Just as cotton-spinning cannot be included among engineering industries simply because the spinner employs mechanical looms, so the specific industry for the production and distribution of electric power cannot be said to belong to the electro-technical industry simply because it employs plant and machinery manufactured by that industry.

Moreover, while the electrical engineering industries have, in certain countries, been affected by the crisis, this does not apply to the industry for the production and distribution of electric power.

It seems clear, therefore, that it was not the Preparatory Committee's intention to include in the agenda of the International Economic Conference questions concerning the special industry for the production and distribution of electric power.

It may perhaps be useful to show that it is unnecessary for the International Economic Conference to deal with such questions, at all events at the coming session.

The questions raised in the German monograph chiefly concern *exchanges of power* and *statistics*.

(a) *Exchanges of Power.*

It should first of all be pointed out that the question of exchanges of power was referred to the League of Nations by the General Conference on Communications and Transit, which set up an Advisory and Technical Committee for Communications and Transit as a permanent organ.

The First General Conference, which was held at Barcelona in March 1921, passed the following resolution:

“The Conference, bearing in mind that it is desirable with a view to the improvement of ways of communication of international concern that States having an abundant supply of electrical power should concede a part of it to States in want thereof, recommends that this question should be examined.”

The Advisory and Technical Committee expressed the view that the problem referred to it under this resolution could not be studied in its general terms, but selected two special points, namely: the transmission in transit of electric power and the development of hydraulic power affecting more than one State, these two questions forming the subject of international conventions framed at Geneva in 1923 at the Second General Conference.

The question of the exchange of power as between nations, in its strict sense, has thus, from the diplomatic point of view, been left open. (Extract from the report of M. Genissieu, Chief Engineer to the World Power Conference, Basle, 1926.)

It seems undesirable, for administrative reasons, that the question already referred to an organ of the League of Nations should be studied simultaneously by another organ of the League. It would, I think, be particularly inexpedient to remove this question from the sphere of the General Conference on Communications and Transit, as difficulties which may exist in the matter of certain exchanges of electric power between nations are political or diplomatic rather than commercial in character.

It is essential to note, in the first place, as regards hydraulic power, which was specially mentioned, that for most countries the hydraulic power admitting of regulation is far below what is required for home consumption; this applies particularly to Germany.

Hence the question of exporting surplus hydraulic power arises only for an extremely limited number of countries, for whom the problems in question appear to have been satisfactorily settled by means of direct agreements between the parties concerned. Thus, to quote a single example, according to M. Genissieu's above-mentioned report, Switzerland, which in 1923 produced 2,261,500,000 kwh., exported during that year 521,500,000 kwh., *i.e.*, 23 per cent.

The question does not appear to arise as regards steam plant. While it may be advantageous in certain cases to install big steam plant for the generation of electrical power on the actual site of coal or lignite mines, it cannot be claimed that this is the only possible solution; in certain cases, on the contrary, it has been found preferable to install such plant at considerable distances from the coal mines.

The power of any steam plant, moreover, unlike that of hydraulic plant, is what the engineer chooses to make it, and the demands of big countries, like Germany for example, are sufficient to guarantee satisfactory business conditions for even big steam plant, without its being necessary to contemplate the exportation of the power to other countries.

If such countries find it advantageous to organise exchanges of steam-generated electrical power of which the value may or may not balance each year, such exchanges can doubtless be arranged without difficulty and independently of foreign intervention, but there appears to be no justification for any attempt to impose upon a State the use of electric power produced by some other country.

(b) Statistics.

The German report points out quite rightly that many countries do not yet possess statistics concerning the distribution of electric power and that, in countries where such statistics exist, they have been compiled under different conditions, which preclude comparison between one country and another.

The German report gives certain information concerning the production of electric power in 1924-1925, but does so subject to the fullest reservations. We might simply mention, as conforming these reservations, that the French production in 1924-1925, which was given as 6 milliards of kwh., was in reality assessed in the French official statistics at 9 milliards of kwh. for 1924 and 10 milliards of kwh. for 1925.

The importance of this question has not escaped the International Union of Producers and Distributors of Electric Power, which, since its foundation, has regarded it as one of its essential objects. The Union is particularly representative of the electric-power-producing and distributing industry; it includes not individuals but the associations which in every country formally represent the producers and distributors of electric power. It had already served as a means of co-ordinating the efforts of most European countries where the distribution of electric power is organised on a big scale and has just obtained the adhesion of the United States of America, which will undoubtedly give it most valuable assistance.

Considerable obstacles stand in the way of establishing statistics of the production and distribution of electric power in the different countries and sometimes give rise to difficult problems. It is not easy to establish such statistics on a sufficiently uniform basis to be of international value without the express and direct co-operation of the producers and distributors themselves, and such co-operation could hardly be arranged except through the International Union of Producers and Distributors of Electric Power.

Further, the producers and distributors are alone able to realise the possibilities as regards the division of statistical data into different categories.

Such being the case, it would appear preferable, for the time being at all events, to leave it to the International Union of Producers and Distributors of Electric Power to continue its work in the matter of international statistics, as the Union would always be prepared to place before the League of Nations any results that it obtains.

5.

**NOTE ON THE
AUSTRIAN ELECTRICAL INDUSTRY**

Prepared by

**THE VERBAND DER ELEKTRIZITÄTSINDUSTRIE
OESTERREICHS**

NOTE ON THE AUSTRIAN ELECTRICAL INDUSTRY.

The electrical industry is an industry working with invested capital, and the amount of business it transacts is therefore dependent upon the general economic situation. The orders which it receives are determined by the funds available for investment in the industry, by the requirements of public bodies, trade and agriculture and, in particular, by the general building activity. The fact that electrical products are used in the humblest households makes the electrical industry also dependent upon the purchasing power of the mass of the population. In addition to these general factors, an important part is played in Austria by the development of water-power. At the same time, the influence on employment in the electrical industry exercised by electrification work in the Federal States and by the introduction of electrical traction on the Federal railways has been greatly exaggerated in many quarters. It is true that the orders in connection with development of water-power are very numerous regarded individually, but it must be remembered that they only provide employment for a few firms making apparatus or machinery for high-tension current, and even then only for works engaged on the construction of heavy machinery. Employment in the high-tension industry is dependent in the last resort on the normal supply and installation of standardised electro-motors and generators with their accessories turned out by methods of mass production, in the laying down of local systems and the installation of lighting.

It is a very common though quite erroneous assertion that the development of wireless business has improved conditions in the electrical industry. No doubt there was a great demand for wireless articles among the public in the early days following the inauguration of the service in Austria, and this gave employment to the Austrian wireless industry. A large part of the required material, however, was imported from abroad in spite of the ability of the Austrian industry to meet the demand, and for that reason the supply of part of these requirements was once for all withdrawn from the native industry. After Christmas of 1924, business suddenly stopped, and since then the industry has taken on the distinctive character of a seasonal trade with periods of idleness, particularly in the summer months.

Under the former Austro-Hungarian Empire, the Austrian electrical industry was organised to supply the whole monarchy, while exports also were mainly to the Balkan States. Owing to the break-up of the monarchy and the prohibitive measures adopted by the Succession States, and further owing to diminished purchasing power at home, the actual output in relation to output capacity has

decreased further and further in the different works, and it may now be generally stated that works are only employed at about 60 per cent of their capacity. Special mention should be made of the high level of technical perfection reached by the Austrian electrical industry. The fact that some firms belong to large foreign combines further ensures that full use is made of the technical achievements of foreign countries. Eloquent testimony to the technical capacity of our electrical industry is furnished by the development of Austrian water-power, which placed a heavy responsibility on the firms supplying the material and carrying out the work. It is a matter for congratulation, however, that our electrical works have proved fully equal to their task, and the large hydro-electric stations constructed in the last few years, with their distributing systems, are working to general satisfaction.

Further, the orders given to the Austrian lead-cable industry for the execution of the telephone cable between Vienna and Passau made heavy claims upon the technical capacity of the industry.

The wireless industry is also highly developed, which is no wonder, since it has grown out of the telephone and telegraph industry, which is the second largest of its kind in Europe.

The Austrian electrical engineering industry employs at the present time about 20,000 workmen and employees.

The eight-hour day is general in the electrical industry as in other industrial branches. Output per head is smaller than in Germany.

Wages are high, which greatly affects our power to compete in foreign markets. It has not yet been possible to effect a reduction of wages, which might improve our export business.

The electrical industry partly employs raw materials and semi-manufactured products obtained from within Austria, and partly imports these articles from abroad. In the high-tension industry, the principal materials employed are semi-manufactures of iron, first and foremost, castings and metal plates, some of which are of Austrian manufacture, and some obtained from abroad. Copper plays a large part in the high-tension industry, the cable and connecting materials industry, and, as regards prices, our firms are dependent upon the fluctuations of the international copper market. In the manufacture of cable and connecting material, rubber is also of great importance. Insulating material, press-spahn, fibre, insulating varnish, etc., are used in the high-tension industry, the telegraph and telephone industry, and to some extent in the manufacture of cables. These materials are mostly imported from Germany and Switzerland. The industry for the manufacture of connecting material also uses textiles (cotton yarn, cotton thread, wire thread, artificial silk and natural silk). In the manufacture of incandescent lamps, glass bulbs are important; some of these are manufactured in Austria and some imported. An important product used in the high-tension industry is porcelain, which is mostly obtained from Germany and Czechoslovakia. During the last few years, a beginning has been made with the manufacture of porcelain for use in the electrical industry in Austria, but it is still only in its initial stages.

The Customs protection offered to the electrical industry by the Austrian Customs tariff averages 15 to 20 per cent, but the figure is smaller as regards many articles, averaging, for example, only 11 per cent for insulated wire.

The following list gives an approximate idea of the Customs protection which the Austrian industry has to overcome in its export business; the figures represent Customs duties calculated in percentages of the value of the articles.

	Czecho- slovakia	Poland	S. H. S. Kingdom	Hungary
Electrical machinery	40	70	30	50
Electrical apparatus	70	110	40	30
Meters	70	25	20	90
Insulated conducting material	20	30	40	20

In Austria, and in the Succession States and other countries of importance to Austria's export trade, import and export prohibitions have now for some time, with a very few exceptions, been abolished — more particularly through commercial treaties. High duties have now taken the place of import prohibitions in constituting a formidable obstacle to the Austrian electrical industry in its export trade to the Succession States.

The Austrian electrical industry represents an important asset on the credit side in the Austrian trade balance, seeing that exports always considerably exceed imports. The electrical industry in Austria as a whole is largely engaged in producing for the export market, and in certain branches, such as the incandescent lamp industry, almost exclusively so.

Under the pressure of foreign competition and mutual competition between Austrian firms themselves, and in face of the small purchasing power of the population and the reduced demand, the level of prices has fallen in all branches of the electrical industry. Particularly unfavourable prices are obtained in the export business, which frequently works at a loss merely in order to maintain turnover, thereby covering overhead expenses, and in order also to maintain contact with foreign markets and avoid dismissals of workers.

The different Austrian electrical undertakings have formed an association, the Verband der Elektrizitätsindustrie Oesterreichs, Vienna III, Lothringerstrasse, 12, which is subdivided into groups for the following branches of the industry:

- Machinery and apparatus;
- Telegraph and telephone;
- Wireless;
- Cables.

Further, the incandescent lamp works have a group of their own and the meter works also have their own organisation. Certain other firms not included in the above technical groups also belong to the association.

6.

**NOTE ON THE
ELECTRIFICATION OF THE ITALIAN RAILWAYS.**

Communicated by H.E. M. DE STEFANI.

NOTE ON THE ELECTRIFICATION OF THE ITALIAN RAILWAYS.

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I. — PROGRESS IN RAILWAY ELECTRIFICATION.

1. *From 1899 until the outbreak of the war.*

Italy may be legitimately proud of the fact that — as a result of Government encouragement and of the efforts of the companies which held concessions for the Adriatic and Mediterranean systems — she was the first country in Europe to employ electric railway traction on a really large scale.

At the outset it was decided to conduct experiments with three systems of electric traction:

1. Electric motors with accumulators on the Bologna–San Felice (R.A.) and Milan–Monza (R.M.) lines;
2. Three-phase high-tension current on the Valtellina lines: Lecco–Colico–Sondrio and Colico–Chiavenna (R.A.);
3. Continuous current with third-rail on the Milan–Varese (R.M.) line.

The experiments with accumulator electric-motors were begun in 1899, but they soon revealed so many drawbacks of various kinds that the companies did not feel inclined to continue them, and in 1903 these experiments were in fact discontinued.

The two other experiments, however, proved a complete success. Indeed, the results obtained — particularly in the case of the Valtellina lines, which was an absolute novelty — contributed decisively towards the solution of the problem of applying electric energy to railway traction on a large scale.

An electric system with a continuous current (650 volts) and third-rail with contact conductor, was inaugurated over the Milan–Varese line in October 1901, and in June 1902 it was extended to Porto Ceresio.

This three-phase high-tension (3,400 volts) and low-frequency (15 to 16 periods) current system was in full working order on the Valtellina line in 1902.

These experiments clearly showed:

(1) That electric traction would be particularly suitable on busy lines, rather than on lines with a small amount of traffic; it would be easier to recoup and apportion the initial outlay.

(2) That — the experiment on the Valtellina lines proved this conclusively — in practice the three-phase system could, with financial advantage, entirely replace steam traction for every kind of railway traffic, even on the busier lines and lines where traffic conditions were most difficult.

In July 1905, the State Railway Administration took over the Adriatic, Mediterranean and Sicilian systems from the companies, and, in the light of the experience gained, introduced electric traction wherever it seemed suitable.

The first step was to electrify the busiest goods-traffic services and the first line chosen for this important experiment was the old Giovi line from Pontedecimo to Busalla. A considerable amount of thought had already been bestowed on this line, with a view to relieving the increasing congestion caused by the goods traffic from the port of Genoa to Lombardy and Piedmont.

In 1911 all the services on this line, both passenger and goods, were run by electricity.

The satisfactory results obtained encouraged the Administration to apply electric traction to the subsidiary Giovi lines; this was done in 1914-15.

But even before these subsidiary lines were electrified, the Administration had decided to apply electric traction to the Mont-Cenis line from Bussoleno to Modane, this sector being an extremely difficult one with steam traction, on account of the intolerable atmosphere in the numerous tunnels.

The work of installation, begun in July 1912, progressed so rapidly that by May 1915 electric traction over this line was an accomplished fact.

Then came the turn of the Savona-San Giuseppe line (January 1914) and immediately afterwards the San Giuseppe-Ceva line, in order to meet the continual development of traffic from the port of Savona to Piedmont, Lombardy and Switzerland.

In May 1914, electric traction was extended to the Lecco-Monza line, partly with a view to utilising to its full extent the plant which had been established for the Valtellina lines, and partly to meet the remarkable industrial development which had taken place in this region and which necessitated more frequent and rapid communications between Lecco and Milan.

On the outbreak of the great war, electric traction was in operation on the State Railways over 349 kilometres of track, with 141 locomotives, serving an annual traffic of 1,300 million kilometre-tons actually hauled with a consumption of 40 million kilowatt-hours per annum and representing an annual economy of 95,000 tons of coal.

2. War and Post-War Period.

As a result of the war, there was a great slowing-down in the electrification of the railways during the period July 1914 to June 1920.

The electrification of the Mont-Cenis line had, however, made it possible during the war, at specially difficult moments, to cope with a volume of traffic five times greater than that which could have been hauled by steam traction. Thus was established the efficiency of electric traction on a large scale on lines which were technically and constructionally unfavourable. It was also established that this system was advantageous for countries possessing limited resources in fuel.

While, therefore, in the period 1914-20 the only lines on the State system to be electrified were the Savona-Sampierdarena and Turin-Pinerolo sectors — an extension which brought up the total electric kilometrage to not more than 467 kilometres — there was a great revival of activity after that period.

Between July and September 1921 the Pinerolo-Bricherasio-Torre Pellice and Bricherasio-Barge lines were electrified. From the point of view of the public the improvement was considerable, while the line itself became simpler to work.

Steps were then taken to electrify the line from Bussoleno and i Giovi (Ronco) with a view to establishing electric traction between the port of Genoa and the Mont-Cenis pass. In November 1920 the line from Bussoleno to Turin was electrified. This was followed in April 1921 by the electrification of the Turin-Trofarello and Chieri line, and, in March 1922, the Trofarello and Ronco line, the system being completed by the electrification of the lines leading to the port of Genoa from the dockyards of Sampierdarena and from Campasso.

Subsequently the subsidiary lines in the direction of Voghera were electrified, namely: Ronco-Tortona, Alexandria-Voghera and Novi-Tortona. On the first of these lines the electric service was inaugurated in November 1923, and on the other two in April 1924. By June 1924 the whole service, passengers and goods, was running on electric power.

Another large undertaking was the electrification of the Genoa-Leghorn line along the coast. This had been decided upon in 1921-22 with a view to improving working conditions, which were difficult: the line, though fairly level, had to carry a large volume of traffic, there were very numerous tunnels, and a part of the line was single-track only. It was also desired to make better use of the plants for the electric system of which Genoa was the starting-point.

In the course of the work very serious difficulties had to be overcome, owing to the peculiar configuration of the line. Nevertheless, in April 1925, it became possible to inaugurate the electric service between Genoa and Sestri Levante. A year later (April 1926) the service was extended from Sestri Levante to Spezia, and towards the end of the present year the Administration hopes to commence electric traction on the last sector of the line, *i.e.*, from Spezia to Leghorn.

Italy therefore will soon possess the longest electrified line in Europe, namely, the Modane-Leghorn line, more than 450 kilometres in length, which — apart from all the other advantages of electric traction — will be covered in three hours less than by the fastest steam-locomotives. The journey itself, which in the past was extremely unpleasant on account of the smoke in the long and numerous tunnels — particularly between Genoa and Spezia — will now become a convenient and agreeable run.

Finally, in September 1925 the Naples-Pozzuoli sector of the Rome-Naples main express line was opened for suburban traffic. For this sector, as serving very heavy suburban passenger traffic, the continuous-current and third-rail system was employed — as on the Varese line, as being best adapted to the purpose.

To sum up, there are at present in operation over the Italian State system 914 kilometres of electrified lines, as follows:

	Kilometres
1. <i>Lombard Group</i> (Varese lines and Valtellina lines, with the Lecco-Monza extension)	216
2. <i>Ligurian-Piedmont Group</i>	683
3. <i>Naples-Pozzuoli</i>	15
	914

The figures for the year 1924-25 are the latest official ones available. They do not, therefore, include the electrified lines subsequently opened to the public (Naples-Pozzuoli and Sestri Levante-Spezia), but they enable us to draw the following comparison with the year 1919-20, the year in which, as we have said, the work of electrification was again resumed and speeded up and with the year 1914-15.

	1924-25	1919-20	1914-15
Length of electrified lines, kilometres	855	467	349
Traffic in millions of kilometre-tons actually hauled . . .	5,550	2,337	1,300
Consumption of electric energy in millions of kilowatt-hours	161	70	40
Corresponding economy in coal, in thousands of tons, per annum	325	150	95

In view of the enormous advantages of electric traction, *private companies* running subsidiary lines in Italy have followed the example of the State Railways Administration and made provision for the electrification of many of their lines.

Thus, on December 31st, 1925, a total of 988 kms. of secondary lines had been electrified, of which 305 kms. were ordinary gauge and 683 narrow gauge.

II. — LENGTH IN KILOMETRES OF THE ELECTRIFIED SYSTEM CLASSIFIED ACCORDING TO THE NATURE OF THE CURRENT.

1. As has been pointed out, the electrified lines of the State system are run:

- (a) With continuous current and third rail;
- (b) Or with three-phase current.

In the first category we have the Varese (Lombard group) lines and the Naples-Pozzuoli lines — 88 kilometres.

In the second category there are:

- (1) Lines run on a three-phase 15-16 period, 3,400-volt current;
- (2) Lines run on a three-phase, 16-17 period, 3,600-volt current.

As regards (1), we have the Valtellina and Lecco-Monza (Lombard group) lines — 143 kilometres.

As regards (2), we have all the lines of the Ligurian-Piedmontese group — 683 kilometres.

In view of the wide application of the three-phase low-frequency system, this is known as the *Italian system*.

2. On the subsidiary lines run by private companies, the three-phase system has not been employed; it is better suited to main-line traffic.

Thus, of the 988 kilometres of electric lines now in operation, 758 kilometres are run on continuous current, and 230 on single-phase current.

Of the lines run on continuous current, special mention should be made of the Turin-Ceres lines on account of the tension adopted (4,000 volts).

III. — PROPORTION BETWEEN THE FIGURES GIVEN IN SECTION II AND THE TOTAL KILOMETRAGE OF THE RAILWAY SYSTEM.

This can only be calculated for the State Railways system, as no recent official data are available concerning the secondary lines.

Of the 15,760 kilometres of State railways, 855 kilometres were being run on electric traction at the end of the official year 1924-25, that is on June 30th, 1925. The proportion is therefore 5.4 per cent. With regard to traffic, the proportion between the kilometre-tons actually hauled by electric traction (5,550 millions) and the total amount carried over the whole State system, is 10.9 per cent. This proves that electric traction has been applied to just those lines in which the virtual coefficient of length (steeper gradients) is greatest and the goods traffic most intense.

The same proportions in 1914 and 1915 were:

Proportion of electrified lines to the whole system.	2.4 per cent
Traffic carried by electric traction in proportion to the total amount carried	2.8 per cent

IV. PRESENT STATE OF THE WORK OF ELECTRIFICATION.

1. On the State system 683 kilometres of lines are being electrified at the present time. Of these 93 will be open to traffic in 1926 (Spezia–Leghorn), 426 next year, and the remaining 164 in 1928. In 1928, therefore, the electrified portion of the State Railways system will total about 1,600 kilometres. This figure will probably be exceeded if two proposals for electrification are accepted; namely, the Chiasso–Milan–Voghera line (114 kilometres) and the Iselle–Domodossola–Gallarate line (82 kilometres), in order to connect, by electric traction, the port of Genoa with the Gothard and Simplon Passes in the Alps, as it is already connected with the Mont-Cenis Pass. *If these proposals are carried out, the Italian electrified system will have been brought up to about 1,800 kilometres.*

It should be added that in the work of electrification now being carried out, the State Railway Administration is proposing — in addition to the application of the present continuous current, third-rail and three-phase current systems — to conduct experiments with two other systems of electric traction which have not yet been used on the Italian railways, namely, the three-phase system with industrial frequency, and the continuous high-potential (3,000 volts) current system with overhead wire.

The first of these systems is being applied on the Rome–Avezzano–Sulmona (172 kilometres) line, the work on which is in a very advanced stage; the second is being applied on the Benevento–Foggia (102 kilometres) line, on which the work is also proceeding actively.

2. Of the secondary lines run by private companies another 341 kilometres were on December 31st, 1925, in course of electrification; of these 124 kilometres were ordinary gauge and 217 kilometres narrow gauge.

We have no official information as to the nature of the current which will be used on these new lines now being electrified.

7.

**STATISTICS OF
THE ELECTRIFICATION OF FRENCH RAILWAYS
(January 1st, 1927)**

Prepared by the

UNION DES SYNDICATS DE L'ÉLECTRICITÉ.

Communicated by M. DE PEYERIMHOFF DE FONTENELLE.

STATISTICS OF THE ELECTRIFICATION OF FRENCH RAILWAYS

(January 1st, 1927).

Headings	P. L. M.	State	P. O.	Midi	Totals
Lines electrified :					
1 track	37 Km.	20 Km.	260 Km.	205 Km.	522 Km. or 522 of single track
2 tracks	—	59 „	206 „	302 „	567 Km. or 1,134 „
4 tracks	—	—	56 „	—	56 Km. or 224 „
	—	—	—	—	—
	37 Km.	79 Km.	522 Km.	507 Km.	1,145 Km. or 1,880 Km.
Lines in course of electrification :			The second stage of the electrification of the line will be begun shortly		
1 track	—	7.5 Km.		3 Km.	10.5 Km.
2 tracks	135 Km.	35 „		252 „	422 Km. or 844 of single track
Power of central stations owned by the railway :		Power is purchased from the power stations at Nanterre, Gennevilliers, and Les Moulineaux.			
Working	4,760 Kw.		50,000 Kw.	78,500 Kw.	133,260 Kw.
Building	—		—	56,000 „	56,000 Kw.
Energy consumed by electric locomotives (per annum).	2,500,000 Kwh.	19,272,000 Kwh.	60,000,000 Kwh.	23,795,500 Kwh.	105,567,500 Kwh.
Number of electric locomotives and of electric self-driven motors					
Working	136 autom. 6 locom.	{ 159 autom. 39 locom.	{ 76 autom. 89 locom.	{ 72 autom. 59 locom.	{ 443 autom. 193 locom.
Building	15 autom. 28 locom.	{ 22 autom. —	{ 4 autom. 116 locom.	{ — 44 locom.	{ 41 autom. 188 locom.