

Home(1918) Department.
Education

Ordinary SERIES.

G.O. No. 324

DATED 9-3-18

INDEXED

[Despatch Abstract.]

Department of Industries.

Recording revised memorandum on the ----- proposed by Mr.
Innes for the Indian Industrial Commission.

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DEPARTMENT.

Received



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1918

Subject.

Memorandum on the Department of Industries:- Forwarding for the information of Government four copies of the revised prepared for the Indian Industries Commission.

ENCLOSURES.

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Rec No. 1179

Station Madras., Dated the 26th February 1918.

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From (Name) C.A. Innes, Esqr., I.C.S.,

(Designation) Director of Industries, Madras.

To The Secretary to the Government of Madras,

Home (Education) Department.
Fort Saint George. Madras.

Sir,

I have the honour to forward herewith for the information of Government four copies of my revised Memorandum on the Department of Industries, Madras submitted to the Indian Industries Commission. The Memorandum has been revised and brought up to date as suggested by Sir Thomas Holland.

I have the honour to be,

Sir,

Your most obedient servant,

Calmes

Director of Industries.

M.N.

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MEMORANDUM ON THE DEPARTMENT OF INDUSTRIES IN THE
MADRAS PRESIDENCY.

Early History.—In December 1897 the Superintendent of the School of Arts in Madras fell ill, and Mr. A. Chatterton, who was then Professor of Engineering at the Engineering College, was placed in charge of the school. Mr. Chatterton, who had already devoted much time to the question, obtained a small grant from Government in the beginning of 1898 for experiments in the manufacture of aluminium vessels in the School of Arts, and by August 1899 so much progress had been made in the introduction and development of the industry that the Government applied to the Secretary of State for permission to employ Mr. Chatterton for a term of three years in furthering the progress of technical and industrial education in the Madras Presidency. It was further proposed that he should devote himself to the restoration, organization and development of those technical trades and industries, especially metal work and connected arts, which appeared most likely to prove successful, and that he should pay special attention to the following matters:—

- (1) the development of the aluminium industry;
- (2) the inspection and reorganization of existing industrial schools and the establishment of new ones;
- (3) the development of indigenous industries; and
- (4) the establishment of a manual training class in the College of Engineering workshops or elsewhere.

The Government of India recommended these proposals for sanction subject to the remark that too much had been done in the way of the commercial development of the aluminium industry, but the Secretary of State sanctioned the proposals merely remarking that he noted that the aluminium industry would be left to private enterprise so soon as the success of the industry was assured, and that trade would benefit by the methods which had been adopted under Government supervision. The date of this despatch was 15th February 1900, and it may be noted that when it was written, the aluminium department of the School of Arts was already working on a considerable commercial scale, its sale receipts in the year 1898-99 having amounted to Rs. 44,621, while in the year 1899-1900 they rose to Rs. 91,432. It is evident, therefore, that in 1900 the Secretary of State had no objection to the working of pioneer industries by Government on a commercial scale, provided that as soon as their success was assured they were handed over to private enterprise.

2. The aluminium industry, together with his work as Superintendent of the School of Arts, occupied the greater part of Mr. Chatterton's time during the term of his special duty, but the period was also marked by the inception of experiments with hand-loom weaving, with oil-engines and centrifugal pumps for lift irrigation and with chrome tanning. Consequently when Mr. Chatterton went on leave in 1904, he was deputed to make enquiries into the American system of well irrigation, the possibility of introducing an improved pump for irrigation purposes, the possibility of introducing warping and sizing machinery suitable for the weaving industry of the Presidency, and the methods of chrome tanning as practised in America. On return from leave he was again placed on special duty for the purpose of exploiting and developing technical trades and industries in the Presidency. He was entrusted with the direction of industrial education and technical education in so far as it was connected with the exploitation of industries and with the superintendence of experiments in irrigation and pumping. His special instructions were first to devote particular attention to the development of irrigation by pumping and to the encouragement of the chrome tanning and weaving industries. As Inspector of Technical Schools and of the School of Arts, he was placed under the Director of Public Instruction, and in regard to his other work he was subject to the control of the Board of Revenue.

3. *The Department of Industrial and Technical Enquiries.*—These orders were passed in March 1905, but at the same time Government had a more important scheme under contemplation. Hitherto Mr. Chatterton had been on special duty, and the temporary nature of his appointment prejudiced the development of his work on a stable and orderly basis. Consequently later on in 1905, a step in advance was taken, and a scheme was submitted to the Government of India for the further advancement of the industrial development of the Presidency. To that end it was proposed to create a department which should make a survey of existing industries and should investigate the possibility of creating new ones. It was not proposed to work industries experimentally on a commercial scale, but merely to initiate experiments which might assist private enterprise to take up fresh industrial undertakings. It was also proposed to establish a bureau where the best available advice on industrial methods might be obtained. By this time Lord Morley had become Secretary of State for India, and in view of subsequent developments it is not surprising that he did not view the general principles underlying the scheme with much favour. He regarded with scepticism the prospect of attaining satisfactory results from the direction of State effort towards the creation of industries, and he doubted whether the lack of industrial energy and progress in the Madras Presidency might not be due to economic causes beyond the reach of State endeavour. However, by way of experiment he sanctioned the creation of the new department and the appointment of Mr. Chatterton to the charge of it with the title of Director of Industrial and Technical Enquiries. Thus the Department of Industries came into existence in August 1906, though not under that name, and in the following year it was strengthened by the appointment of an Assistant Director in the person of a junior Engineer of the Public Works Department. The work consisted largely of chrome tanning and investigations into the hand-loom weaving industry, but experiments in other directions were also carried on. Boring operations were begun, and it was shown that in certain districts of the Presidency considerable supplies, often artesian or semi-artesian in character, of subterranean water existed. And by encouraging the installation of pumps driven by internal combustion engines, it was proved that these and other supplies of water could profitably be used for irrigation.

4. *The Industrial Conference.*—In September 1908 an Industrial Conference was held at Ootacamund, the representatives of the leading industrial interests being invited to attend. The object of the Conference was to consider the best method of developing further the work which had been begun by the Director of Industrial and Technical Enquiries, and also to review the question of the improvement and extension of technical education. Sixty-eight resolutions were passed by the Conference under the heads (1) Industrial development, (2) Technical education, (3) Textiles and dyeing, (4) Sugar, chemicals and leather, and (5) other industries. The Conference defined the three functions of the Department of Industries as (1) the supply of advice in regard to new industries, and the introduction of new methods and processes, (2) the carrying out of investigations and experiments, and (3) the development of selected industries, and added that the department should open a bureau of information and an industrial museum. And in regard to the vexed question of pioneer industries, the Conference passed the following resolution:—

"The Government may undertake, as a pioneer, the introduction of new industries or industrial processes for the purpose of training students or apprentices or for demonstrating that such industries will be commercially successful.

"Provided—

"(1) that no such undertakings be engaged in without prior consultation with an Advisory Board upon which Indian interests and the leading commercial and trading interests in the Presidency should be represented;

"(2) that no such undertaking, if used for demonstrating any process as commercially successful, should be engaged in unless, after careful enquiry, the Government arrives at the conclusion that it is one in which the private capitalist does not already exist nor is willing to venture;

"(3) that it should be a principle of such undertakings that the fullest possible publicity should be given by the periodical publication of reports and by a full statement of the accounts of the undertakings; and

"(4) that, looking to the principle that such undertakings, if used for demonstrating that any process is commercially successful, should be directed to the assistance of private enterprise, it should be a rule that Government should withdraw from any such undertaking as soon as it is clear that it has sufficiently demonstrated the advantage of the improved methods of working in that particular industry."

5. These resolutions, however, were not passed without protest. The operations of the chrome tanning department, the sales in which in the year 1907-08 had amounted to Rs. 85,520, had already begun to excite alarm in business circles, and three prominent representatives of European business interests in Madras recorded a minute of dissent from the resolutions relating to industrial development, holding that Government should confine assistance to commerce to matters of research, technical education, industrial instruction, and the dissemination of industrial information. On this point the Government accepted the resolution of the Conference. They recognized as a general principle that the exploitation of industries should be regarded not as a normal but as an exceptional function of Government, and on the general question of the limitations that should be set to the functions of the State in attempting to promote industrial development, they accepted the conclusions arrived at by the Conference. Accordingly in March 1909 they made the following proposals to the Secretary of State:—

(1) that a permanent Department of Industries under the control of an officer to be styled the Director of Industries should be created;

(2) that industrial education, as opposed to technical education, should be placed under this department; and

(3) that the department should further be entrusted with the duty of encouraging trade by the introduction of new industries, that it should establish and maintain a bureau of industrial information and that it should have the charge of the well-boring and pumping operations which were then in progress.

It was further proposed that an expert assistant should be attached to the Director of Industries, who should also have the assistance, as a temporary measure, of experts in dyeing, weaving and leather work.

6. *Lord Morley's Despatch.*—Lord Morley, however, in a despatch, dated 29th July 1910, differed fundamentally from the views expressed by the Conference and approved by Government as to the functions of a Department of Industries. As before, he condemned a policy of attempting to create new industries by State intervention, and he was sceptical as to the utility of State effort in this direction unless it was strictly limited to industrial instruction and avoided the semblance of a commercial venture. The danger of a new State industry was either that it would be a petty and ineffective plaything, or that it would prove to be a costly and hazardous speculation. The policy that he sanctioned was that State funds might be expended upon familiarising the people with such improvements in the methods of production as modern science and the practice of European countries could suggest. Further than this the State should not go, and it should be left to private enterprise to demonstrate that these improvements could be adopted with commercial advantage. He negatived the proposal to establish a Department of Industries, but he sanctioned the appointment of a Superintendent of Industrial Education working under the Director of Public Instruction, and he also agreed to the recruitment of dyeing, weaving and leather experts on the condition that they should be employed for instructional purposes only. He stated further that his objections did not extend to the establishment of a bureau of industrial information or to the dissemination from such a centre of intelligence and advice regarding new industries, processes and appliances provided that nothing was done to interfere with private enterprise.

7. *Abolition of Department.*—As the result of these orders the Department of Industries, which on the recommendation of the Conference had been created in

anticipation of sanction in October 1908, was abolished, and Mr. Chatterton was placed under the control of the Education Department as Superintendent of Industrial Education. In that capacity he still retained control of pumping and boring operations, but the chrome tannery was sold, the hand loom weaving factory at Salem disbanded and all industrial institutions were transferred to the management of the Education Department. Steps were also taken to recruit the experts whose appointments had been sanctioned by the Secretary of State. The above arrangements, however, proved unworkable, and it was soon found necessary to relieve Mr. Chatterton of his duties in connection with industrial education and to place him on special duty in connection with the pumping and boring operations. In July 1912, his services were lent to the Mysore Darbar and since that date up to the present time he has not been employed in the Madras Presidency.

8. *Its reconstitution.*—Lord Morley's orders, however, aroused considerable opposition in India. The Sixth Indian Industrial Congress, which was held at Allahabad in December 1910, protested against the abolition of the Department of Industries, and, in the following February, a resolution was passed in the Legislative Council of Madras inviting the Secretary of State to reconsider his decision. In pursuance of this resolution, the Government again addressed the Secretary of State in May 1911. They referred to the general disappointment which Lord Morley's orders had occasioned, and laid stress on the difference between the industrial condition of India and those prevailing in Europe, pointing out how difficult it was in a country like Southern India, "to bridge the gulf which exists between mere scholastic instruction and the practical application of industrial teaching, unless factories under State management are founded." And they asked for authority, in special cases, and subject to the safeguards suggested by the Industrial Conference, to undertake the experimental introduction of new industrial processes. Apart, however, from the question of State intervention on a commercial scale in industrial enterprises they asked for a reconsideration of the decision regarding the creation of a separate Department of Industries independent of the Director of Public Instruction. They had no objection to the retention of the inspection of technical and industrial schools under the Director of Public Instruction, provided that a separate Inspector was appointed, but they pointed out that such matters as the conduct of a bureau of industrial information and the supply of expert advice regarding the purchase of industrial and agricultural machinery were outside the province of the Educational Department. These proposals were supported by the Government of India and Lord Crewe's reply was not altogether unfavourable. He reaffirmed Lord Morley's decision against the extension of the activities of a Department of Industries to trading on a commercial scale, but he had no objection to the creation of a separate Department of Industries, provided that its functions were confined within the limits which will be referred to later. He asked for further information regarding the proposed appointment of an Inspector of Industrial Schools, and it was not until the end of 1913 that final orders were passed on this point, the control and supervision of industrial as opposed to technical schools being transferred to the Director of Industries for whose assistance an appointment of Inspector of Industrial Schools was sanctioned. Accordingly the Department of Industries in its present form came finally into existence on the 21st March 1914. The functions of the Director were thus defined:—

- (1) to collect information as to existing industries, their needs and the possibility of improving them or of introducing new industries;
- (2) to carry out and direct experiments connected with local enquiries;
- (3) to keep in touch with local manufacturers, to bring the results of his experiments to their notice and to obtain their co-operation in the conduct of experiments on a commercial scale;
- (4) to supervise the training of students; and
- (5) to advise Government with regard to technical matters involving legislation.

9. *Subsequent changes.*—Since these orders were passed the only important change in the function of the department has been the transfer in 1916 to the

Agricultural Department of all pumping and boring work. But the outbreak of the war in August 1914 seriously prejudiced the work of the department in some of its branches. Experimental and teaching work by the Dyeing Expert has been stopped owing to the lack of dye stuffs. The Leather Expert joined the Indian Army Reserve of officers in July 1915. The officiating Director (Mr. Tressler) followed suit last August, and a Civilian has been placed on special duty to submit proposals for the reorganization of the department.

10. *Present staff.*—The superior staff of the department now consists of an officer on special duty, a Dyeing Expert and a temporary engineer who acts as Assistant Director. The Leather Expert is at present on military duty and his place has been filled temporarily by an assistant who, as a Government of India scholar, was trained in tanning at home. There is a sanctioned post of Weaving Expert which is at present vacant. Sub-Engineers of the Public Works Department are at present in charge of the Madura Technical Institute and Glass Factory and there are three sanctioned posts of supervisors. The question of organizing a district staff is now before Government. An Inspector of Industrial Schools has just been appointed.

11. Brief notes are appended on some of the activities of the department since its inception.

12. *Aluminium.*—The first reference to aluminium in Madras that appears in the records was in 1891 when Mr. Chatterton made proposals to the Government for the utilization of water power in the manufacture of the metal. A committee of experts was appointed by the Secretary of State to examine the proposals, and in due course a report was published, and the matter left to private enterprise. Nothing practical resulted therefrom till Mr. Chatterton went on furlough in 1896. He then consulted the officers of the British Aluminium Company who informed him that there was no prospect of commercial success attending the manufacture of aluminium in India unless there was a large local market for the metal. He then, with the sanction of the Director of Public Instruction, proposed to introduce the working up of aluminium into some of the Industrial Schools in the Presidency and on his return from furlough at the end of 1897, he brought out a hundredweight of metal for the purpose. He was given permission to make experiments in the School of Arts and early in 1898, he applied for funds to carry on the work. This application was refused; but a further application to carry on the work at his own expense was sanctioned. At the end of March, Government reversed their previous decision and sanctioned the expenditure of a sum of Rs. 3,800 on the purchase of metal and agreed to the experiments forming an integral part of the work of the School of Arts. No great difficulty was experienced in manipulating the metal, and from the outset the work done was sold though it was naturally rough and deficient in finish. Coppersmiths and bell-metal foundries were employed, and, at first, indigenous methods of working were adopted. But gradually, as the workmen became more skilled, changes were made, and improved methods and modern tools were introduced, with the result that the cost of production was considerably reduced. Attention was also paid to the commercial side of the venture. From the outset there was a good demand from the military authorities and from Europeans for aluminium vessels and by establishing agents and subsidiary workshops at various places the Indian demand was also stimulated. The following figures give the annual receipts and charges of the aluminium department till it was sold in 1903:—

Year.	Receipts.			Charges.		
	RS.	A.	P.	RS.	A.	P.
1897-98	...	...	...	3,800	0	0
1898-99	...	...	...	44,014	7	5
1899-1900	...	...	...	91,432	0	0
1900-01	...	...	...	1,745	2	9
1901-02	...	...	...	184,549	13	8
1902-03	...	...	...	1,69,711	15	8
1903-04	...	...	...	2,91,582	8	6
				94,142	15	1

13. In 1900 the Indian Aluminium Company was formed by Mr. Eardley Norton, then practising as a barrister in Madras, with the view of following up and developing the pioneer work of the Department of Industries. For the time the company worked in conjunction with the department to open up a market in India, and in 1903 it was decided that the time had arrived when private enterprise could be left to carry on the business unaided. Accordingly in September 1903, the company took over the aluminium department of the School of Arts, purchasing all the tools, plant and stock after valuation. The results of the valuation showed that the department had made a net profit of about Rs. 60,000 during the period it had been pioneering the industry. Of this surplus one half was surrendered to the Indian Aluminium Company as a free gift to enable it to finance the transfer. The Government of India also permitted Mr. Chatterton to act as Consulting Engineer to the company for a period of eighteen months from the date of transfer. The company is now firmly established in Madras. It has extended the use of machine processes as far as possible in its workshops, but in spite of this fact it employs on an average nearly 250 workmen. The nominal capital of the company is Rs. 10 lakhs. In the six years preceding 1914 it paid on an average a dividend of 12½ per cent on a paid-up capital of Rs. 6,80,000, but since the war owing to army contracts its dividends have been much larger. Since the prohibition of the import of aluminium into India—a war necessity—the company has taken up the manufacture of copper and brass ware. From plans prepared by Mr. Chatterton, it has furnished the equipment of the two large sandalwood-oil distilleries which have recently been started in Bangalore and Mysore. The manufacture of aluminium vessels is also carried on in seven factories in the city of Bombay and in three factories in Ratnagiri. It has also become a bazaar industry in the Godavari district of this Presidency. Before the war 60 or 70 workshops were engaged in the industry in Rajahmundry alone, and 3,000 men were employed, the men skilled among them earning from Rs. 30 to Rs. 40 a month. The vessels manufactured were sent all over India as far as Benares in the north and Madura in the south. But as the figures given below indicate, the bazaar industry has been hard-hit by the war. The export of aluminium from England has been prohibited, and it is now unprocurable except at fancy prices.

14. Aluminium is not made in India and the existing industry, which is entirely an offspring of the company's work at the School of Arts, extends only to the manufacture of aluminium vessels. But such as it is, and though the war has materially affected it, it is an industry of some dimensions as the appended table of imports of aluminium into India shows:—

Table of imports.

Year.	Bombay.		Madras.		Cocanada.		Total.	
	CWT.	LAKHS. RS.	CWT.	LAKHS. RS.	CWT.	LAKHS. RS.	CWT.	LAKHS. RS.
1904-05	...	...	890	1.05	...	...	890	1.05
1905-06	...	...	188	0.25	1,615	1.81	...	1,803
1906-07	...	...	429	0.71	1,535	2.18	...	1,964
1907-08	...	...	1,126	1.73	1,670	1.89	...	2,696
1908-09	...	...	1,158	1.03	2,275	1.91	301	0.27
19 8-10	...	...	5,873	8.04	4,477	3.46	1,838	1.52
1910-11	...	...	7,875	6.38	2,333	1.73	1,573	1.08
1911-12	...	...	12,358	8.91	6,267	4.39	3,086	1.90
1912-13	...	...	26,118	19.46	4,089	2.82	4,847	2.90
1913-14	...	...	17,714	14.90	5,056	3.81	3,302	2.48
1914-15	...	...	7,673	6.46	3,681	3.10	3,232	2.12
1915-16	...	...	10,407	9.75	3,141	2.90	1,801	0.95

15. *Chrome tanning.*—The question of the intervention by Government in the Madras tanning industry was first taken up in January 1903 when the Chamber of Commerce was consulted as to the causes which had led to the

temporary decline of the industry in Madras, and as to whether Government could do anything to assist the industry. The Chamber's reply was in the negative. It ascribed the falling off in the industry to a natural reaction following the over-production of the previous years, and thought that the industry would revive in the natural course without interference by Government. Chrome tanning was not feasible in Madras owing to climatic difficulties, the process having already been tried by an experienced tanner brought out from home and found impracticable. The whole question was reviewed by Mr. Chatterton in a report, which was later expanded into a monograph on the Madras Leather trade, and in March 1903 Government decided that no reason existed for State intervention. Later on, however, in the same year this decision was reconsidered with reference to the economic waste involved in the use of country leather for *kavalais* or the buckets used by the ryots for well irrigation. Large numbers of these buckets were required annually by the ryots, for owing to inferior methods of tanning the leather perished after a comparatively short period of use, and Mr. Chatterton suggested that experiments should be made with the object of introducing and popularizing the more enduring chrome leather. In September 1903 therefore Government sanctioned the expenditure of a sum of Rs. 2,000 on experiments in the School of Arts to determine whether chrome tanning could be successfully carried on in the Presidency, the object in view being not to manufacture a leather which would compete with the products of Europe and America, but merely to turn out something superior to the locally made article. The field of chrome tanning was at that time clear. It is true that in 1910, when the operations of the department had led to the whole question of State interference with private enterprise arising in an acute form, the Chamber of Commerce explained that its letter of 1903 had been written solely with reference to chrome tanning by the two-bath process, and stated that the one-bath process had been found practicable before the department had undertaken its further development. Nevertheless, it does not appear that at the time when the department began work, any one else was engaged in chrome tanning though Mr. Chambers of Messrs. Chambers & Co. began work on an experimental scale some months later instigated by Mr. Brand, the Assistant in the School of Arts in immediate charge of the experimental work.

16. The experiments at first were conducted on a small scale, the establishment consisting merely of a tanning maistry, a fletcher and three coolies, but even in the first year the sales amounted to Rs. 4,779, and enquiries from all parts of India indicated that the venture had aroused considerable interest. The demand for water buckets, however, was not great at first, and it was soon found necessary to embark on the manufacture of boots, shoes and sandals, partly in order to popularize the use of chrome leather and partly in consequence of the difficulty of disposing of the leather cuttings not utilizable in the making of water buckets. Chrome leather water buckets gradually became more popular, and in the year 1908-09 Rs. 9,000 worth of leather was sold for this one purpose in two districts of the Presidency, but the main business of the department always consisted in supplying the demand for foot-wear, especially sandals. A boot shop was opened in the Mount Road by private enterprise, and large orders for sandals were obtained from some Government departments. In 1907-08 alone nearly 20,000 pairs of sandals were sold. The scale of these operations necessitated the removal of the department from the School of Arts, and in March 1905 the department moved over to a tannery of its own at Sembiam near Madras. Another consequence was that the commercial side of the venture now began to attract attention. At the end of 1908 Messrs. Chambers & Co. entered a protest against the department's interference with private trade, and in the following year further protests were made by the Upper India Chamber of Commerce and by the Madras Chamber. In reply to these protests Government expressed their willingness to withdraw from the venture, and in July 1910 they accepted an offer from the Rewah Darbar to purchase the plant of the tannery for the sum of Rs. 50,000 the whole stock also being taken over at a valuation. The transfer was finally effected in the beginning of 1911.

17. The appended statement shows the receipts and charges of the department from the inception of the operation till the tannery was finally closed down :—

Total cost of the chrome tanning department from the beginning to the end.

Expenditure.	Details.	Total.	Receipts.	Details.	Total.	Net cost.
	RS. A. P.	RS. A. P.		RS. A. P.	RS. A. P.	RS. A. P.
Capital outlay.			Receipts.			
Land and buildings.	13,100 0 0		Sale of the tannery with machinery.	50,000 0 0	50,000 0 0	
Machinery.	35,518 0 0					
Improvements to buildings.	20,978 0 0	69,596 0 0	Sales—			
Charges.			1903-04 ...	41 0 0		
1903-04 ...	2,200 0 0		1904-05 ...	4,470 0 0		
1904-05 ...	5,405 0 0		1905-06 ...	25,729 8 2		
1905-06 ...	49,485 6 4		1906-07 ...	61,466 2 1		
1906-07 ...	72,322 3 0		1907-08 ...	85,357 3 6		
1907-08 ...	88,727 12 7		1908-09 ...	1,07,798 0 0		
1908-09 ...	1,35,463 10 0		1909-10 ...	88,971 4 4		
1909-10 ...	99,704 18 9		1910-11 ...	62,585 6 2	4,51,317 9 7	
1910-11 ...	53,920 15 11	4,56,975 13 7				
		5,56,571 13 7			5,01,317 9 7	55,254 4 0

Note.—Figures are taken from the draft final report after the closing of the chrome tanning business.

It will be seen that the net cost to Government was Rs. 55,000 odd spread over a period of seven years. The chrome leather industry is now firmly established in India at any rate as regards certain classes of leather, and there is no doubt but that the Government of Madras helped materially to contribute towards this result. Messrs. Chambers & Co.'s tannery at Pallavaram now employs about 1,100 men partly on bark and partly on chrome tanning.

18. The Superintendent of the Mysore Tannery (Limited) and Managing Agent of the Berhampur Leather Manufacturing Company (Limited) (which two tanneries turn out, it is reported, Rs. 1,50,000 worth of chrome upper leather every month) was trained by Mr. Chatterton, and in addition there are the following tanneries in India engaged to a greater or less extent in the manufacture of chrome leather :—

The National Tannery, Calcutta.
The Utkal Tannery, Cuttack.
The Thazgunj Tannery, Agra.
The Allahabad Tannery, Allahabad.
The Rewa State Tannery, Umari.
The Calcutta Tannery Syndicate, Calcutta.

At least two of these tanneries were started by students originally trained by Mr. Chatterton.

19. *Weaving.*—Experiments in improved methods of weaving were commenced in the beginning of 1901-02 and a few flyshuttle looms were set up in the School of Arts with the object of obtaining experience as to their working capacity and data regarding their possibilities. At the same time certain improved methods of sizing, chiefly hanksizing, were tried. About the beginning of next year the looms were removed to the Anjuman Buildings and the experiments there continued. Hanksizing was soon given up as the results of the experiments were found unsatisfactory. The looms were of the type of those already in use in the Basel Mission weaving establishments in the Madras Presidency on the West Coast, but so far as was known no attempt had ever been made to turn out purely indigenous cloths on flyshuttle looms, and it was to achieve this object that investigations were begun. At first the manufacture of Madras handkerchiefs was taken up, and

though it was not much of a success at the beginning gradual improvements were effected. Experiments with the Madras handkerchiefs and subsequently with other classes of indigenous goods such as *saris* and *dotis* yielded results which left no doubt as to the practicability of turning out a much larger percentage of cloth on a flyshuttle loom than on the ordinary country loom. In 1905 it was decided to continue the experimental work in a properly organized hand loom weaving factory. Accordingly in February 1906 a weaving factory was opened at Salem, where there was a large weaver population, the objects in view being, in the words of Mr. Chatterton, to ascertain by experiment whether it was possible to improve the conditions of the hand weavers in Southern India—

(1) by substituting for the country hand loom an improved hand loom which would enable the weaver to produce a greater length of cloth in a given time without in any way sacrificing the essential characteristics of the country hand-woven goods;

(2) by introducing the factory system among weavers so that they might work under the management of men with commercial and manufacturing experience and so that capital and organization might be introduced into the industry; and

(3) by introducing, if possible, improved preparatory processes to diminish the cost of the preliminary warping and sizing.

20. Much difficulty was experienced in getting together a sufficient number of capable hand weavers adequately to test the possibilities of a hand loom factory. Good wages and regular continuous employment were offered, but the weavers much preferred working in their own houses assisted by their women and children, and evinced great dislike to the discipline and regular hours incidental to factory life. Few of them moreover were free agents. Most of them were in the hands of the cloth merchants, who viewed the factory with suspicion and directed their influence against it. By dint of patience, however, improvement was effected, and though even in the last year of the factory's existence, complaints were made that practical weavers of the right class would not work in the factory, the financial results of each year showed a progressive improvement and indicated that, if properly managed, a hand loom factory might be a success. Thus the factory aroused considerable interest, and was the direct cause of numerous small private factories being started. Subsequent investigations showed that most of these factories failed sooner or later, the cause of the failure being, it was reported, (1) lack of technical knowledge on the part of the management, (2) inability of the Directors to work harmoniously together, and (3) the dislike of the weavers themselves of discipline and control; but, as will be shown later, they helped to popularize the flyshuttle loom.

21. Not much progress was made in the improvement of the preparatory processes in order to diminish the cost of the preliminary warping and sizing. A complete plant of warping and sizing machinery was obtained from England in 1907, but only negative results were obtained and little further work on the problem was attempted at Salem. One of the facts, however, brought out by the weaving competition held at Madras in 1908 was that the sizing methods of the Presidency were much in advance of those in use in other parts of India.

22. Undoubtedly the most useful work done at the factory was in connection with the first of the problems which Mr. Chatterton set out to solve. From the time when weaving had first been started by Government, experiments had been made with the flyshuttle loom and various small improvements had been effected, and the type of loom ultimately adopted at the Salem factory was practically the old English flyshuttle loom modified as far as possible in the direction of simplicity and so as to suit it for the manufacture of indigenous cloths. But numerous other types of improved looms were kept under observation and trial, and in 1903 a weaving competition was arranged at Madras with the object of procuring definite data regarding the merits of the various types of loom which then were being offered to the Indian weaver. The result of the

competition was to confirm the conclusions of the Salem Factory, the looms which did the best all round work being those manufactured at Madras on the lines of the old English hand loom. The advantages of this type of loom over the country loom have been described as follows :—

(1) The flyshuttle slay is cheaper than the ordinary slay ;

(2) The flyshuttle gives a greater outturn ; the increase varies not only with the experience and skill of the weaver but also with the different counts of yarn used, the outturn relative to that of the country loom being nearly double in the case of coarse counts, more than 50 per cent greater with medium counts and rather less than 25 per cent greater with finer counts ranging from 80s to 150s.

Efforts accordingly were made to spread the use of the flyshuttle loom, but the results were not at first apparent, and pessimistic remarks about the prospects of success appear more than once in the earlier reports. As a matter of fact, the use of the flyshuttle spread with a considerable rapidity, partly owing to demonstration work done by the private factories alluded to above, and a census of flyshuttle looms in ordinary use taken in 1911 revealed the existence in the 89 towns and villages visited of not less than 6,528 looms fitted with flyshuttle slays. Practically all these villages were in the coast districts north of Madras, and it was estimated that in these districts roughly 40 per cent of the weavers had adopted the new method of plying the shuttle.

23. The factory was worked on a commercial scale, so far as an experimental factory could be run on commercial lines. Besides cotton goods, silk cloths and worsted shawls were manufactured, and the sale receipts in some years amounted to nearly Rs. 12,000. But this fact proved the factory's undoing. The Chamber of Commerce entered a protest ; Lord Morley's ultimatum followed shortly afterwards ; and the factory was closed in September 1910.

24. In the meantime, on the recommendation of the Industrial Conference, it had been decided to appoint a Weaving Expert and to open a Weaving Institute at Madura. A Government of India scholar was appointed to the Expert's post, but he was not much of a success, and his services were dispensed with after a few months' trial. The project of a Weaving Institute at Madura also took a long time to mature, and after the closure of the Salem Factory, some rather desultory work followed mainly in the demonstration of jacquard looms. At the end of 1911, however, as already noted, a census of flyshuttle looms was made. It was found that the looms had already become very popular, and that the use of it was steadily increasing and the enquiry also indicated that further demonstration work was necessary in the direction of introducing (1) some sort of warping mill in places where the flyshuttle had been adopted, (2) dobbies for weaving simple designs, (3) the jacquard machine for complicated patterns, and (4) the frame loom wherever it might be profitable. Previous experience pointed to the conclusion that the best way to convince the weavers of the efficiency of any new appliance was by demonstrating it at their very doors, and though it was recognized that the introduction of improved appliance would not by itself solve all the problems connected with the improvement of the material condition of the weavers, it was decided to organize a peripatetic weaving party for the purpose of demonstrating to the weavers the advantages of improved methods of work and appliances.

25. The first party accordingly was organized in March 1913 for work in the southern districts of the Presidency. The party consisted of a superintendent and five weavers and was equipped with the following plant : warping mill, beaming frame, frame loom with automatic take up motion, spare slays, dobbies, jacquard machine and card cutting machines. A small stock of machinery for sale was added. A second party for the Northern Circars was organized in 1914. In the southern districts the chief work done has been in pushing the introduction of flyshuttle slays and dobbies, but in the northern districts, where weaving is more advanced, warping mills and dobbies have been popularized to some extent.

26. The cost of the weaving operations of the department in each year since the operations were begun is exhibited in the following table :—

Year.	Weaving experiments.	
	Receipts.	Expenditure.
	RS.	RS.
1901-02	177	2,281
1902-03	4,174	12,779
1903-04	3,592	10,210
1904-05	3,427	7,037
1905-06	2,512	10,935
1906-07	6,628	17,535
1907-08	10,537	15,023
1908-09	11,775	15,768
1909-10	8,601	14,341
1910-11	9,147	11,390
1911-12	1,430	5,476
1912-13	1,054	4,229
1913-14	3,156	9,521
1914-15	2,347	8,921
1915-16	1,417	9,501
Total	69,969	1,54,947

27. The net expenditure was thus Rs. 84,978 spread over fifteen years. In return for this expenditure the department can claim to have attained a considerable measure of success in the introduction of the flyshuttle loom and other improved appliances. Ten years after the first experiments were begun, as the result of the census taken, 6,500 looms out of 15,500 counted were found to be fitted with flyshuttle slays, and it was estimated that in the coast districts north of Madras 40 per cent of the weavers had adopted the flyshuttle. In 1915 the proportion in the Kistna district had risen to two-thirds, and at a conservative estimate the number of flyshuttle looms in use in the Presidency may be put at something like 15,000. Mr. Chatterton has estimated that the adoption of the flyshuttle increases the wages of a weaver by Rs. 2-8-0 per mensem, and on the basis of this figure, the monthly increase in wages resulting from the adoption of the flyshuttle may be put at Rs. 37,500 per mensem, or Rs. 4½ lakhs per annum.

28. *Pumping and Boring.*—The records of the pumping and boring branch of the department are very voluminous, and it is not possible here to give more than a very brief sketch of the development of the operations. In September 1903, the aluminium industry was made over to the Indian Aluminium Company, and as part of his programme of work in connection with the development of Indian industries, Mr. Chatterton proposed that a number of pumping installations should be set up with the object of demonstrating the advantages of modern machinery in agricultural operations. Some work had already been done in this direction, and Mr. Chatterton himself and the Public Works Department had both experimented with pumping by machinery. But these experiments had furnished evidence merely as to the value of lift irrigation on a comparatively large scale, and much scepticism still prevailed as to whether comparatively small areas of land could be profitably irrigated by small engines and pumps. One small installation had already been put up at Melrosapuram in the Chingleput district, and in 1904 permission was obtained to open four other pumping stations where experiments were begun with engines varying in horse power from 3½ to 6½ and with 3 and 4 inch pumps. From the first the progress made was encouraging, and by March 1905 so many applications for assistance had been received that Government agreed to advances being made under the Land Improvement Loans Act for the purchase of oil engines and pumps and provided Mr. Chatterton with the nucleus of a staff to assist those wishing to put up installations with advice and supervision. A class for training oil engine drivers was also opened at the School of Arts. It soon became evident, however, that very few of the wells in the Presidency could furnish enough water to make it worthwhile to put in an engine and pump, and that in order to bring pumping installations into more extended use it would be

necessary to deepen existing wells or to sink new ones so as to tap the subterranean reservoirs which were suspected to exist at no very great depth in certain districts of the Presidency. These results had been anticipated from the very beginning and in 1904 a set of boring tools was purchased with which experimental borings were put down in various places. This led to the discovery of sub-artesian water both in the Chingleput and South Arcot districts and it became evident that it was desirable greatly to extend the scale of operations. Accordingly in 1906 the boring branch of the department was inaugurated by the deputation of a special party to the Chingleput district, partly to develop well irrigation by the expeditious disposal of applications for loans, and partly to prevent waste of money by preliminary borings before wells were sunk. Later on the operations of the party were extended to the improvement of existing wells, and from this time forward progress was rapid until the outbreak of the war operated as a check. By March 1916 operations were in progress over nearly the whole of the Presidency, and 3,333 borings had been put down. Rather more than half of these borings were made for the purpose of improving existing supplies, the remainder being fresh explorations. The percentage of success is reported to have exceeded 60, sub-soil water being met with at depths ranging from 35 to 200 feet. In the same period 818 local investigations were made in connection with projected pumping installations, more than 400 installations were set up, and a sum of Rs. 2,99,800 was advanced under the Land Improvement Loans Act to 117 persons for the purchase of oil engines and pumps. Many other installations were put up independently of the department, the machines being mostly obtained from engineering firms on the hire purchase system, and an admittedly incomplete census taken in 1915 disclosed the existence of nearly 900 installations irrigating an estimated area of nearly 50,000 acres. In addition, a number of oil engines were installed under the advice and with the aid of the department in rice mills and other industrial concerns.

29. The rapid increase, however, in the popularity of oil engines and pumps entailed correspondingly heavy work in the department. In the circumstances of South India, it was necessary to provide for the supervision and periodical inspection of the pumps. A system of compounding fees was accordingly instituted, and by 1915, 236 plants were on the inspection list. For inspection and boring purposes the pumping and boring staff was augmented from time to time till in 1915 it consisted of 12 supervisors, 21 mechanics and 38 boring maistries. Much of the Director's time was taken up in the supervision of his supervising staff and in what was practically consulting engineering work. Most of this work, moreover, was work which really appertained to the Agricultural Department, and eventually that department was strengthened by the appointment of an Agricultural Engineer who has relieved the Director of Industries of all work connected with pumping and boring.

The following statement exhibits the cost of the pumping and boring department from 1904-05 to 1915-16:—

Year.							Receipts.	Expenditure.
							RS.	RS.
1903-06	...	...	...	...	...	...	...	65,033
1906-07	...	...	...	...	...	...	...	14,105
1907-08	...	...	...	...	...	53	...	21,444
1908-09	...	...	...	...	...	2,692	...	39,177
1909-10	...	...	...	...	...	4,370	...	46,808
1910-11	...	...	...	...	...	5,987	...	66,299
1911-12	...	...	...	...	...	14,461	...	63,060
1912-13	...	...	...	...	...	26,407	...	98,757
1913-14	...	...	...	...	...	31,237	...	1,54,076
1914-15	...	...	...	...	...	38,654	...	1,58,017
1915-16	...	...	...	...	...	40,429	...	1,17,920
						Totál	1,64,240	8,44,796

* Includes Rs. 15,081 spent when the experiments were in charge of the Public Works Department. The figures are taken from the Annual Administration Report.

30. *Industrial Installations.*—The oil engines first used by the Department were worked with kerosine oil; but at the request of the Shell Transport and Trading Company, which then supplied Madras with kerosine oil, experiments were taken up with a view to utilizing the very large stock of liquid fuel which had been brought out to Madras in the hope that it would be found suitable for generating steam in the mills and factories. The scheme proved a failure and the company were left with a large tank containing about 4,000 tons of liquid fuel on their hands. It was found that the Hornsby-Ackroyd oil engine was equally well adapted for use with either liquid fuel or kerosine oil and on this fact being made known by Mr. Chatterton in a letter to the "Madras Mail," the numerous users of Hornsby-Ackroyd oil engines in the Madras Presidency naturally at once displaced kerosine oil, which cost from 7 annas to 8 annas a gallon by liquid fuel which could then be obtained at 2 annas a gallon in Madras. The great reduction in the cost of generating power, consequent upon this discovery, gave a considerable impetus to the development of small power installations. These were principally applied to the preparation of agricultural produce for the market and in the course of a few years, numerous paddy hullers, oil mills and a few saw mills and sugarcane crushing mills were installed.

31. In 1911, Mr. Chatterton urged on the Government the necessity for experimental work in connection with the manufacture of jaggery and a sum of Rs. 10,000 being placed at his disposal, a jaggery boiling plant on improved lines was set up in the village of Singanallur near Coimbatore. Very little progress had been made when he left Madras for Mysore and on the establishment of a Department of Industries in that State a number of similar plants were set up by him. Arrangements were made for the two departments to work in co-operation, with the ultimate result that very considerable improvements were effected and a large number of installations have been set up both in Mysore and the Madras Presidency. A full account of the work done in this connection will be found in Bulletin No. 55 of the Agricultural Research Institute, Pusa, which is entitled, "The Manufacture of Jaggery in South India."

32. *Experimental work.*—Allusion has already been made in paragraph 12 to the proposals submitted by Mr. Chatterton in 1891 for the utilization of water power in Southern India, and although these have not been carried out, they drew attention to the value of water power, and undoubtedly first suggested to the Mysore Government the idea of utilizing the Cauvery Falls at Sivasamudram. Later on, in 1902, extensive studies were made regarding the cost of generating power in Southern India, the results of which were published in the Indian Review of that year. This paper was communicated to the Agents of the Kolar Gold Mines and resulted ultimately in the central generating station which was erected at the Mines to supplement the supply of power from the hydraulic installation at Sivasamudram.

Recognizing that cheap power was essential to the development of the country and that the South of India was greatly handicapped by the dearth of fuel experiments were also started in 1902 to determine the value of Wind Mills as a source of power for lifting water for irrigation. Messrs. Parry & Co., the Madras Agents of the Chicago Aer-Motor Company, provided a 16-foot aer-motor mounted on a 70-foot tower and this was erected in the compound of the School of Arts and its performances were kept under observation for more than a year. The results of the investigation were published in June 1903 in a bulletin issued by the Department entitled, "The value of Wind Mills in India."

In 1906, a similar report was published on experiments in Pumping with oil engines and centrifugal pumps. Attention was drawn to the defects of existing pumps on the market and, falling into the hands of an engineer in England, it resulted in this gentleman setting himself the task of producing a new pump free from these defects. This led to the invention of the Rees Roturbo Pump which is now extensively used all over the world and has been adopted as

the most suitable type of pump for the majority of the installations in this Presidency.

In 1906-07, the flow of water in spring channels in the South Indian rivers was investigated and it was found that when the hydraulic gradient was less than one in about 250, the water is unable to move through the sand. This disposed of the idea that there was a subterranean flow of water in the beds of our rivers and explained the partial failure of water supply schemes for towns like Madura, Trichinopoly and Conjeevaram. A full account of the investigations is given in the report of the experimental pumping department for the year 1906-07.

The development of irrigation by pumping with oil engines and centrifugal pumps gave rise to a considerable number of investigations regarding the duty of water in the South of India and the results have been published from time to time in the bulletins and annual reports which have been issued.

33. *Enquiries.*—It would unduly extend the scope of this memorandum to furnish any detailed account of the industrial enquiries which have been made but have yielded no practical results. Only two matters are of sufficient importance to be referred to.

34. *The Utilization of the Periyar Water Power.*—Reference has already been made in paragraph 12 to Mr. Chatterton's original proposals. A revised scheme was submitted by him to Government in 1908, the principal feature of which was the regulation of the Periyar lake so as to provide a perennial supply of water sufficient to yield 20,000 h.p. for 12 hours every day throughout the year. It was proposed to transmit this power to Madura and the owners of the mills there signified their willingness to use it. The scheme fell through when we referred to the Government of India owing to objections raised by the Inspector-General of Irrigation. The importance of industrial development was not then so keenly appreciated as it is now, and it is possible that in the future the Irrigation department may be prepared to waive their objections.

35. *Wood Distillation.*—In January 1907, Mr. Chatterton invited the attention of the Board of Revenue to the question of the manufacture of charcoal from timber grown in the neighbourhood of the Buckingham Canal. He proposed the establishment of a wood distillation plant to manufacture charcoal for which a market was anticipated in Madras and elsewhere as fuel for Suction Gas Producer Plants as well as for the ordinary requirements of the City. Of the bye-products, the most important was Acetate of Lime which was needed by the Cordite Factory at Wellington for conversion into Acetone. Government sanctioned the preliminary proposal to send a sample consignment of ten tons of casuarina wood to England to ascertain what percentage of charcoal it would yield and what would be the value of the bye-products. The tests were eminently satisfactory, and a very extensive correspondence developed which was ultimately referred to the Industrial Conference which was held at Ootacamund in September 1908. Finally, the proposals were submitted to a committee chiefly consisting of non-official gentlemen who were asked to state whether the industry was to be left to private enterprise or to be taken up by Government. "The Committee were of opinion that Government could not undertake the establishment of a factory for wood distillation on a large scale without undue interference with private enterprise, though, upon the information at present available and in view of the uncertainty of a market for some of the most important bye-products, it was highly improbable that private enterprise would embark upon an undertaking of so much importance and difficulty." The Government accepted the opinion of the Committee and decided to take no further action in the matter. Had wood distillation then been started as was proposed, there is not the least doubt that it would, by now, have been an industry of great national importance in India as some of the bye-products are of great military value.

36. *Pencil Factory.*—In 1908 two pencil factories were started in the Vizagapatam district, one at Bimlipatam and the other at Anakapalle. The Bimlipatam Company imported machinery from Germany, but after spending about Rs. 28,000

failed to make pencils and sold the plant to a group of merchants at Cocanada. The factory was then started at Cocanada under the management of an Indian who claimed to have studied the processes of pencil manufacture in Japan. But after spending some Rs. 14,000 he failed to make saleable pencils, and operations came to a standstill. The Anakapalle Company began life with a paid-up capital of Rs. 5,000 and a loan of Rs. 6,000. But this capital was exhausted in procuring machinery from Germany, and further sums were borrowed in order to enable the company to work. No expert appears to have been employed, and all attempts to make pencils failed. The machinery was made over to the creditor in payment of the money owing to him and eventually passed into the possession of the Superintendent of an Industrial School at Waltair.

37. In 1914 the attention of the Department of Industries was drawn to the industry which was then defunct, and terms were arranged on which the department obtained the use of the machinery. An expert was obtained and some pencils were made. But it soon appeared that the expert was expert only as regards the wood part of the process, and that he was unable to assist in the production of a satisfactory lead. His services were accordingly dispensed with in March 1915, and a Supervisor of the Department was sent to Bangalore to study the composition of the lead in imported pencils with the help of the chemists of the Tata Institute. The refinement of the crude graphite also gave some trouble, but eventually with the help of Professor Erlam Smith of the Presidency College an effective method was discovered. Many other samples of Madras graphite were also tested, but none of the deposits in the Presidency are regularly worked, and since the graphite usually occurs in pockets, it is doubtful whether it will ever pay to work them. Eventually therefore it was decided to make use of Ceylon graphite which can be bought on the basis of a guaranteed carbon content. The question of wood gave far more trouble. Nearly 80 Indian woods have been tested, but so far no really satisfactory Indian wood has been discovered and the efforts made to place on the market a cheap white wood pencil made of Indian timbers have not been successful. The experiments with Indian woods are still going on, but the experience gained points clearly to the conclusion that pencil factories in India, as in European countries, will have to rely mainly on imported cedar. Fortunately there is a source of supply comparatively close at hand in British East Africa. Besides black lead pencils of different kinds (including carpenters' pencils and diary pencils), satisfactory copying pencils have been made, though the outturn of this class of pencil is limited by the scarcity of Methyl Violet of the right quality. Experiments have also been made with coloured pencils. The factory is now being run on commercial lines, and it is hoped that before long it will be possible to make it over to private enterprise.

38. *Glass Manufacture.*—The original experiments in glass-making in this Presidency were carried out at Ennore near Madras by the late Mr. James Short and Mr. August Scholl of Messrs. Volkart Brothers. Satisfied with the results of their preliminary enquiries regarding the supply of the requisite raw materials and with the success obtained by the experiments, they floated a company in 1909 with a capital of Rs. 2,00,000. A German expert and four Austrian blowers were brought out. An intermittent furnace and gas producer were constructed and work was started in 1910. In March 1910 a free grant of half the wood used in the company's furnace for the first two years was granted by Government. Month blown 7,200 tons for the whole period was granted by Government. Month blown soda water bottles were produced which stood a pressure of 260 lb. per square inch, and were used in large quantities by Messrs. Spencer & Co. and found perfectly satisfactory.

39. After working for some time it was found that the available local labour could not turn out mouth blown bottles in sufficiently large quantities to make the business profitable, and it was decided to get automatic machines. In 1911 therefore six bottle-making machines, an air compressor and mechanical gear were obtained from Messrs. Forsters of St. Helens. The factory worked till November 1911 and turned out a considerable number of soda bottles, the maximum output in any one month being upwards of 26,000. The company, however, experienced

many difficulties. The furnace had been constructed on a faulty design. It was an intermittent one, and work had to be stopped every time the furnace was charged. The concession of Government in regard to wood fuel did not prove of much value, and ultimately coal was used at a heavy cost and the losses in the annealing chamber were excessive. In the month referred to above, for instance, though 44,000 bottles were put into the chamber only 26,000 sound bottles were taken out. In 1913 therefore an attempt was made to raise further capital in order to construct a new continuous furnace. But the shareholders declined to invest any further money in the enterprise, and the company went into liquidation. Nearly Rs. 3,00,000 had been dropped in the venture.

40. The property then passed into the hands of a private gentleman, and in October 1914, the factory and plant were placed at the disposal of Mr. Tressler, then Director of Industries, for experimental purposes. Efforts however to obtain a glass expert were not successful, and the experiments were closed down in January 1917. They led to one valuable result, namely, the appointment of a Committee which surveyed the prospects of a glass-making industry in the Madras Presidency. Conditions clearly are not favourable in a locality where fuel is particularly dear and the Committee was not in favour of the experiments being continued.

41. Lime Sand Bricks.—Another experiment which must be written down as a failure is that of lime sand bricks. Proposals for the inception of these experiments were submitted in May 1914. At that time the Chetput brick fields were approaching exhaustion, and it had been decided to open a new brick field further afield. Mr. Tressler suggested that before Government committed themselves to the expenditure involved in this scheme the question of making lime sand bricks should be considered. The materials, lime and sand, were available in large quantities in Madras; if properly made these bricks had a crushing strength of between 200 to 300 tons to the square foot; and Mr. Tressler anticipated that they could be made at about the same cost as the clay brick. The experiments were accordingly sanctioned in G.O. No. 1472, Educational, dated 23rd June 1914, and an indent for machinery sufficient for an output of 8,000 bricks a day was sent home to an English firm. Part of the machinery delivered in June 1915 was set up in accommodation kindly provided by the South Indian Industrials, but owing to the war and the fact that one consignment was sunk by a submarine, the delivery was not completed till September 1916. Unfortunately provision had not been made for an adequate power plant. An engine of an antiquated type was lent by a local firm, and two worn out boilers were borrowed from Government House, but with this plant it was not possible to work the grinding mill and press simultaneously. Accordingly in September 1916 an estimate was submitted for working the plant in 1917-18 with a 50 B.H.P. electric motor. In the meantime after all efforts to procure an engine of the horse-power required had failed, a supplementary steam engine was obtained from the glass factory, and work was begun towards the end of October. A number of bricks were made. They were massive, firm and clean in shape, and to all outward appearances were excellent bricks, but possibly owing to the fact that sufficient pressure could not be maintained in the hardening chamber they were not satisfactory in point of crushing strength. Not only did they vary excessively from brick to brick, but on the average they were inferior in crushing strength to the best quality Madras stock bricks. Further, though owing to the fact that two engines and two boilers were employed for purposes of power accurate figures of the cost of production had not been obtained, sufficient information had been gathered to make it practically certain that the bricks could not be made in Madras for the price of the best clay bricks, viz., Rs. 16-18 per 1,000. An officer was then deputed to Colombo to study the conditions in which the manufacture of lime sand bricks was successfully carried on in Ceylon and the processes of manufacture, and his enquiries showed that given a satisfactory power plant and provided that our processes were somewhat elaborated, we could possibly turn out a really high class brick at a price which at a minimum, in his opinion would not be less than Rs. 21 per 1,000. Enquiries were therefore made of the Port Trust, the Madras and Southern

Mahratta Railway, the South Indian Railway and the Madras Corporation as to whether there was likely to be any demand in Madras for a superior but more expensive brick than the best quality Madras clay brick. The answers were all in the negative. All Superintending Engineers in the Presidency were also consulted whether owing to the absence of clay and building stone the conditions were favourable for lime sand bricks in any part of the Presidency, but here again answers were unfavourable. Accordingly it was decided that the experiments which had been temporarily closed down in December 1916 should be abandoned.

42. Technical and Industrial Education.—The history of the development of technical education in Madras is described in full detail in a note presented by the Hon'ble Mr. (now Sir A. G.) Cardew to the Industrial Conference of 1908. The Conference divided the subject into two parts, Industrial Instruction and Technical Education, the object of the former being "instruction in the performance of definite operations, such instruction not necessarily involving the teaching of general principles but only their application," while the object of the latter is to train a student to apply theoretical principles to practical purposes, and it then proceeded to pass a number of resolutions on the subject. Among other things it recommended that the control both of industrial instruction and technical education should rest with the Department of Industries and that a whole-time Inspector of Industrial Schools should be appointed. Government accepted this recommendation in respect of industrial instruction, but decided that technical education should remain under the Director of Public Instruction. The School of Arts and the Reformatory School at Chingleput, as well as all purely commercial schools, were also retained under the Director of Public Instruction, and eventually in 1909, 35 industrial schools were transferred to the Department of Industries. Most of these schools were carefully inspected by the acting Director of Industries (Mr. C. W. E. Cotton), and on his report the Government proposed in 1910 the appointment of a full-time Inspector of Schools. But very shortly afterwards the Department of Industries was abolished under the orders of the Secretary of State, and the control of industrial schools was resumed by the Director of Public Instruction, Mr. Chatterton being appointed Superintendent of Industrial Education under that officer. As already noted, however, in May 1911 Mr. Chatterton was placed on special duty in connection with the pumping and boring department and Mr. Tressler succeeded him as Superintendent of Industrial Education.

43. The Madras Trade School.—In the meantime, however, Mr. Chatterton had submitted a scheme to Government for the industrial education of workmen such as smiths, moulders, pattern-makers, turners, fitters and general machine men. The main feature of the scheme was a system of State apprenticeships by which each boy would be apprenticed to a particular trade for a period of years, and it was also proposed to establish a school in an industrial centre like Perambur where the apprentices would receive such elementary technical instruction as their educational attainments would permit them to assimilate. The scheme was referred to a committee which was composed largely of gentlemen connected with the various engineering firms and workshops in Madras, and this committee passed a number of resolutions, the most important being that a system of State apprenticeships should be established among the engineering shops north of Madras, and that some provision should be made for technical training in a school outside the workshops. The Government accepted generally the recommendations made, and called, in August 1912, for definite proposals for the establishment of State apprenticeships and the opening of a technical school on the lines advised by the committee. Tentative proposals were submitted shortly afterwards, but the consideration of them was delayed pending the receipt of the orders of the Secretary of State on the constitution of the Department of Industries, and the question also arose whether in addition to mechanical engineering, the facilities for technical education in the proposed school should not be extended to other branches of work such as motor engineering. Another committee was appointed to consider this question in 1914 and also to work out detailed proposals both for the school and for the system of apprenticeships. This committee, which was composed largely of men of practical experience, considered that such technological

education as was necessary in the Presidency might, for the present, be conveniently arranged for by means of scholarships to the Victoria Technical Institute at Bombay, and three scholarships of the value of Rs. 30 per mensem each for four years are now awarded to natives of the Madras Presidency for the study at the above institute either of mechanical engineering, electrical engineering, textile manufactures or technical chemistry, as well as three scholarships of the same value for the study of mechanical and electrical engineering at the Madras College of Engineering. The committee also proposed that extension classes should be provided in the proposed Trades School for subjects such as fitting and turning, blacksmith's work, foundry work, carpentry and joinery, plumbing and sanitary work, brick work and masonry, electric wiring and fitting, motor-car work and motor-car driving, weaving and dyeing, metal work and metal spinning. Government decided to begin work experimentally in a rented building, and much difficulty was experienced in obtaining a building in a suitable locality. Eventually, however, a building was secured in Georgetown and a beginning made with classes in mechanical engineering and plumbing. The school has now overflowed into another building, and classes are now held in mechanical engineering (first and second year), plumbing (first and second year), electric wiring (two classes), and machine drawing, while a class has also been opened for apprentices from the Perambur railway workshops. So far the experiment has been successful, and it is hoped to make the school permanent.

44. *Madura Technical Institute.*—Among the industrial schools transferred to the control of the Department of Industries in 1909 in pursuance of the recommendation of the Industrial Conference were the two technical institutes maintained by the District Boards of Madura and Tinnevely. Subsequently both institutes were taken over by Government, and while the Tinnevely institute was abolished, it was decided to rebuild and remodel the Madura one on a more ambitious scale. The institute will comprise weaving, dyeing and mechanical departments, the central idea being that the technical and industrial education provided should be connected with the industries of the town. In the mechanical department a small workshop will be established well equipped with different kinds of machinery, and ten apprentices will be admitted yearly for a three years' course which may be extended to five in the case of promising lads. The workshop will undertake repairs for private oil engines and pumps as well as for the pumping and boring department, and will also undertake demonstration of up-to-date agricultural and industrial machinery. The apprentices will thus be provided with practical experience, and three afternoons a week will be devoted to lectures on materials and simple forms of mechanism and to mechanical drawing. The idea is not to turn out engineer subordinates or draftsmen, but an intelligent class of mechanics somewhat resembling the old English mill wrights. Industrial classes will also be opened for carpentry and blacksmith's work. Five students a year will be admitted to each class, admission being confined to caste workmen, and the period of instruction will cover a period of five years. In the weaving department, for the present, industrial classes only will be opened. Twenty boys will be admitted each year, they will be apprenticed for five years and will be housed in a hostel. Details of the course of instruction have not yet been worked out, but roughly three hours a day will be devoted to general education and five hours a day to practical work. The practical work will be done in a weaving factory, the object being to train workmen capable of dealing with every stage of the processes of hand weaving for every kind of cloth manufactured in Southern India. It was also proposed to tackle in earnest at the institute the question of the improvement of indigenous methods of sizing and with this object in view to obtain "drum winding, beam warping and dresser sizing" machinery from England as well as to import an expert European sizer. But it was decided that the restrictions placed by Lord Morley upon departmental work made it impossible to test the value of this machinery on commercial lines, and this part of the scheme (which included the higher technical training of students) has been held in abeyance for the present. In the dyeing class no industrial training will be undertaken, and it has been decided that "all that is required is higher education for prospective 'works-owners and managers, to place them in a position to understand the nature

"of the processes carried on in the works and to keep in touch with and appreciate "the value of developments in methods and dyestuffs." Instruction for the present will be limited to the sons of dyers and of those engaged in business connected with dyeing, and the course which as at present arranged will last for one year, will include instruction in elementary science and chemistry of dyeing materials, technology of textile fibres and dyeing processes.

45. Various causes have conspired to delay the opening of the institute. The negotiations with the District Board of Madura as to the terms on which the old institute should be taken over were not concluded till 31st March 1910, and a new site for the institute was not finally selected till the end of 1911. The site originally selected for the quarters of the Principal and lecturers was subsequently commandeered for the headquarters of the Ramnad district and the acquisition of the new site has only just been sanctioned. The preparation of plans and estimates was also delayed in the Public Works Department, but final estimates for the institute and hostel amounting to Rs. 3,24,700 have now been sanctioned, and work is proceeding steadily. In the meantime the work of the old Technical School has been carried on in temporary buildings.

46. *Industrial Schools.*—Apart from the Madura Technical Institute, there are 35 aided industrial schools under the control of the Director. They may be roughly classified as below :—

Schools where carpentry is the principal subject taught	15
Schools where lace-making and needle-work are the principal subjects taught	2
Printing schools	15
Agricultural school	2
Weaving schools	1
Total	35

These schools at present follow the curriculum prescribed for the Government Technical Examinations and prepare students for the examinations in the Elementary, Intermediate and Advanced grades. The majority of these are managed by different missions, and aided by grants awarded under the Grant-in-Aid Code. One hundred and ninety-nine scholarships are at the disposal of the Director and are awarded to deserving pupils. The whole question of the policy to be followed in regard to these schools has been reviewed by Mr. Tressler, and his ideas have been embodied in a draft Grant-in-Aid Code which is now under the consideration of Government.

47. The following statement exhibits the grants paid to the industrial schools in the last four years :—

Year.	Teaching grant.	Building grant.	Furniture and special grant.	Scholarships.
	RS.	RS.	RS.	RS.
1912-13	28,780	549	15,952	6,138
1913-14	29,760	24,819	17,315	3,150
1914-15	29,610	7,140	8,033	5,243
1915-16	33,273	9,639	6,104	5,259

48. *Leather Trades School.*—Resolution No. 50 of the Industrial Conference ran as follows: "The Conference considers that the leather trade in the Madras Presidency is of sufficient importance to justify the establishment of a leather trade school which should be associated with a small tannery in which efficient practical instruction can be given, that provision should be made for technical education in tanning, and that in the Leather Trades School experiments may be fitly undertaken to determine whether or not the status of the Madras tanning trade can be improved." Government accepted the resolution and the Secretary of State sanctioned the school on condition that it should be a technical school pure

and simple. In it workmen should be instructed in methods of chrome tanning and other processes of leather manufacture, the idea being that if the school were properly managed it would supply "a private capitalist with instructed workmen and with all the information he requires for a commercial venture." But no attempt was to be made to convert the school into a factory in order to demonstrate that articles can be manufactured and sold at a profit. On this understanding Lord Morley sanctioned the establishment of the school and the recruitment of a European expert in tanning for industrial purposes. Mr. Allan Guthrie of Messrs. Cooper, Allan & Co., Cawnpore, was appointed Leather Expert and joined his appointment on 1st September 1911. In the following year he submitted his proposals in regard to the establishment of a school. He reported that, except in the type of tools used and the methods of using them, and the treatment of water, there was very little that could be taught to the export tanners, and that it would be better to aim at the improvement of leather tanned and dressed for use in this country. He proposed, therefore, that a school should be established and worked as a small tannery, lectures being cut down to a minimum, and the greater part of the two years' course being devoted to practical work in tanning, currying and dressing and to chemical checks in the laboratory on the practical work done. Admission should be confined as far as possible to sons of tanners and of those connected with the leather trade, and at the outset it was suggested that the school should be devoted mainly to the training of operatives. These proposals were approved, and a model tannery has been constructed in Washermanpet. Space has also been reserved on the same site for a Government Trades School in which lectures will be given. Unfortunately, just as the school was opened, Mr. Guthrie went off on military service, and temporary arrangements have been made to carry on the school in the tannery under the charge of an Assistant Leather Expert. Twelve students are now attending the school which is run partly as a model tannery and school and partly as a research institute. Experiments are being conducted with wattle as a tanning agent and with various mixtures.

49. The following statement exhibits the receipts from and expenditure on the department since Mr. Chatterton first began work on aluminium in the School of Arts:—

Year.	Receipts.		Expenditure.		Net cost.	
	Rs.		Rs.		Rs.	
1897-98	...	...	...	...	3,500	3,500
1898-99	...	...	...	...	45,014	392
1899-1900	...	...	...	...	91,432	1,568
1900-01	...	...	...	...	1,37,452	57,485
1901-02	...	...	...	...	1,84,727	52,428
1902-03	...	...	...	...	1,73,886	62,894
1903-04	...	...	...	...	2,95,216	1,65,017
1904-05	...	...	...	...	7,897	19,033
1905-06	...	...	...	...	28,142	83,518
1906-07	...	...	...	...	58,088	69,846
1907-08	...	...	...	...	55,948	1,01,663
1908-09	...	...	...	...	1,22,205	1,13,535
1909-10	...	...	...	...	96,942	1,12,871
1910-11	...	...	...	...	1,07,526	25,669
1911-12	...	...	...	...	81,923	72,603
1912-13	...	...	...	...	35,890	1,85,112
1913-14	...	...	...	...	43,536	2,76,685
1914-15	...	...	...	...	50,142	3,70,104
1915-16	...	...	...	...	57,762	2,95,052
Total	...	17,13,396	...	34,52,537	...	17,39,141

* Net profits.

MEMORANDUM ON THE DEPARTMENT OF INDUSTRIES IN THE MADRAS PRESIDENCY.

Early History.—In December 1897 the Superintendent of the School of Arts in Madras fell ill, and Mr. A. Chatterton, who was then Professor of Engineering at the Engineering College, was placed in charge of the school. Mr. Chatterton, who had already devoted much time to the question, obtained a small grant from Government in the beginning of 1898 for experiments in the manufacture of aluminium vessels in the School of Arts, and by August 1899 so much progress had been made in the introduction and development of the industry that the Government applied to the Secretary of State for permission to employ Mr. Chatterton for a term of three years in furthering the progress of technical and industrial education in the Madras Presidency. It was further proposed that he should devote himself to the restoration, organization and development of those technical trades and industries, especially metal work and connected arts, which appeared most likely to prove successful, and that he should pay special attention to the following matters:—

- (1) the development of the aluminium industry;
- (2) the inspection and reorganization of existing industrial schools and the establishment of new ones;
- (3) the development of indigenous industries; and
- (4) the establishment of a manual training class in the College of Engineering workshops or elsewhere.

The Government of India recommended these proposals for sanction subject to the remark that too much had been done in the way of the commercial development of the aluminium industry, but the Secretary of State sanctioned the proposals merely remarking that he noted that the aluminium industry would be left to private enterprise so soon as the success of the industry was assured, and that trade would benefit by the methods which had been adopted under Government supervision. The date of this despatch was 15th February 1900, and it may be noted that when it was written, the aluminium department of the School of Arts was already working on a considerable commercial scale, its sale receipts in the year 1898-99 having amounted to Rs. 44,621, while in the year 1899-1900 they rose to Rs. 91,432. It is evident, therefore, that in 1900 the Secretary of State had no objection to the working of pioneer industries by Government on a commercial scale, provided that as soon as their success was assured they were handed over to private enterprise.

2. The aluminium industry, together with his work as Superintendent of the School of Arts, occupied the greater part of Mr. Chatterton's time during the term of his special duty, but the period was also marked by the inception of experiments with hand-loom weaving, with oil-engines and centrifugal pumps for lift irrigation and with chrome tanning. Consequently when Mr. Chatterton went on leave in 1904, he was deputed to make enquiries into the American system of well irrigation, the possibility of introducing an improved pump for irrigation purposes, the possibility of introducing warping and sizing machinery suitable for the weaving industry of the Presidency, and the methods of chrome tanning as practised in America. On return from leave he was again placed on special duty for the purpose of exploiting and developing technical trades and industries in the Presidency. He was entrusted with the direction of industrial education and technical education in so far as it was connected with the exploitation of industries and with the superintendence of experiments in irrigation and pumping. His special instructions were first to devote particular attention to the development of irrigation by pumping and to the encouragement of the chrome tanning and weaving industries. As Inspector of Technical Schools and of the School of Arts, he was placed under the Director of Public Instruction, and in regard to his other work he was subject to the control of the Board of Revenue.

3. *The Department of Industrial and Technical Enquiries.*—These orders were passed in March 1905, but at the same time Government had a more important scheme under contemplation. Hitherto Mr. Chatterton had been on special duty, and the temporary nature of his appointment prejudiced the development of his work on a stable and orderly basis. Consequently later on in 1905, a step in advance was taken, and a scheme was submitted to the Government of India for the further advancement of the industrial development of the Presidency. To that end it was proposed to create a department which should make a survey of existing industries and should investigate the possibility of creating new ones. It was not proposed to work industries experimentally on a commercial scale, but merely to initiate experiments which might assist private enterprise to take up fresh industrial undertakings. It was also proposed to establish a bureau where the best available advice on industrial methods might be obtained. By this time Lord Morley had become Secretary of State for India, and in view of subsequent developments it is not surprising that he did not view the general principles underlying the scheme with much favour. He regarded with scepticism the prospect of attaining satisfactory results from the direction of State effort towards the creation of industries, and he doubted whether the lack of industrial energy and progress in the Madras Presidency might not be due to economic causes beyond the reach of State endeavour. However, by way of experiment he sanctioned the creation of the new department and the appointment of Mr. Chatterton to the charge of it with the title of Director of Industrial and Technical Enquiries. Thus the Department of Industries came into existence in August 1906, though not under that name, and in the following year it was strengthened by the appointment of an Assistant Director in the person of a junior Engineer of the Public Works Department. The work consisted largely of chrome tanning and investigations into the hand-loom weaving industry, but experiments in other directions were also carried on. Boring operations were begun, and it was shown that in certain districts of the Presidency considerable supplies, often artesian or semi-artesian in character, of subterranean water existed. And by encouraging the installation of pumps driven by internal combustion engines, it was proved that these and other supplies of water could profitably be used for irrigation.

4. *The Industrial Conference.*—In September 1908 an Industrial Conference was held at Ootacamund, the representatives of the leading industrial interests being invited to attend. The object of the Conference was to consider the best method of developing further the work which had been begun by the Director of Industrial and Technical Enquiries, and also to review the question of the improvement and extension of technical education. Sixty-eight resolutions were passed by the Conference under the heads (1) Industrial development, (2) Technical education, (3) Textiles and dyeing, (4) Sugar, chemicals and leather, and (5) other industries. The Conference defined the three functions of the Department of Industries as (1) the supply of advice in regard to new industries, and the introduction of new methods and processes, (2) the carrying out of investigations and experiments, and (3) the development of selected industries, and added that the department should open a bureau of information and an industrial museum. And in regard to the vexed question of pioneer industries, the Conference passed the following resolution:—

“The Government may undertake, as a pioneer, the introduction of new industries or industrial processes for the purpose of training students or apprentices or for demonstrating that such industries will be commercially successful.

“Provided—

“(1) that no such undertakings be engaged in without prior consultation with an Advisory Board upon which Indian interests and the leading commercial and trading interests in the Presidency should be represented;

“(2) that no such undertaking, if used for demonstrating any process as commercially successful, should be engaged in unless, after careful enquiry, the Government arrives at the conclusion that it is one in which the private capitalist does not already exist nor is willing to venture;

“(3) that it should be a principle of such undertakings that the fullest possible publicity should be given by the periodical publication of reports and by a full statement of the accounts of the undertakings; and

“(4) that, looking to the principle that such undertakings, if used for demonstrating that any process is commercially successful, should be directed to the assistance of private enterprise, it should be a rule that Government should withdraw from any such undertaking as soon as it is clear that it has sufficiently demonstrated the advantage of the improved methods of working in that particular industry.”

5. These resolutions, however, were not passed without protest. The operations of the chrome tanning department, the sales in which in the year 1907-08 had amounted to Rs. 85,520, had already begun to excite alarm in business circles, and three prominent representatives of European business interests in Madras recorded a minute of dissent from the resolutions relating to industrial development, holding that Government should confine assistance to commerce to matters of research, technical education, industrial instruction, and the dissemination of industrial information. On this point the Government accepted the resolution of the Conference. They recognized as a general principle that the exploitation of industries should be regarded not as a normal but as an exceptional function of Government, and on the general question of the limitations that should be set to the functions of the State in attempting to promote industrial development, they accepted the conclusions arrived at by the Conference. Accordingly in March 1909 they made the following proposals to the Secretary of State:—

(1) that a permanent Department of Industries under the control of an officer to be styled the Director of Industries should be created;

(2) that industrial education, as opposed to technical education, should be placed under this department; and

(3) that the department should further be entrusted with the duty of encouraging trade by the introduction of new industries, that it should establish and maintain a bureau of industrial information and that it should have the charge of the well-boring and pumping operations which were then in progress.

It was further proposed that an expert assistant should be attached to the Director of Industries, who should also have the assistance, as a temporary measure, of experts in dyeing, weaving and leather work.

6. *Lord Morley's Despatch.*—Lord Morley, however, in a despatch, dated 29th July 1910, differed fundamentally from the views expressed by the Conference and approved by Government as to the functions of a Department of Industries. As before, he condemned a policy of attempting to create new industries by State intervention, and he was sceptical as to the utility of State effort in this direction unless it was strictly limited to industrial instruction and avoided the semblance of a commercial venture. The danger of a new State industry was either that it would be a petty and ineffective plaything, or that it would prove to be a costly and hazardous speculation. The policy that he sanctioned was that State funds might be expended upon familiarising the people with such improvements in the methods of production as modern science and the practice of European countries could suggest. Further than this the State should not go, and it should be left to private enterprise to demonstrate that these improvements could be adopted with commercial advantage. He negatived the proposal to establish a Department of Industries, but he sanctioned the appointment of a Superintendent of Industrial Education working under the Director of Public Instruction, and he also agreed to the recruitment of dyeing, weaving and leather experts on the condition that they should be employed for instructional purposes only. He stated further that his objections did not extend to the establishment of a bureau of industrial information or to the dissemination from such a centre of intelligence and advice regarding new industries, processes and appliances provided that nothing was done to interfere with private enterprise.

7. *Abolition of Department.*—As the result of these orders the Department of Industries, which on the recommendation of the Conference had been created in

anticipation of sanction in October 1908, was abolished, and Mr. Chatterton was placed under the control of the Education Department as Superintendent of Industrial Education. In that capacity he still retained control of pumping and boring operations, but the chrome tannery was sold, the hand loom weaving factory at Salem disbanded and all industrial institutions were transferred to the management of the Education Department. Steps were also taken to recruit the experts whose appointments had been sanctioned by the Secretary of State. The above arrangements, however, proved unworkable, and it was soon found necessary to relieve Mr. Chatterton of his duties in connection with industrial education and to place him on special duty in connection with the pumping and boring operations. In July 1912, his services were lent to the Mysore Darbar and since that date up to the present time he has not been employed in the Madras Presidency.

8. *Its reconstitution.*—Lord Morley's orders, however, aroused considerable opposition in India. The Sixth Indian Industrial Congress, which was held at Allahabad in December 1910, protested against the abolition of the Department of Industries, and, in the following February, a resolution was passed in the Legislative Council of Madras inviting the Secretary of State to reconsider his decision. In pursuance of this resolution, the Government again addressed the Secretary of State in May 1911. They referred to the general disappointment which Lord Morley's orders had occasioned, and laid stress on the difference between the industrial condition of India and those prevailing in Europe, pointing out how difficult it was in a country like Southern India, "to bridge the gulf which exists between mere scholastic instruction and the practical application of industrial teaching, unless factories under State management are founded." And they asked for authority, in special cases, and subject to the safeguards suggested by the Industrial Conference, to undertake the experimental introduction of new industrial processes. Apart, however, from the question of State intervention on a commercial scale in industrial enterprises they asked for a reconsideration of the decision regarding the creation of a separate Department of Industries independent of the Director of Public Instruction. They had no objection to the retention of the inspection of technical and industrial schools under the Director of Public Instruction, provided that a separate Inspector was appointed, but they pointed out that such matters as the conduct of a bureau of industrial information and the supply of expert advice regarding the purchase of industrial and agricultural machinery were outside the province of the Educational Department. These proposals were supported by the Government of India and Lord Crewe's reply was not altogether unfavourable. He reaffirmed Lord Morley's decision against the extension of the activities of a Department of Industries to trading on a commercial scale, but he had no objection to the creation of a separate Department of Industries, provided that its functions were confined within the limits which will be referred to later. He asked for further information regarding the proposed appointment of an Inspector of Industrial Schools, and it was not until the end of 1913 that final orders were passed on this point, the control and supervision of industrial as opposed to technical schools being transferred to the Director of Industries for whose assistance an appointment of Inspector of Industrial Schools was sanctioned. Accordingly the Department of Industries in its present form came finally into existence on the 21st March 1914. The functions of the Director were thus defined:—

- (1) to collect information as to existing industries, their needs and the possibility of improving them or of introducing new industries;
- (2) to carry out and direct experiments connected with local enquiries;
- (3) to keep in touch with local manufacturers, to bring the results of his experiments to their notice and to obtain their co-operation in the conduct of experiments on a commercial scale;
- (4) to supervise the training of students; and
- (5) to advise Government with regard to technical matters involving legislation.

9. *Subsequent changes.*—Since these orders were passed the only important change in the function of the department has been the transfer in 1916 to the

Agricultural Department of all pumping and boring work. But the outbreak of the war in August 1914 seriously prejudiced the work of the department in some of its branches. Experimental and teaching work by the Dyeing Expert has been stopped owing to the lack of dye stuffs. The Leather Expert joined the Indian Army Reserve of officers in July 1915. The officiating Director (Mr. Tressler) followed suit last August, and a Civilian has been placed on special duty to submit proposals for the reorganization of the department.

10. *Present staff.*—The superior staff of the department now consists of an officer on special duty, a Dyeing Expert and a temporary engineer who acts as Assistant Director. The Leather Expert is at present on military duty and his place has been filled temporarily by an assistant who, as a Government of India scholar, was trained in tanning at home. There is a sanctioned post of Weaving Expert which is at present vacant. Sub-Engineers of the Public Works Department are at present in charge of the Madras Technical Institute and Glass Factory and there are three sanctioned posts of supervisors. The question of organizing a district staff is now before Government. An Inspector of Industrial Schools has just been appointed.

11. Brief notes are appended on some of the activities of the department since its inception.

12. *Aluminium.*—The first reference to aluminium in Madras that appears in the records was in 1891 when Mr. Chatterton made proposals to the Government for the utilization of water power in the manufacture of the metal. A committee of experts was appointed by the Secretary of State to examine the proposals, and in due course a report was published, and the matter left to private enterprise. Nothing practical resulted therefrom till Mr. Chatterton went on furlough in 1896. He then consulted the officers of the British Aluminium Company who informed him that there was no prospect of commercial success attending the manufacture of aluminium in India unless there was a large local market for the metal. He then, with the sanction of the Director of Public Instruction, proposed to introduce the working up of aluminium into some of the Industrial Schools in the Presidency and on his return from furlough at the end of 1897, he brought out a hundredweight of metal for the purpose. He was given permission to make experiments in the School of Arts and early in 1898, he applied for funds to carry on the work. This application was refused; but a further application to carry on the work at his own expense was sanctioned. At the end of March, Government reversed their previous decision and sanctioned the expenditure of a sum of Rs. 3,500 on the purchase of metal and agreed to the experiments forming an integral part of the work of the School of Arts. No great difficulty was experienced in manipulating the metal, and from the outset the work done was sold though it was naturally rough and deficient in finish. Copper-smiths and bell-metal foundries were employed, and, at first, indigenous methods of working were adopted. But gradually, as the workmen became more skilled, changes were made, and improved methods and modern tools were introduced, with the result that the cost of production was considerably reduced. Attention was also paid to the commercial side of the venture. From the outset there was a good demand from the military authorities and from Europeans for aluminium vessels and by establishing agents and subsidiary workshops at various places the Indian demand was also stimulated. The following figures give the annual receipts and charges of the aluminium department till it was sold in 1903:—

Year.	Receipts.			Charges.		
	RS.	A.	P.	RS.	A.	P.
1897-98	...	...	...	3,800	0	0
1898-99	...	...	...	44,621	13	9
1899-1900	...	...	...	91,432	0	8
1900-01	...	...	...	1,37,452	2	9
1901-02	...	...	...	1,81,549	13	8
1902-03	...	...	...	1,69,711	15	8
1903-04	...	...	...	2,91,582	8	6
				94,142	15	1

13. In 1900 the Indian Aluminium Company was formed by Mr. Eardley Norton, then practising as a barrister in Madras, with the view of following up and developing the pioneer work of the Department of Industries. For the time the company worked in conjunction with the department to open up a market in India, and in 1903 it was decided that the time had arrived when private enterprise could be left to carry on the business unaided. Accordingly in September 1903, the company took over the aluminium department of the School of Arts, purchasing all the tools, plant and stock after valuation. The results of the valuation showed that the department had made a net profit of about Rs. 60,000 during the period it had been pioneering the industry. Of this surplus one half was surrendered to the Indian Aluminium Company as a free gift to enable it to finance the transfer. The Government of India also permitted Mr. Chatterton to act as Consulting Engineer to the company for a period of eighteen months from the date of transfer. The company is now firmly established in Madras. It has extended the use of machine processes as far as possible in its workshops, but in spite of this fact it employs on an average nearly 250 workmen. The nominal capital of the company is Rs. 10 lakhs. In the six years preceding 1914 it paid on an average a dividend of 12½ per cent on a paid-up capital of Rs. 6,80,000, but since the war owing to army contracts its dividends have been much larger. Since the prohibition of the import of aluminium into India—a war necessity—the company has taken up the manufacture of copper and brass ware. From plans prepared by Mr. Chatterton, it has furnished the equipment of the two large sandalwood-oil distilleries which have recently been started in Bangalore and Mysore. The manufacture of aluminium vessels is also carried on in seven factories in the city of Bombay and in three factories in Ratanagiri. It has also become a bazaar industry in the Godavari district of this Presidency. Before the war 60 or 70 workshops were engaged in the industry in Rajahmundry alone, and 3,000 men were employed, the men skilled among them earning from Rs. 30 to Rs. 40 a month. The vessels manufactured were sent all over India as far as Benares in the north and Madras in the south. But as the figures given below indicate, the bazaar industry has been hard-hit by the war. The export of aluminium from England has been prohibited, and it is now unprocurable except at fancy prices.

14. Aluminium is not made in India and the existing industry, which is entirely an offspring of the company's work at the School of Arts, extends only to the manufacture of aluminium vessels. But such as it is, and though the war has materially affected it, it is an industry of some dimensions as the appended table of imports of aluminium into India shows:—

Table of imports.

Year.	Bombay.		Madras.		Cocanada.		Total.	
	CWT.	LAKHS. RS.	CWT.	LAKHS. RS.	CWT.	LAKHS. RS.	CWT.	LAKHS. RS.
1904-05	...	...	890	1.05	...	...	890	1.05
1905-06	...	...	188	0.25	1,016	1.31	1,204	1.56
1906-07	...	...	429	0.71	1,535	2.18	1,964	2.89
1907-08	...	...	1,126	1.73	1,470	1.89	2,596	3.62
1908-09	...	...	1,195	1.93	2,275	3.31	3,470	5.24
19 9-10	...	...	5,578	8.04	4,477	6.86	10,055	14.90
1910-11	...	...	7,875	11.58	3,336	5.08	11,211	16.66
1911-12	...	...	12,258	18.11	6,267	9.40	18,525	27.51
1912-13	...	...	26,115	39.18	14,089	21.13	40,204	59.31
1913-14	...	...	17,714	26.57	8,361	12.54	26,075	39.11
1914-15	...	...	7,673	11.51	3,281	4.92	10,954	16.43
1915-16	...	...	10,407	15.61	3,141	4.71	13,548	20.32

15. *Chrome tanning.*—The question of the intervention by Government in the Madras tanning industry was first taken up in January 1903 when the Chamber of Commerce was consulted as to the causes which had led to the

temporary decline of the industry in Madras, and as to whether Government could do anything to assist the industry. The Chamber's reply was in the negative. It ascribed the falling off in the industry to a natural reaction following the over-production of the previous years, and thought that the industry would revive in the natural course without interference by Government. Chrome tanning was not feasible in Madras owing to climatic difficulties, the process having already been tried by an experienced tanner brought out from home and found impracticable. The whole question was reviewed by Mr. Chatterton in a report, which was later expanded into a monograph on the Madras Leather trade, and in March 1903 Government decided that no reason existed for State intervention. Later on, however, in the same year this decision was reconsidered with reference to the economic waste involved in the use of country leather for *kavalais* or the buckets used by the ryots for well irrigation. Large numbers of these buckets were required annually by the ryots, for owing to inferior methods of tanning the leather perished after a comparatively short period of use, and Mr. Chatterton suggested that experiments should be made with the object of introducing and popularizing the more enduring chrome leather. In September 1903 therefore Government sanctioned the expenditure of a sum of Rs. 2,000 on experiments in the School of Arts to determine whether chrome tanning could be successfully carried on in the Presidency, the object in view being not to manufacture a leather which would compete with the products of Europe and America, but merely to turn out something superior to the locally made article. The field of chrome tanning was at that time clear. It is true that in 1910, when the operations of the department had led to the whole question of State interference with private enterprise arising in an acute form, the Chamber of Commerce explained that its letter of 1903 had been written solely with reference to chrome tanning by the two-bath process, and stated that the one-bath process had been found practicable before the department had undertaken its further development. Nevertheless, it does not appear that at the time when the department began work, any one else was engaged in chrome tanning though Mr. Chambers of Messrs. Chambers & Co. began work on an experimental scale some months later instigated by Mr. Brand, the Assistant in the School of Arts in immediate charge of the experimental work.

16. The experiments at first were conducted on a small scale, the establishment consisting merely of a tanning maistry, a fletcher and three coolies, but even in the first year the sales amounted to Rs. 4,779, and enquiries from all parts of India indicated that the venture had aroused considerable interest. The demand for water buckets, however, was not great at first, and it was soon found necessary to embark on the manufacture of boots, shoes and sandals, partly in order to popularize the use of chrome leather and partly in consequence of the difficulty of disposing of the leather cuttings not utilizable in the making of water buckets. Chrome leather water buckets gradually became more popular, and in the year 1908-09 Rs. 9,000 worth of leather was sold for this one purpose in two districts of the Presidency, but the main business of the department always consisted in supplying the demand for foot-wear, especially sandals. A boot shop was opened in the Mount Road by private enterprise, and large orders for sandals were obtained from some Government departments. In 1907-08 alone nearly 20,000 pairs of sandals were sold. The scale of these operations necessitated the removal of the department from the School of Arts, and in March 1905 the department moved over to a tannery of its own at Sembiam near Madras. Another consequence was that the commercial side of the venture now began to attract attention. At the end of 1908 Messrs. Chambers & Co. entered a protest against the department's interference with private trade, and in the following year further protests were made by the Upper India Chamber of Commerce and by the Madras Chamber. In reply to these protests Government expressed their willingness to withdraw from the venture, and in July 1910 they accepted an offer from the Rawah Darbar to purchase the plant of the tannery for the sum of Rs. 50,000 the whole stock also being taken over at a valuation. The transfer was finally effected in the beginning of 1911.

competition was to confirm the conclusions of the Salem Factory, the looms which did the best all round work being those manufactured at Madras on the lines of the old English hand loom. The advantages of this type of loom over the country loom have been described as follows:—

(1) The flyshuttle slay is cheaper than the ordinary slay;

(2) The flyshuttle gives a greater outturn; the increase varies not only with the experience and skill of the weaver but also with the different counts of yarn used, the outturn relative to that of the country loom being nearly double in the case of coarse counts, more than 50 per cent greater with medium counts and rather less than 25 per cent greater with finer counts ranging from 80s to 150s.

Efforts accordingly were made to spread the use of the flyshuttle loom, but the results were not at first apparent, and pessimistic remarks about the prospects of success appear more than once in the earlier reports. As a matter of fact, the use of the flyshuttle spread with a considerable rapidity, partly owing to demonstration work done by the private factories alluded to above, and a census of flyshuttle looms in ordinary use taken in 1911 revealed the existence in the 89 towns and villages visited of not less than 6,528 looms fitted with flyshuttle slays. Practically all these villages were in the coast districts north of Madras, and it was estimated that in these districts roughly 40 per cent of the weavers had adopted the new method of plying the shuttle.

23. The factory was worked on a commercial scale, so far as an experimental factory could be run on commercial lines. Besides cotton goods, silk cloths and worsted shawls were manufactured, and the sale receipts in some years amounted to nearly Rs. 12,000. But this fact proved the factory's undoing. The Chamber of Commerce entered a protest; Lord Morley's ultimatum followed shortly afterwards; and the factory was closed in September 1910.

24. In the meantime, on the recommendation of the Industrial Conference, it had been decided to appoint a Weaving Expert and to open a Weaving Institute at Madura. A Government of India scholar was appointed to the Expert's post, but he was not much of a success, and his services were dispensed with after a few months' trial. The project of a Weaving Institute at Madura also took a long time to mature, and after the closure of the Salem Factory, some rather desultory work followed mainly in the demonstration of jacquard looms. At the end of 1911, however, as already noted, a census of flyshuttle looms was made. It was found that the looms had already become very popular, and that the use of it was steadily increasing and the enquiry also indicated that further demonstration work was necessary in the direction of introducing (1) some sort of warping mill in places where the flyshuttle had been adopted, (2) dobbies for weaving simple designs, (3) the jacquard machine for complicated patterns, and (4) the frame loom wherever it might be profitable. Previous experience pointed to the conclusion that the best way to convince the weavers of the efficiency of any new appliance was by demonstrating it at their very doors, and though it was recognized that the introduction of improved appliance would not by itself solve all the problems connected with the improvement of the material condition of the weavers, it was decided to organize a peripatetic weaving party for the purpose of demonstrating to the weavers the advantages of improved methods of work and appliances.

25. The first party accordingly was organized in March 1913 for work in the southern districts of the Presidency. The party consisted of a superintendent and five weavers and was equipped with the following plant: warping mill, beaming frame, frame loom with automatic take up motion, spare slays, dobbies, jacquard machine and card cutting machines. A small stock of machinery for sale was added. A second party for the Northern Circars was organized in 1914. In the southern districts the chief work done has been in pushing the introduction of flyshuttle slays and dobbies, but in the northern districts, where weaving is more advanced, warping mills and dobbies have been popularized to some extent.

26. The cost of the weaving operations of the department in each year since the operations were begun is exhibited in the following table:—

						<i>Weaving experiments.</i>	
Year.						Receipts.	Expenditure.
						RS.	RS.
1901-02	...	...	...	...	...	177	2,281
1902-03	...	...	...	...	...	4,174	12,779
1903-04	...	...	...	...	...	3,592	10,210
1904-05	...	...	...	...	...	3,427	7,087
1905-06	...	...	...	...	...	2,512	10,935
1906-07	...	...	...	...	...	6,628	17,535
1907-08	...	...	...	...	...	10,537	15,023
1908-09	...	...	...	...	...	11,775	15,768
1909-10	...	...	...	...	...	8,601	14,341
1910-11	...	...	...	...	...	9,147	11,390
1911-12	...	...	...	...	...	1,430	5,476
1912-13	...	...	...	...	...	1,054	4,229
1913-14	...	...	...	...	...	3,156	9,521
1914-15	...	...	...	...	...	2,347	8,921
1915-16	...	...	...	...	...	1,417	9,501
Total						69,969	1,54,947

27. The net expenditure was thus Rs. 84,978 spread over fifteen years. In return for this expenditure the department can claim to have attained a considerable measure of success in the introduction of the flyshuttle loom and other improved appliances. Ten years after the first experiments were begun, as the result of the census taken, 6,500 looms out of 15,500 counted were found to be fitted with flyshuttle slays, and it was estimated that in the coast districts north of Madras 40 per cent of the weavers had adopted the flyshuttle. In 1915 the proportion in the Kistna district had risen to two-thirds, and at a conservative estimate the number of flyshuttle looms in use in the Presidency may be put at something like 15,000. Mr. Chatterton has estimated that the adoption of the flyshuttle increases the wages of a weaver by Rs. 2-8-0 per mensem, and on the basis of this figure, the monthly increase in wages resulting from the adoption of the flyshuttle may be put at Rs. 37,500 per mensem, or Rs. 4½ lakhs per annum.

28. *Pumping and Boring.*—The records of the pumping and boring branch of the department are very voluminous, and it is not possible here to give more than a very brief sketch of the development of the operations. In September 1903, the aluminium industry was made over to the Indian Aluminium Company, and as part of his programme of work in connection with the development of Indian industries, Mr. Chatterton proposed that a number of pumping installations should be set up with the object of demonstrating the advantages of modern machinery in agricultural operations. Some work had already been done in this direction, and Mr. Chatterton himself and the Public Works Department had both experimented with pumping by machinery. But these experiments had furnished evidence merely as to the value of lift irrigation on a comparatively large scale, and much scepticism still prevailed as to whether comparatively small areas of land could be profitably irrigated by small engines and pumps. One small installation had already been put up at Melrosapuram in the Chingleput district, and in 1904 permission was obtained to open four other pumping stations where experiments were begun with engines varying in horse power from 3½ to 6½ and with 3 and 4 inch pumps. From the first the progress made was encouraging, and by March 1905 so many applications for assistance had been received that Government agreed to advances being made under the Land Improvement Loans Act for the purchase of oil engines and pumps and provided Mr. Chatterton with the nucleus of a staff to assist those wishing to put up installations with advice and supervision. A class for training oil engine drivers was also opened at the School of Arts. It soon became evident, however, that very few of the wells in the Presidency could furnish enough water to make it worthwhile to put in an engine and pump, and that in order to bring pumping installations into more extended use it would be

necessary to deepen existing wells or to sink new ones so as to tap the subterranean reservoirs which were suspected to exist at no very great depth in certain districts of the Presidency. These results had been anticipated from the very beginning and in 1904 a set of boring tools was purchased with which experimental borings were put down in various places. This led to the discovery of sub-artesian water both in the Chingleput and South Arcot districts and it became evident that it was desirable greatly to extend the scale of operations. Accordingly in 1906 the boring branch of the department was inaugurated by the deputation of a special party to the Chingleput district, partly to develop well irrigation by the expeditious disposal of applications for loans, and partly to prevent waste of money by preliminary borings before wells were sunk. Later on the operations of the party were extended to the improvement of existing wells, and from this time forward progress was rapid until the outbreak of the war operated as a check. By March 1916 operations were in progress over nearly the whole of the Presidency, and 3,333 borings had been put down. Rather more than half of these borings were made for the purpose of improving existing supplies, the remainder being fresh explorations. The percentage of success is reported to have exceeded 60, sub-soil water being met with at depths ranging from 35 to 200 feet. In the same period 818 local investigations were made in connection with projected pumping installations, more than 400 installations were set up, and a sum of Rs. 2,99,800 was advanced under the Land Improvement Loans Act to 117 persons for the purchase of oil engines and pumps. Many other installations were put up independently of the department, the machines being mostly obtained from engineering firms on the hire purchase system, and an admittedly incomplete census taken in 1915 disclosed the existence of nearly 900 installations irrigating an estimated area of nearly 50,000 acres. In addition, a number of oil engines were installed under the advice and with the aid of the department in rice mills and other industrial concerns.

29. The rapid increase, however, in the popularity of oil engines and pumps entailed correspondingly heavy work in the department. In the circumstances of South India, it was necessary to provide for the supervision and periodical inspection of the pumps. A system of compounding fees was accordingly instituted, and by 1915, 236 plants were on the inspection list. For inspection and boring purposes the pumping and boring staff was augmented from time to time till in 1915 it consisted of 12 supervisors, 21 mechanics and 38 boring maistries. Much of the Director's time was taken up in the supervision of his supervising staff and in what was practically consulting engineering work. Most of this work, moreover, was work which really appertained to the Agricultural Department, and eventually that department was strengthened by the appointment of an Agricultural Engineer who has relieved the Director of Industries of all work connected with pumping and boring.

The following statement exhibits the cost of the pumping and boring department from 1904-05 to 1915-16:—

Pumping and Boring Operations.

Year.	Receipts.					Expenditure.				
	RS.					RS.				
1903-06	...	...	...	...	...	...	...	...	...	65,038
1906-07	...	...	...	...	...	...	...	...	...	14,105
1907-08	...	...	...	...	...	53	...	...	...	21,444
1908-09	...	...	...	...	...	2,692	...	...	...	39,177
1909-10	...	...	...	...	...	4,370	...	...	...	46,908
1910-11	...	...	...	...	...	5,287	...	...	...	66,299
1911-12	...	...	...	...	...	14,481	...	...	...	63,060
1912-13	...	...	...	...	...	26,407	...	...	...	98,757
1913-14	...	...	...	...	...	31,237	...	...	...	1,54,076
1914-15	...	...	...	...	...	38,654	...	...	...	1,58,017
1915-16	...	...	...	...	...	40,429	...	...	...	1,17,920
Total	...	...	...	...	...	1,64,280	...	...	...	8,44,796

* Includes Rs. 15,081 spent when the experiments were in charge of the Public Works Department. The figures are taken from the Annual Administration Report.

30. *Industrial Installations.*—The oil engines first used by the Department were worked with kerosine oil; but at the request of the Shell Transport and Trading Company, which then supplied Madras with kerosine oil, experiments were taken up with a view to utilizing the very large stock of liquid fuel which had been brought out to Madras in the hope that it would be found suitable for generating steam in the mills and factories. The scheme proved a failure and the company were left with a large tank containing about 4,000 tons of liquid fuel on their hands. It was found that the Hornsby-Ackroyd oil engine was equally well adapted for use with either liquid fuel or kerosine oil and on this fact being made known by Mr. Chatterton in a letter to the "Madras Mail," the numerous users of Hornsby-Ackroyd oil engines in the Madras Presidency naturally at once displaced kerosine oil, which cost from 7 annas to 8 annas a gallon by liquid fuel which could then be obtained at 2 annas a gallon in Madras. The great reduction in the cost of generating power, consequent upon this discovery, gave a considerable impetus to the development of small power installations. These were principally applied to the preparation of agricultural produce for the market and in the course of a few years, numerous paddy hullers, oil mills and a few saw mills and sugarcane crushing mills were installed.

31. In 1911, Mr. Chatterton urged on the Government the necessity for experimental work in connection with the manufacture of jaggery and a sum of Rs. 10,000 being placed at his disposal, a jaggery boiling plant on improved lines was set up in the village of Singanallur near Coimbatore. Very little progress had been made when he left Madras for Mysore and on the establishment of a Department of Industries in that State a number of similar plants were set up by him. Arrangements were made for the two departments to work in co-operation, with the ultimate result that very considerable improvements were effected and a large number of installations have been set up both in Mysore and the Madras Presidency. A full account of the work done in this connection will be found in Bulletin No. 55 of the Agricultural Research Institute, Pusa, which is entitled, "The Manufacture of Jaggery in South India."

32. *Experimental work.*—Allusion has already been made in paragraph 12 to the proposals submitted by Mr. Chatterton in 1891 for the utilization of water power in Southern India, and although these have not been carried out, they drew attention to the value of water power, and undoubtedly first suggested to the Mysore Government the idea of utilizing the Cauvery Falls at Sivasamudram. Later on, in 1902, extensive studies were made regarding the cost of generating power in Southern India, the results of which were published in the Indian Review of that year. This paper was communicated to the Agents of the Kolar Gold Mines and resulted ultimately in the central generating station which was erected at the Mines to supplement the supply of power from the hydraulic installation at Sivasamudram.

Recognizing that cheap power was essential to the development of the country and that the South of India was greatly handicapped by the dearth of fuel experiments were also started in 1902 to determine the value of Wind Mills as a source of power for lifting water for irrigation. Messrs. Parry & Co., the Madras Agents of the Chicago Aer-Motor Company, provided a 16-foot aer-motor mounted on a 70-foot tower and this was erected in the compound of the School of Arts and its performances were kept under observation for more than a year. The results of the investigation were published in June 1903 in a bulletin issued by the Department entitled, "The value of Wind Mills in India."

In 1906, a similar report was published on experiments in Pumping with oil engines and centrifugal pumps. Attention was drawn to the defects of the existing pumps on the market and, falling into the hands of an engineer in England, it resulted in this gentleman setting himself the task of producing a new pump free from these defects. This led to the invention of the Rees Roturbo Pump which is now extensively used all over the world and has been adopted as

the most suitable type of pump for the majority of the installations in this Presidency.

In 1906-07, the flow of water in spring channels in the South Indian rivers was investigated and it was found that when the hydraulic gradient was less than one in about 250, the water is unable to move through the sand. This disposed of the idea that there was a subterranean flow of water in the beds of our rivers and explained the partial failure of water supply schemes for towns like Madura, Trichinopoly and Conjeevaram. A full account of the investigations is given in the report of the experimental pumping department for the year 1906-07.

The development of irrigation by pumping with oil engines and centrifugal pumps gave rise to a considerable number of investigations regarding the duty of water in the South of India and the results have been published from time to time in the bulletins and annual reports which have been issued.

33. *Enquiries*.—It would unduly extend the scope of this memorandum to furnish any detailed account of the industrial enquiries which have been made but have yielded no practical results. Only two matters are of sufficient importance to be referred to.

34. *The Utilization of the Periyar Water Power*.—Reference has already been made in paragraph 12 to Mr. Chatterton's original proposals. A revised scheme was submitted by him to Government in 1908, the principal feature of which was the regulation of the Periyar lake so as to provide a perennial supply of water sufficient to yield 20,000 h.p. for 12 hours every day throughout the year. It was proposed to transmit this power to Madura and the owners of the mills there signified their willingness to use it. The scheme fell through when we referred to the Government of India owing to objections raised by the Inspector-General of Irrigation. The importance of industrial development was not then so keenly appreciated as it is now, and it is possible that in the future the Irrigation department may be prepared to waive their objections.

35. *Wood Distillation*.—In January 1907, Mr. Chatterton invited the attention of the Board of Revenue to the question of the manufacture of charcoal from timber grown in the neighbourhood of the Buckingham Canal. He proposed the establishment of a wood distillation plant to manufacture charcoal for which a market was anticipated in Madras and elsewhere as fuel for Suction Gas Producer Plants as well as for the ordinary requirements of the City. Of the bye-products, the most important was Acetate of Lime which was needed by the Cordite Factory at Wellington for conversion into Acetone. Government sanctioned the preliminary proposal to send a sample consignment of ten tons of casuarina wood to England to ascertain what percentage of charcoal it would yield and what would be the value of the bye-products. The tests were eminently satisfactory, and a very extensive correspondence developed which was ultimately referred to the Industrial Conference which was held at Ootacamund in September 1908. Finally, the proposals were submitted to a committee chiefly consisting of non-official gentlemen who were asked to state whether the industry was to be left to private enterprise or to be taken up by Government. "The Committee were of opinion that Government could not undertake the establishment of a factory for wood distillation on a large scale without undue interference with private enterprise, though, upon the information at present available and in view of the uncertainty of a market for some of the most important bye-products, it was highly improbable that private enterprise would embark upon an undertaking of so much importance and difficulty." The Government accepted the opinion of the Committee and decided to take no further action in the matter. Had wood distillation then been started as was proposed, there is not the least doubt that it would, by now, have been an industry of great national importance in India as some of the bye-products are of great military value.

36. *Pencil Factory*.—In 1908 two pencil factories were started in the Vizagapatam district, one at Bimlipatam and the other at Anakapalle. The Bimlipatam Company imported machinery from Germany, but after spending about Rs. 28,000

failed to make pencils and sold the plant to a group of merchants at Cocanada. The factory was then started at Cocanada under the management of an Indian who claimed to have studied the processes of pencil manufacture in Japan. But after spending some Rs. 14,000 he failed to make saleable pencils, and operations came to a standstill. The Anakapalle Company began life with a paid-up capital of Rs. 5,000 and a loan of Rs. 6,000. But this capital was exhausted in procuring machinery from Germany, and further sums were borrowed in order to enable the company to work. No expert appears to have been employed, and all attempts to make pencils failed. The machinery was made over to the creditor in payment of the money owing to him and eventually passed into the possession of the Superintendent of an Industrial School at Waltair.

37. In 1914 the attention of the Department of Industries was drawn to the industry which was then defunct, and terms were arranged on which the department obtained the use of the machinery. An expert was obtained and some pencils were made. But it soon appeared that the expert was expert only as regards the wood part of the process, and that he was unable to assist in the production of a satisfactory lead. His services were accordingly dispensed with in March 1915, and a Supervisor of the Department was sent to Bangalore to study the composition of the lead in imported pencils with the help of the chemists of the Tata Institute. The refinement of the crude graphite also gave some trouble, but eventually with the help of Professor Erlam Smith of the Presidency College an effective method was discovered. Many other samples of Madras graphite were also tested, but none of the deposits in the Presidency are regularly worked, and since the graphite usually occurs in pockets, it is doubtful whether it will ever pay to work them. Eventually therefore it was decided to make use of Ceylon graphite which can be bought on the basis of a guaranteed carbon content. The question of wood gave far more trouble. Nearly 80 Indian woods have been tested, but so far no really satisfactory Indian wood has been discovered and the efforts made to place on the market a cheap white wood pencil made of Indian timbers have not been successful. The experiments with Indian woods are still going on, but the experience gained points clearly to the conclusion that pencil factories in India, as in European countries, will have to rely mainly on imported cedar. Fortunately there is a source of supply comparatively close at hand in British East Africa. Besides black lead pencils of different kinds (including carpenters' pencils and diary pencils), satisfactory copying pencils have been made, though the outturn of this class of pencil is limited by the scarcity of Methyl Violet of the right quality. Experiments have also been made with coloured pencils. The factory is now being run on commercial lines, and it is hoped that before long it will be possible to make it over to private enterprise.

38. *Glass Manufacture*.—The original experiments in glass-making in this Presidency were carried out at Ennore near Madras by the late Mr. James Short and Mr. August Scholl of Messrs. Volkart Brothers. Satisfied with the results of their preliminary enquiries regarding the supply of the requisite raw materials and with the success obtained by the experiments, they floated a company in 1909 with a capital of Rs. 2,00,000. A German expert and four Austrian blowers were brought out. An intermittent furnace and gas producer were constructed and work was started in 1910. In March 1910 a free grant of half the wood used in the company's furnace for the first two years of its working up to a maximum of 7,200 tons for the whole period was granted by Government. Mouth blown soda water bottles were produced which stood a pressure of 260 lb. per square inch, and were used in large quantities by Messrs. Spencer & Co. and found perfectly satisfactory.

39. After working for some time it was found that the available local labour could not turn out mouth blown bottles in sufficiently large quantities to make the business profitable, and it was decided to get automatic machines. In 1911 therefore six bottle-making machines, an air compressor and mechanical gear were obtained from Messrs. Forsters of St. Helens. The factory worked till November 1911 and turned out a considerable number of soda bottles, the maximum output in any one month being upwards of 26,000. The company, however, experienced

many difficulties. The furnace had been constructed on a faulty design. It was an intermittent one, and work had to be stopped every time the furnace was charged. The concession of Government in regard to wood fuel did not prove of much value, and ultimately coal was used at a heavy cost and the losses in the annealing chamber were excessive. In the month referred to above, for instance, though 44,000 bottles were put into the chamber only 26,000 sound bottles were taken out. In 1913 therefore an attempt was made to raise further capital in order to construct a new continuous furnace. But the shareholders declined to invest any further money in the enterprise, and the company went into liquidation. Nearly Rs. 3,00,000 had been dropped in the venture.

40. The property then passed into the hands of a private gentleman, and in October 1914, the factory and plant were placed at the disposal of Mr. Tressler, then Director of Industries, for experimental purposes. Efforts however to obtain a glass expert were not successful, and the experiments were closed down in January 1917. They led to one valuable result, namely, the appointment of a Committee which surveyed the prospects of a glass-making industry in the Madras Presidency. Conditions clearly are not favourable in a locality where fuel is particularly dear and the Committee was not in favour of the experiments being continued.

41. *Lime Sand Bricks.*—Another experiment which must be written down as a failure is that of lime sand bricks. Proposals for the inception of these experiments were submitted in May 1914. At that time the Chetput brick fields were approaching exhaustion, and it had been decided to open a new brick field further afield. Mr. Tressler suggested that before Government committed themselves to the expenditure involved in this scheme the question of making lime sand bricks should be considered. The materials, lime and sand, were available in large quantities in Madras; if properly made these bricks had a crushing strength of between 200 to 300 tons to the square foot; and Mr. Tressler anticipated that they could be made at about the same cost as the clay brick. The experiments were accordingly sanctioned in G.O. No. 1472, Educational, dated 23rd June 1914, and an indent for machinery sufficient for an output of 8,000 bricks a day was sent home to an English firm. Part of the machinery delivered in June 1915 was set up in accommodation kindly provided by the South Indian Industrials, but owing to the war and the fact that one consignment was sunk by a submarine, the delivery was not completed till September 1916. Unfortunately provision had not been made for an adequate power plant. An engine of an antiquated type was lent by a local firm, and two worn out boilers were borrowed from Government House, but with this plant it was not possible to work the grinding mill and press simultaneously. Accordingly in September 1916 an estimate was submitted for working the plant in 1917-18 with a 50 B.H.P. electric motor. In the meantime after all efforts to procure an engine of the horse-power required had failed, a supplementary steam engine was obtained from the glass factory, and work was begun towards the end of October. A number of bricks were made. They were massive, firm and clean in shape, and to all outward appearances were excellent bricks, but possibly owing to the fact that sufficient pressure could not be maintained in the hardening chamber they were not satisfactory in point of crushing strength. Not only did they vary excessively from brick to brick, but on the average they were inferior in crushing strength to the best quality Madras stock bricks. Further, though owing to the fact that two engines and two boilers were employed for purposes of power accurate figures of the cost of production had not been obtained, sufficient information had been gathered to make it practically certain that the bricks could not be made in Madras for the price of the best clay bricks, viz., Rs. 16—18 per 1,000. An officer was then deputed to Colombo to study the conditions in which the manufacture of lime sand bricks was successfully carried on in Ceylon and the processes of manufacture, and his enquiries showed that given a satisfactory power plant and provided that our processes were somewhat elaborated, we could possibly turn out a really high class brick at a price which at a minimum, in his opinion would not be less than Rs. 21 per 1,000. Enquiries were therefore made of the Port Trust, the Madras and Southern

Madras Railway, the South Indian Railway and the Madras Corporation as to whether there was likely to be any demand in Madras for a superior but more expensive brick than the best quality Madras clay brick. The answers were all in the negative. All Superintending Engineers in the Presidency were also consulted whether owing to the absence of clay and building stone the conditions were favourable for lime sand bricks in any part of the Presidency, but here again answers were unfavourable. Accordingly it was decided that the experiments which had been temporarily closed down in December 1916 should be abandoned.

42. *Technical and Industrial Education.*—The history of the development of technical education in Madras is described in full detail in a note presented by the Hon'ble Mr. (now Sir A. G.) Cardew to the Industrial Conference of 1905. The Conference divided the subject into two parts, Industrial Instruction and Technical Education, the object of the former being "instruction in the performance of definite operations, such instruction not necessarily involving the teaching of general principles but only their application," while the object of the latter is to train a student to apply theoretical principles to practical purposes, and it then proceeded to pass a number of resolutions on the subject. Among other things it recommended that the control both of industrial instruction and technical education should rest with the Department of Industries and that a whole-time Inspector of Industrial Schools should be appointed. Government accepted this recommendation in respect of industrial instruction, but decided that technical education should remain under the Director of Public Instruction. The School of Arts and the Reformatory School at Chingleput, as well as all purely commercial schools, were also retained under the Director of Public Instruction, and eventually in 1909, 35 industrial schools were transferred to the Department of Industries. Most of these schools were carefully inspected by the acting Director of Industries (Mr. C. W. E. Cotton), and on his report the Government proposed in 1910 the appointment of a full-time Inspector of Schools. But very shortly afterwards the Department of Industries was abolished under the orders of the Secretary of State, and the control of industrial schools was resumed by the Director of Public Instruction, Mr. Chatterton being appointed Superintendent of Industrial Education under that officer. As already noted, however, in May 1911 Mr. Chatterton was placed on special duty in connection with the pumping and boring department and Mr. Tressler succeeded him as Superintendent of Industrial Education.

43. *The Madras Trade School.*—In the meantime, however, Mr. Chatterton had submitted a scheme to Government for the industrial education of workmen such as smiths, moulders, pattern-makers, turners, fitters and general machine men. The main feature of the scheme was a system of State apprenticeships by which each boy would be apprenticed to a particular trade for a period of years, and it was also proposed to establish a school in an industrial centre like Perambur where the apprentices would receive such elementary technical instruction as their educational attainments would permit them to assimilate. The scheme was referred to a committee which was composed largely of gentlemen connected with the various engineering firms and workshops in Madras, and this committee passed a number of resolutions, the most important being that a system of State apprenticeships should be established among the engineering shops north of Madras, and that some provision should be made for technical training in a school outside the workshops. The Government accepted generally the recommendations made, and called, in August 1912, for definite proposals for the establishment of State apprenticeships and the opening of a technical school on the lines advised by the committee. Tentative proposals were submitted shortly afterwards, but the consideration of them was delayed pending the receipt of the orders of the Secretary of State on the constitution of the Department of Industries, and the question also arose whether in addition to mechanical engineering, the facilities for technical education in the proposed school should not be extended to other branches of work such as motor engineering. Another committee was appointed to consider this question in 1914 and also to work out detailed proposals both for the school and for the system of apprenticeships. This committee, which was composed largely of men of practical experience, considered that such technological

education as was necessary in the Presidency might, for the present, be conveniently arranged for by means of scholarships to the Victoria Technical Institute at Bombay, and three scholarships of the value of Rs. 30 per mensem each for four years are now awarded to natives of the Madras Presidency for the study at the above institute either of mechanical engineering, electrical engineering, textile manufactures or technical chemistry, as well as three scholarships of the same value for the study of mechanical and electrical engineering at the Madras College of Engineering. The committee also proposed that extension classes should be provided in the proposed Trades School for subjects such as fitting and turning, blacksmith's work, foundry work, carpentry and joinery, plumbing and sanitary work, brick work and masonry, electric wiring and fitting, motor-car work and motor-car driving, weaving and dyeing, metal work and metal spinning. Government decided to begin work experimentally in a rented building, and much difficulty was experienced in obtaining a building in a suitable locality. Eventually, however, a building was secured in Georgetown and a beginning made with classes in mechanical engineering and plumbing. The school has now overflowed into another building, and classes are now held in mechanical engineering (first and second year), plumbing (first and second year), electric wiring (two classes), and machine drawing, while a class has also been opened for apprentices from the Perambur railway workshops. So far the experiment has been successful, and it is hoped to make the school permanent.

44. *Madura Technical Institute.*—Among the industrial schools transferred to the control of the Department of Industries in 1909 in pursuance of the recommendation of the Industrial Conference were the two technical institutes maintained by the District Boards of Madura and Tinnevely. Subsequently both institutes were taken over by Government, and while the Tinnevely institute was abolished, it was decided to rebuild and remodel the Madura one on a more ambitious scale. The institute will comprise weaving, dyeing and mechanical departments, the central idea being that the technical and industrial education provided should be connected with the industries of the town. In the mechanical department a small workshop will be established well equipped with different kinds of machinery, and ten apprentices will be admitted yearly for a three years' course which may be extended to five in the case of promising lads. The workshop will undertake repairs for private oil engines and pumps as well as for the pumping and boring department, and will also undertake demonstration of up-to-date agricultural and industrial machinery. The apprentices will thus be provided with practical experience, and three afternoons a week will be devoted to lectures on materials and simple forms of mechanism and to mechanical drawing. The idea is not to turn out engineer subordinates or draftsmen, but an intelligent class of mechanics somewhat resembling the old English mill wrights. Industrial classes will also be opened for carpentry and blacksmith's work. Five students a year will be admitted to each class, admission being confined to caste workmen, and the period of instruction will cover a period of five years. In the weaving department, for the present, industrial classes only will be opened. Twenty boys will be admitted each year, they will be apprenticed for five years and will be housed in a hostel. Details of the course of instruction have not yet been worked out, but roughly three hours a day will be devoted to general education and five hours a day to practical work. The practical work will be done in a weaving factory, the object being to train workmen capable of dealing with every stage of the processes of hand weaving for every kind of cloth manufactured in Southern India. It was also proposed to tackle in earnest at the institute the question of the improvement of indigenous methods of sizing and with this object in view to obtain "drum winding, beam warping and dresser sizing" machinery from England as well as to import an expert European sizer. But it was decided that the restrictions placed by Lord Morley upon departmental work made it impossible to test the value of this machinery on commercial lines, and this part of the scheme (which included the higher technical training of students) has been held in abeyance for the present. In the dyeing class no industrial training will be undertaken, and it has been decided that "all that is required is higher education for prospective 'works-owners and managers, to place them in a position to understand the nature

"of the processes carried on in the works and to keep in touch with and appreciate 'the value of developments in methods and dyestuffs.'" Instruction for the present will be limited to the sons of dyers and of those engaged in business connected with dyeing, and the course which as at present arranged will last for one year, will include instruction in elementary science and chemistry of dyeing materials, technology of textile fibres and dyeing processes.

45. Various causes have conspired to delay the opening of the institute. The negotiations with the District Board of Madura as to the terms on which the old institute should be taken over were not concluded till 31st March 1910, and a new site for the institute was not finally selected till the end of 1911. The site originally selected for the quarters of the Principal and lecturers was subsequently commandeered for the headquarters of the Ramnad district and the acquisition of the new site has only just been sanctioned. The preparation of plans and estimates was also delayed in the Public Works Department, but final estimates for the institute and hostel amounting to Rs. 3,24,700 have now been sanctioned, and work is proceeding steadily. In the meantime the work of the old Technical School has been carried on in temporary buildings.

46. *Industrial Schools.*—Apart from the Madura Technical Institute, there are 35 aided industrial schools under the control of the Director. They may be roughly classified as below:—

Schools where carpentry is the principal subject taught	15
Schools where lace-making and needle-work are the principal subjects taught	15
Printing schools	2
Agricultural school	1
Weaving schools	2
Total	35

These schools at present follow the curriculum prescribed for the Government Technical Examinations and prepare students for the examinations in the Elementary, Intermediate and Advanced grades. The majority of these are managed by different missions, and aided by grants awarded under the Grant-in-Aid Code. One hundred and ninety-nine scholarships are at the disposal of the Director and are awarded to deserving pupils. The whole question of the policy to be followed in regard to these schools has been reviewed by Mr. Tressler, and his ideas have been embodied in a draft Grant-in-Aid Code which is now under the consideration of Government.

47. The following statement exhibits the grants paid to the industrial schools in the last four years:—

Year.	Teaching grant.	Building grant.	Furniture and special grant.	Scholarships.
	RS.	RS.	RS.	RS.
1912-13	23,780	549	15,359	9,138
1913-14	23,760	24,819	17,315	4,150
1914-15	29,610	7,140	8,033	5,243
1915-16	33,273	9,639	6,104	5,259

48. *Leather Trades School.*—Resolution No. 50 of the Industrial Conference ran as follows: "The Conference considers that the leather trade in the Madras Presidency is of sufficient importance to justify the establishment of a leather 'trade school which should be associated with a small tannery in which efficient 'practical instruction can be given, that provision should be made for technical 'education in tanning, and that in the Leather Trades School experiments may be 'fitly undertaken to determine whether or not the status of the Madras tanning 'trade can be improved." Government accepted the resolution and the Secretary of State sanctioned the school on condition that it should be a technical school pure

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Of Arus — Year.	Receipts.	Expenditure.	Net cost.
	RS.	RS.	RS.
1897-98	...	3,600	3,800
1898-99	...	44,622	45,014
1899-1900	...	91,432	93,000
1900-01	...	157,452	164,937
1901-02	...	154,727	237,155
1902-03	...	173,886	236,780
1903-04	...	2,95,216	1,80,199
1904-05	...	7,897	26,939
1905-06	...	28,142	1,11,660
1906-07	...	58,088	1,27,874
1907-08	...	95,248	1,27,511
1908-09	...	1,22,265	2,35,800
1909-10	...	96,942	2,09,813
1910-11	...	1,07,526	1,33,195
1911-12	...	81,923	1,54,536
1912-13	...	35,890	2,31,092
1913-14	...	48,836	3,20,221
1914-15	...	50,142	4,20,246
1915-16	...	57,762	3,52,814
Total	17,13,896	34,52,537	17,39,141

* Net profits

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