REPORT

OF THE

Indian Tariff Board

ON THE

HEAVY CHEMICAL INDUSTRY

CALCUTTA: GOVERNMENT OF INDIA
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Secretary	Mr. R. L. Walker, I.C.S. (from 16th July 1928 to 25th October 1928 and from 4th February 1929). Mr. H. C. Sen (from 26th October 1928 to 3rd February 1929).

TABLE OF CONTENTS.

Para.		Page.
	Preliminary	vii

CHAPTER I.—THE HEAVY CHEMICAL INDUSTRY IN INDIA.

1.	Introductory	1
2.	Plan of the Report	1
3.	Sulphuric acid	2
4.	Rectified oil of vitriol	3
5.	Nitric acid	3
6.	Hydrochloric acid	4
7.	Glauber's salts	4
8.	Anhydrous sodium sulphate	4
9.	Sodium sulphide	5
10.	Zinc chloride	5
11.	Epsom salts	5
12.	Copperas	5
13.	Copper sulphate	5
14.	Aluminium sulphate	5
15.	Alum	6
16.	Ammonium sulphate	6
17.	Superphosphate	6
18.	Raw materials	6

CHAPTER II.—THE CLAIM TO PROTECTION.

19.	Dependence on sulphuric acid	8
20.	Organization of the industry	8
21.	Market	9
22.	Advantages of the indigenous industry	10
23.	Chemical industry—a key industry	10
24.	Claim to protection on ground of national defence	11
25.	Absence of sulphur in India not an insuperable objection	12
26.	Other raw materials	13
27.	Importance of chemical research	13
28.	Claim to protection established on ground of national importance	14
29.	Economic aspect of Fiscal Commission's conditions	15

CHAPTER III.—PRESENT COSTS.

30.	Existing sulphuric acid plants	16
31.	Method of procedure	16
32.	Chamber sulphuric acid: works cost	17
33.	Overhead charges: Depreciation	18
34.	Interest on working capital	18

PARA.		PAGE.
35.	Head office expenses and agents' commission	18
36.	Manufacturer's profit	19
37.	Rectified oil of vitriol	19
38.	Nitric acid (70 per cent.)	20
39.	Hydrochloric acid (33 per cent.)	21
40.	Glauber's salts	22
41.	Epsom salts	23
42.	Copperas	24
43.	Copper sulphate	25
44.	Alumino-ferric	26
45.	Potash alum	27
46.	Sodium sulphide and zinc chloride	27
47.	Second condition of Fiscal Commission fulfilled	28
48.	Present costs no basis for proposals	29
49.	Causes of present small scale production	30

CHAPTER IV.—ESTIMATE OF FUTURE COSTS.

50.	Basis of estimate	31
51.	Anticipated economies and other modifications	31
52.	Chamber sulphuric acid	33
53.	Rectified oil of vitriol	34
54.	Nitric acid	35
55.	Hydrochloric acid	36
56.	Glauber's salts	38
57.	Sodium sulphide	39
58.	Zinc chloride	39
59.	Epsom salts	40
60.	Copperas	41
61.	Copper sulphate	42
62.	Alumino-ferric	43
63.	Potash alum	44
64.	Assistance required	44

CHAPTER V.—THIRD CONDITION OF THE FISCAL COMMISSION.

65.	Cost of sulphuric acid on 8,000 ton output	47
66.	Reduction in cost of other chemicals	48
67.	Ability of industry to dispense with protection	49

CHAPTER VI.—MAIN PROPOSALS.

68.	Specific duties	51
69.	Detailed recommendations	51
70.	Future course of import prices uncertain	53
71.	Overproduction in Europe	53
72.	Trusts	54
73.	Effect on Indian prices	54
74.	Imposition of offsetting duties	56
75.	Period of protection	56

PARA. PAGE.

CHAPTER VII.—ARTIFICIAL MANURES.

76. Connection with chemical industry 57
77. Use of artificial manures 57
78. Conditions in India 57
79. Results of experiments 59
80. Ammonium sulphate 59
81. Organization of market 60
82. Superphosphate 61
83. Manufacture of superphosphate 62
84. Advantage of local manufacture 63
85. Economic unit 63
86. Estimate of cost of materials 64
87. Cost above materials 65
88. Overhead charges and profit 65
89. Charges for propaganda 66
90. C. i. f. landed price 67
91. Protection required 67
92. Estimate on 10,000 ton output 67
93. Conditions of Fiscal Commission 68
94. Method of protection explained 69
95. Burden on Government revenues 69
96. Conditions of payment of bounty 70
97. Power to make rules 71
98. Compound fertilisers 71

CHAPTER VIII.—UNIT OF PRODUCTION.

99. Rationalisation 73
100. Economic unit 73
101. Reorganization required 74
102. Special conditions in India 75
103. Results of foreign competition 76
104. Reduction of freights 76

CHAPTER IX.—ESTIMATE OF ECONOMIES RESULTING FROM LARGE SCALE PRODUCTION.

105. Intermediate stage: 8,000 tons 78
106. Full production: 16,000 tons 79
107. Sulphuric acid 80
108. Rectified oil of vitriol 81
109. Nitric acid 81
110. Hydrochloric acid 82
111. Glauber's salts 83
112. Sodium sulphide 83
113. Zinc chloride 84
114. Epsom salts 85
115. Copperas 86
116. Copper sulphate 86

PARA. PAGE.
117. Alumino-ferric 87
118. Potash alum 88
119. Margin of profit 88

CHAPTER X.—RAILWAY FREIGHTS.

120. General 89
121. Goods rating 89
122. Special rates for coal 90
123. Telescopic rates 91
124. Rate of freight which industry can afford 92
125. Reduction of earnings 94
126. Haulage costs 96
127. Railways—a public utility service 97
128. Increased traffic 97
129. Shortening of period of protection 99
130. Economic justification 100
131. Reduction of freights in Great Britain 101
132. Disappearance of smaller units 101
133. Location of industry 102

CHAPTER XI.—REMOVAL OF DUTIES.

134. Sacrifice of revenue involved 103
135. Individual representations considered 104
136. Removal of duties not justified 105

CHAPTER XII.—SUMMARY OF FINDINGS AND PROPOSALS.

137. Summary of conclusions 107

APPENDICES.

APPENDIX I.—Alterations necessary in Schedule II of the Indian Tariff Act, 1894 111

APPENDIX II—
Table A.—Market in the Bombay Presidency 112
Table B.—Market in Bengal 113
Table C.—Market in the Madras Presidency 113
Table D.—Market in India (excluding Burma) 114

APPENDIX III.—Table showing the imports of chemicals and associated products into British India during 1913-14 and each of the five years from 1923-24 to 1927-28 115

APPENDIX IV.—Summary prepared by Dr. Clouston, Agricultural Adviser to the Government of India, of the results of experiments with phosphatic manures in India . 118

PAGE.

APPENDIX V.—Figures showing the benefits obtained from the application of manures in the Madras Presidency . . 123

APPENDIX VI.—Statement giving a summary of the results obtained from the application of artificial manures in a number of experiments carried out under the direction of Imperial Chemical Industries (India), Limited 124

APPENDIX VII.—A.—Statement showing the world production and agricultural consumption of nitrogen compounds in metric tons of nitrogen for the five years 1923-24 to 1927-28 127

B.—Statement showing the production of superphosphate in Europe and America in 1913 and 1925 . 127


सत्यमेव जयते

PRELIMINARY.

The subject of this enquiry was referred to the Indian Tariff Board under Government of India Resolution No. 199-T (8) of 16th July, 1928, which ran as follows:—

"The Government of India have received representations from Messrs. The Eastern Chemical Company and The Dharamsi Morarji Chemical Company requesting that protection may be extended to the marginally noted chemicals. In pursuance of paragraph 3 of the Resolution of the Government of India, Department of Commerce, No. 3748, dated the 10th July, 1923, the Government of India have decided to refer to the Tariff Board for examination these representations along with any others of a similar nature which may be brought to its notice.

Sulphuric Acid.
Hydrochloric Acid.
Nitric Acid.
Magnesium Sulphate.
Ferrous Sulphate.
Potash Alum.
Aluminium Sulphate.
Sodium Sulphide.
Zinc Chloride.
Copper Sulphate.
Glauber's salt.

2. In making its enquiry, the Tariff Board will be guided by the principles laid down in the Resolution adopted by the Legislative Assembly on February 16th, 1923, and will consider—

(1) whether the conditions laid down in paragraph 97 of the Report of the Indian Fiscal Commission are satisfied in each case,

(2) to what extent, if any, and in respect of what articles, or class or description of articles, protection should be afforded, and

(3) how its recommendations, if any, will affect industries using these articles.

3. The removal of the import duties on materials of industry was recommended by the Fiscal Commission and is in accordance with the principle of the Resolution adopted by the Legislative Assembly on the 16th February, 1923. Chemicals are utilised as raw materials in certain Indian industries and the Government of India have decided that, along with the question of extending protection to the manufacture of particular chemicals, the Tariff Board will examine the question of the removal of the import duties on those chemicals which are used as materials in Indian industries.

4. Firms or persons interested, who desire that their views should be considered by the Tariff Board, should address their representations to the Secretary to the Board."

On receipt of this Resolution the Board prepared a detailed questionnaire and in the following press communique after explaining the scope of the enquiry invited all interested persons to submit

representations containing their views for the consideration of the Board—

"The attention of manufacturers of chemicals and consumers of chemicals which are used as materials in Indian industries is drawn to the Resolution of the Government of India in the Commerce Department No. 199-T (8), dated the 16th July, 1928, under which the question of granting protection to the manufacture of certain chemicals and the removal of duty on others has been referred to the Tariff Board for examination. Eleven acids and heavy chemicals have been expressly mentioned in the Resolution, but the scope of the Board's enquiry is not limited to these, and those interested in the manufacture of similar chemicals are at liberty to submit representations to the Tariff Board for investigation. Manufacturers who propose to apply for protection are requested in the first instance, to obtain from the Secretary, No. 1, Council House Street, Calcutta, a copy of the questionnaire prepared by the Board and to submit their replies with six spare copies to the Secretary, not later than the 30th September, 1928. After their replies have been received they will be notified as to the dates on which their oral examination, if any, will take place.

Consumers of chemicals used as materials in industries are also requested to submit representations stating (*a*) the kinds of chemicals used by them and the purposes for which they are used and (*b*) the amount of extra burden thrown upon the industry by reasou of the Customs duties now leviable upon chemicals used. These representations (with six spare copies) should reach the Secretary not later than the 30th of September, 1928."

Representations in support of the original application made to the Government of India were received from the following firms and associations:—

1. Eastern Chemical Company, Limited, Bombay.
2. Dharamsi Morarji Chemical Company, Limited, Bombay.
3. Baroda Chemical Works, Baroda.
4. Industrial Chemical Works, Kirloskarwadi.
5. D. Waldie and Company, Limited, Konnagar.
6. Bengal Chemical and Pharmaceutical Works, Limited, Calcutta.
7. Indian Merchants' Chamber, Bombay.
8. Buyers and Shippers Chamber, Karachi.
9. Maharashtra Chamber of Commerce, Bombay.
10. Karachi Indian Merchants' Association, Karachi.
11. Mr. G. N. Potdar, Bombay.
12. The Burma Chemical Industries, Limited.

Representations protesting against any enhancement of the existing duties or asking for a reduction or the removal of the

duties on certain chemicals used in the manufacture of such finished articles as matches, paints, paper, leather, cloth, etc., were received from the following:—

1. Messrs. Jenson and Nicholson (India) Limited, Calcutta.
2. Messrs. Boeman and Karain, Limited, Calcutta.
3. Shalimar Paint, Colour and Varnish Company, Limited, Calcutta.
4. North West Soap Company, Limited, Calcutta.
5. Messrs. Adamjee Hajee Dawood and Company, The Rangoon Match Works and others (joint representation).
6. Burma Indian Chamber of Commerce.
7. Kaleeswarar Mills, Limited, Coimbatore.
8. Bhavnagar Chemical Works, Vertej.
9. The Punjab Trades Association.
10. The Chrome Leather Company, Madras.
11. Messrs. Peter Spence and Sons, Limited, Manchester.
12. Bengal Paper Mill Company, Limited, Calcutta.

We have dealt with most of these representations in detail in Chapter XI of the report.

During the course of the enquiry the Board visited the following factories:—

The Bengal Chemical and Pharmaceutical Works, Calcutta.

Messrs. D. Waldie and Company's Works, Konnagar, Bengal.

The Eastern Chemical Company's Works, Bombay.

The Dharamsi Morarji Chemical Works, Ambernath, Bombay.

Messrs. Parry and Company's Chemical Works, Ranipet, Madras.

The Government Cordite Factory, Aruvankadu.

Tata Iron and Steel Company's coke oven by-product recovery plant.

The Board also visited the Indian Institute of Science at Bangalore.

In addition to the representatives of the applicant companies the following persons were examined orally by the Board:—

Messrs. W. O. Wright, O.B.E., and J. W. Keith of Messrs Parry and Company.

Mr. G. S. Butler, Officiating Superintendent, Government Cordite Factory.

Lt.-Col. A. M. Urquhart, Superintendent, Government Cordite Factory.

Mr. H. E. Page, Works Manager, Government Cordite Factory.

Messrs. S. Fuchsmann and V. Stuerm, of the Havero Trading Company, Limited, Bombay.

Mr. Purashottamdas Popatlal, Merchant, Bombay.

Messrs. Kapilram Vakil, J. K. Mehta, L. R. Tairsee and Dr. M. Venkatrao, representing Indian Merchants' Chamber, Bombay.

Mr. J. Tinker, representing Bombay Millowners' Association.

Messrs. J. C. K. Peterson, C.I.E., S. K. Sawday and D. M. Madan, representing the Tata Iron and Steel Company, Limited.

Mr. R. M. Hughes, representing Messrs. Brunner Mond and Company (India), Limited, now Imperial Chemical Industries (India), Limited.

Sir Edwin Pascoe, Director, Geological Survey of India.

Dr. L. L. Fermor, O.B.E., Superintendent, Geological Survey of India.

Dr. D. Clouston, C.I.E., Agricultural Adviser to the Government of India.

Mr. R. D. Anstead, C.I.E., Director of Agriculture, Madras.

Mr. C. W. Hutchinson, representing Imperial Chemical Industries (India), Limited.

Mr. H. C. Robson, representing Indian Copper Corporation.

Messrs. O. Gomes and H. D. Henman, representing the Bombay, Baroda and Central India Railway Company, Limited.

Messrs. D. S. Burn and H. J. Raper, representing the Great Indian Peninsula Railway.

Messrs. B. F. Higman, J. C. Rose and Dr. W. R. Horn, representing the East Indian Railway.

Messrs. A. Duncan and R. A. Leakey, representing the Bengal Nagpur Railway Company, Limited.

We desire to acknowledge the assistance which we received from the above witnesses: our special thanks are due to Mr. W. O. Wright of Messrs. Parry and Company who supplied the Board with full details of the Company's costs and much other valuable information although from the outset the firm admitted that they were not directly interested in the Board's enquiry, and to Mr. D. S. Burn, Agent of the Great Indian Peninsula Railway, who appeared before the Board and gave evidence from which we have derived great assistance regarding the possibility of assisting the industry by a reduction in the freight on raw materials and finished products. It is regretted that similar co-operation was not shown by Sir Ernest Jackson, the Agent of the Bombay, Baroda and Central India Railway who was also requested to assist the Board in its enquiry. The special acknowledgments of the Board are also due to Mr. J. C. Rose, Rates and Development Manager,

East Indian Railway, who besides giving valuable oral evidence has assisted us with a number of statements the preparation of which must have involved a considerable expenditure of time and labour.

Finally, we must place on record our acknowledgment of the very great assistance which we have received from our technical adviser, Mr. N. Brodie, M.Sc., F.C.S., A.I.C., Superintendent, Government Test House, Alipore. Although he only joined us about the time when the proposals embodied in our report were being finally shaped and the entire responsibility for these proposals must rest with the Board, his technical experience and knowledge have enabled the Board to form a more accurate judgment regarding existing methods of manufacture and practice. His services were not confined however to assistance in the investigation of the technical aspects of the problems before us. In the examination of the figures upon which our conclusions are based, we have derived great help from his careful scrutiny and throughout the preparation and discussion of the draft report we have had the benefit of his judgment and criticism.


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Report on the Heavy Chemical Industry.

CHAPTER I.

The Heavy Chemical Industry in India.

Introductory.

Among 'heavy chemicals' the two most important groups are sulphuric acid and the chemicals based on it and the various forms of soda and the compounds based on them—the 'alkali' industry. At the present time no chemical of the latter group is manufactured in India. The following chemicals which fall within the first group have been specifically referred to us for examination:—

Sulphuric acid.	Aluminium sulphate.
Nitric acid.	Sodium sulphide.
Hydrochloric acid.	Zinc chloride.
Magnesium sulphate.	Copper sulphate.
Ferrous sulphate.	Glauber's salts.
Potash alum.	

In addition to the above we shall in the course of our report discuss two artificial fertilisers, *viz.*, ammonium sulphate and superphosphate, in the manufacture of which sulphuric acid is also essential.

Plan of the Report.

2. In our report we propose first to give a brief description of the processes of manufacture of these chemicals: next to discuss the special conditions existing in India and then to proceed to a critical examination of the costs of the industry. The present costs of the industry will first be set forth and with reference to these the second condition of the Fiscal Commission will be considered, *viz.*, whether without protection the industry is not likely to develop at all or is not likely to develop as rapidly as is desirable in the interests of the country. If it is held that this condition is fulfilled, we shall consider whether the present organization and output of the industry affords a reasonable basis

on which proposals for protection can be put forward and if not on what output likely of attainment our proposals should be based. Having arrived at a scale of protection suitable for the industry, the future prospects of the industry will be examined and the future costs explained with a view to determining whether the industry will eventually be able to face competition without protection. Since the cost at which chemicals can be manufactured depends very largely on the output, we shall explain what measures we consider should be taken to facilitate the reorganization of the industry in the future and to widen the market, with particular reference to railway freights and the possibility of improving the demand for fertilisers. Our concluding chapter will deal with the question how far our recommendations will affect industries using these chemicals and with the advisability of removing import duties on those chemicals which are used as materials in Indian industries.

Sulphuric acid.

3. The world's annual production of sulphuric acid approximates to 10 million tons. The greater part of this output is used in the manufacture of fertilisers, *viz.*, superphosphate and ammonium sulphate. Very large quantities are also used in the manufacture of other chemicals, explosives, dyes and artificial silk; in petroleum refining, in pickling steel and for innumerable other purposes. The principal raw material used in the manufacture of sulphuric acid is sulphur. This may be either free sulphur (brimstone) or sulphur in a state of combination, generally as a metallic sulphide. The most important of such materials is pyrites (iron sulphide). Large quantities of sulphuric acid are however also made from the sulphide ores of zinc, copper and lead as a subsidiary operation to the extraction of these metals from their ores. Apart from variations in manufacture arising from the nature of the materials, two processes are used for the production of sulphuric acid. These are known as the 'Chamber' process and the 'Contact' process. The latter process is particularly adapted for the manufacture of very concentrated acid. The majority of the sulphuric acid of commerce is however required in a somewhat more dilute form and for such acid the chamber process is cheaper. The bulk of the world's production is therefore manufactured by the chamber process and this is at present the only process in use in India.

The manufacture of sulphuric acid involves in principle the oxidation of sulphur to sulphur di-oxide, the further oxidation of sulphur di-oxide to sulphur tri-oxide and the combination of sulphur tri-oxide with water.

$$SO_3 + H_2O = H_2SO_4$$

Sulphur di-oxide is a gas and is formed when sulphur is burned in air. To effect its further oxidation, the gas is passed to a series of lead chambers from which the process takes its name. In the chambers the sulphur di-oxide is mixed with air, water and nitrogen oxides. The nitrogen oxides oxidise sulphur di-oxide

to the tri-oxide which immediately combines with water to form sulphuric acid. The nitrogen oxides are themselves reduced, that is converted into lower nitrogen oxides, and these are in turn re-oxidised by the air. The nitrogen oxides are produced from nitric acid or more usually a mixture of nitre and sulphuric acid, contained in nitrepots over which the sulphurous gases pass. The alternate reduction and re-oxidation of the nitrogen oxides enables the process to be carried out with the expenditure of no more nitre or nitric acid than is required to make good such losses of nitrogen oxides as occur. Every effort is therefore made to reduce these losses to a minimum. An important factor in achieving this economy is the use of towers. Two towers are used, named after their inventors the Gay-Lussac tower and the Glover tower. The former removes nitrogen oxides from the exit gases from the chambers by bringing them into contact with sulphuric acid, which dissolves the oxides forming nitrous vitriol; the latter brings the gases entering the chamber into contact with the nitrous vitriol. The nitrogen oxides are thus removed from the acid and pass with the burner gases back into the chamber. Sulphuric acid is obtained in this process in two different strengths, *viz.*, acid direct from the chamber, known as chamber acid, and acid from the Glover tower. The latter acid is considerably more concentrated than the chamber acid.

Rectified oil of vitriol.

4. Chamber acid generally contains about 60 to 70 per cent. of sulphuric acid. The balance is water. Acid from the Glover tower is more concentrated but still contains a considerable proportion of water. When a more concentrated acid is required what is known as rectified oil of vitriol is made. Various methods of manufacture are in use of which that most commonly used is known as the 'cascade' process. The cascade consists of a series of basins made of some acid resisting material, such as silica, and heated from below. The acid to be concentrated is fed into the top basin and each basin as it becomes full spills into the next. The acid finally obtained is about 95 per cent. pure.

Nitric acid.

5. Nitric acid is a chemical of the greatest industrial importance. Its principal use is in the process of 'nitration'. Nitration consists of treating an appropriate material with a mixture of nitric acid and sulphuric acid, resulting in the formation of a nitrate or nitro compound. The most important of such nitrated materials is cellulose nitrate (nitro-cellulose). This is used in very large quantities in the manufacture of artificial silk, celluloid, paints and (under the name of gun-cotton) explosives. Other explosives besides gun-cotton are made by nitration, *viz.*, nitro-glycerine, tri-nitrotoluol and picric acid (tri-nitro-phenol). Nitric acid is also used for the refining of gold and for many miscellaneous purposes. Its principal use in India is in gold refining. The process of manufacture consists of heating sulphuric acid with a nitrate. Nitric acid distills and is recovered by condensation. In practice the nitrate

is generally sodium nitrate or nitre which is found principally in Chili and exported thence all over the world. The strength of nitric acid varies according to the strength of the sulphuric acid and to some extent according to the moisture content of the nitre. The acid generally made in India has a strength of about 70 per cent., but if necessary acid can be made up to nearly 100 per cent. pure. The residue remaining in the still is known as nitre cake and consists largely of acid sodium sulphate. The method of manufacture described is the oldest and still the most important. There are, however, now-a-days two important competing processes. By the direct union of the oxygen and nitrogen of the air by means of an electric arc, nitrogen oxides may be obtained and these may be converted into nitric acid. This synthetic process is in use in Scandinavia. It requires extremely cheap electrical energy and is not likely to be of practical importance to India. The second modern method consists of the oxidation of ammonia to nitric acid. This may be combined with the synthetic manufacture of ammonia to which reference is made in a later paragraph. The rapid growth of the synthetic production of ammonia makes this method of manufacturing nitric acid of great importance.

Hydrochloric acid.

6. Hydrochloric acid is used for a large number of chemical and miscellaneous purposes. Its principal use in India is likely to be for the manufacture of zinc chloride. Hydrochloric acid is a gas and is made by heating sulphuric acid with common salt. The gas evolved is absorbed in water and this forms what is commercially known as hydrochloric acid containing about 33 per cent. of the actual acid. The residue left in the still is known as salt cake and consists principally of sodium sulphate. In other countries salt cake is an important article of commerce, being used, for example, in large quantities in the manufacture of glass, but in India it has up to the present proved nearly or quite unsaleable. It is however used at present in small quantities in the manufacture of Glauber's salts and sodium sulphide. Hydrochloric acid can also be made by the direct combination of hydrogen and chlorine, which are obtained as by-products in the electrolytic manufacture of caustic soda.

Glauber's salts.

7. Glauber's salts is a hydrated form of sodium sulphate ($Na_2SO_4 \cdot 10H_2O$). This salt is used in the textile industry and in pharmacy. Salt cake is dissolved in water and the free acid present is neutralised. The iron that always exists in salt cake is oxidised with bleaching powder and precipitated by means of lime. The clear solution is drawn off from the sludge and allowed to crystallise at a low temperature.

Anhydrous sodium sulphate.

8. If the liquor obtained from salt cake in the way described is evaporated at a relatively high temperature, anhydrous sodium sulphate is obtained in place of Glauber's salts. Anhydrous sodium sulphate offers considerable advantages over Glauber's salts

in respect of packing and freight since Glauber's salts contains over 50 per cent. of water.

Sodium sulphide.

9. Sodium sulphide is used in dyeing and as a depilatory in the treatment of hides for leather manufacture. It is made from sodium sulphate in the form of salt cake by reducing the latter with coal dust.

$$Na_2SO_4 + 2C = Na_2S + 2CO_2.$$

The salt cake and coal are mixed and heated in a furnace. The resulting product is extracted with water and the solution concentrated to produce the solid material.

Zinc chloride.

10. Zinc chloride is used in the manufacture of textiles and as a flux for soldering. It is made by dissolving zinc in hydrochloric acid and evaporating the solution thus obtained to dryness.

Epsom salts.

11. Epsom salts is a hydrated form of magnesium sulphate. ($MgSO \cdot 7H_2O$). It is used for sizing cotton fabrics and in pharmacy. Magnesium sulphate is found native in British Columbia. In Germany it is one of the numerous salts prepared from the well known potash deposits at Stassfurt and most of the magnesium sulphate imported into India is at present obtained from this source. Large quantities are also made artificially, usually by dissolving magnesite (natural magnesium carbonate) in sulphuric acid and crystallising the solution so obtained. This is the process used in India.

Copperas.

12. Copperas is hydrated ferrous sulphate. It is used in the manufacture of ink and in the paint industry and has various other uses. It is made by dissolving scrap iron in sulphuric acid and allowing the liquor to deposit crystals.

Copper sulphate.

13. Copper sulphate is principally used as a fungicide and its chief consumers in India are the tea and rubber industries. It may be made in several ways. In India it is proposed to dissolve scrap copper in sulphuric acid with the aid of steam and air and to crystallise the solution so obtained.

Aluminium sulphate.

14. Aluminium sulphate appears on the market in several different forms of varying degrees of purity and has a number of important uses. The less pure forms are largely used for water purification and the purer forms in paper making and dyeing. The crudest product is known as alum cake and is prepared by treating bauxite (aluminium hydroxide) or clay with sulphuric acid. Alum cake contains large quantities of impurities and a purer form of aluminium sulphate is made by dissolving the alum cake in water, removing the impurities, concentrating and allowing the solution to re-solidify. This product is known as aluminoferric and contains a considerable quantity of iron. As the presence of iron is objectionable for many purposes, a purer variety of aluminium sulphate is made by

dissolving pure aluminium hydroxide, artificially prepared, in sulphuric acid.

Alum.

15. The form of aluminium sulphate most nearly free from iron is known as alum. Alum is a double salt, potassium aluminium sulphate (potash alum), ammonium aluminium sulphate (ammonia alum) or sodium aluminium sulphate (soda alum). These salts are only moderately soluble in water and can be freed from iron by dissolving in water and re-crystallising. Aluminium sulphate on the other hand is so soluble in water as to make re-crystallisation impossible.

Ammonium sulphate.

16. Ammonium sulphate is made by the neutralisation of ammonia with sulphuric acid. When coal is distilled as in the manufacture of gas and of coke, the nitrogen contained in the coal is largely converted to ammonia. This is recovered from the gas by the action of sulphuric acid. Ammonia may also be made synthetically. The synthetic ammonia industry is now of very large and rapidly increasing importance. The process consists in principle of the direct combination of nitrogen and hydrogen when subjected to extremely high pressures and simultaneously heated in the presence of a catalyst.

Superphosphate.

17. Superphosphate is made by the action of chamber sulphuric acid of about 65 per cent. strength on very finely divided calcium phosphate. The phosphate is converted into an acid phosphate which is soluble in water and hence available for plant nutrition.

Raw materials.

18. In the following table we summarise the raw materials used and the quantities required in the manufacture of each of these chemicals.

Name of chemical.	Raw materials used.	Approximate quantity of raw materials required per ton of product.
Sulphuric acid	Sulphur	·35
	Nitre	·01
Nitric acid	Nitre	1·43
	Sulphuric acid	1·52
Hydrochloric acid	Salt	2·2
	Sulphuric acid	1·5
Glauber's salts	Salt cake	·5
	Soda ash	·01
	Lime	·02
	Bleaching powder	·004
Sodium sulphide	Salt cake	1·8
	Coal dust	·7
Zinc chloride	Zinc scrap, zinc dross or zinc ash	·5 as zinc.
	Hydrochloric acid	·57

Name of chemical.	Raw materials used.	Aproximate quantity of raw materials required per ton of product.
Epsom salts	Magnesite	·38
	Sulphuric acid	·42
Copperas	Iron scrap	·25
	Sulphuric acid	·40
Copper sulphate	Copper scrap	·27
	Sulphuric acid R. O. V.	·44
Aumino ferric	Bauxite	·36
	Sulphuric acid	·47
Alum	Bauxite	·30
	Sulphuric acid	·38
	Potash sulphate	·21
Sulphate of ammonia	Sulphuric acid	·75
	Ammonia	·26
Superphosphate	Sulphuric acid	·35
	Rock phosphate	·56
	or	
	Sulphuric acid	·16
	Bones	·78

CHAPTER II.

The claim to protection.

19. We have explained in Chapter I that the basis of the group of chemicals that form the subject of our enquiry is sulphuric acid. The cost of producing the different salts must therefore largely be governed by the cost of manufacturing this acid. There are definite reasons why manufacturers in India have confined their efforts mainly to the production of this group of chemicals. Owing to the corrosive qualities of sulphuric acid, its transport from Europe is not entirely free from risk; packing is expensive and the drums or jars in which it is contained are both bulky and difficult to handle. In consequence freights are high and amount to as much as £5 per ton which almost equals the f.o.b. price of sulphuric acid. Manufacture in India has therefore always received a very high natural protection by virtue of the heavy freight and it has consequently been profitable to manufacture sulphuric acid. Naturally the manufacture of those salts of which sulphuric acid is the basis has also been undertaken at any rate on a scale sufficient to meet a portion of the local demand and since these salts are used largely in the industries situated in the sea port towns, their manufacture has been confined mainly to these localities. Thus in Calcutta we find Messrs. D. Waldie and Company's chemical works established over 70 years and the Bengal Chemical and Pharmaceutical Works established in 1901: in Bombay the Eastern Chemical Works established in 1913 and the Dharamsi Morarji Chemical Works some years later. As an exception Messrs. Parry and Company's Chemical Works with an output of about 1,000 tons per annum is situated at Ranipet some 70 miles from Madras. In this case, however, the low cost of land and buildings sufficiently compensates for the distance from the main market.

Dependence on sulphuric acid.

20. We have seen in the course of the match enquiry how a revenue duty on so high a scale as to afford heavy protection to the industry has resulted in the growth of a large number of factories the capacity of which is insufficient to admit of economic production. In the case of chemicals a similar result has followed from the heavy freight protection. It has proved possible to manufacture sulphuric and other acids on a comparatively small scale and yet secure a profit. Small factories upcountry have been protected by the heavy cost of transport from the larger factories at the ports, while the latter have been tempted by the profit obtainable even on a small output to enter into arrangements for a division of the available market among themselves. An arrangement of this nature has recently been made in Bombay between the Eastern Chemical Company and the Dharamsi Morarji Chemical Works. Either of these units is capable of supplying practically the whole

Organization of the industry.

of this market, but as a result of this arrangement each unit produces but a fraction of its possible output at a considerably enhanced cost. With a small output the cost of manufacturing sulphuric acid must always be high, and in consequence the cost of making salts of which sulphuric acid forms the main constituent has been excessive. Since salts are not protected by heavy freights to the same extent as the acids, it has proved difficult for the Indian manufacturer to compete against chemicals other than mineral acids imported from countries in which the industry has reached a high level of organization. One of the most important aspects of the problem before us is the possibility of so organizing the chemical industry as to admit of the production of sulphuric acid at an economic cost and, since in modern conditions the chemical industry perhaps more than any other depends for its success on large scale production, it is necessary to consider the market available in India for the class of chemicals at present manufactured in this country.

21. In Appendix II we have given tables to show the quantities of each of these chemicals imported into and manufactured in India.

Market.

These tables do not include sulphuric acid used in the manufacture of ammonium sulphate nor do they include the production of sulphuric acid in Burma and in various small factories regarding which we have little or no reliable information. At present the total market in India may be estimated at about 17,000 tons for the various salts. These salts would require about 7,000 tons of sulphuric acid (100 per cent. basis). In addition we estimate that about 4,000 tons of rectified oil of vitriol, 400 tons of nitric acid and 200 tons of hydrochloric acid are sold as such in the country. In the production of these acids, about 5,000 tons of sulphuric acid are required. The total market therefore in terms of sulphuric acid may be estimated at about 12,000 tons. In Table A we have given an estimate of the Bombay market and in Table B of the market in Bengal. These are the two principal markets in India. At present the Bombay market will absorb about 6,000 tons and the Calcutta market about 4,500 tons of chemicals in terms of sulphuric acid. We are not in a position to make an estimate of the way in which the market may develop. There is no doubt that the market has expanded considerably since the war. Most of the chemicals under consideration, however, are used by the cotton textile industry. That industry, as is well known, is in a state of great depression and it is not possible to foretell when a revival of its activities may take place. In these circumstances, while it is not unlikely that in terms of sulphuric acid the market may reach at least 8,000 tons in Bombay and about 16,000 tons in the whole of India during or shortly after the period of protection, we propose to proceed on the assumption that the market will remain more or less stationary. We have not taken into account the market for fertilisers the possibilities of which are considerable. These we propose to discuss separately.

22. We have now explained the position as regards the market in India which in our opinion is sufficiently large to permit of the production of chemicals on an economic scale. There are also other advantages which the Indian chemical industry may claim to possess. The processes used in the manufacture of the kind of chemicals with which we are directly concerned are as we have explained simple. The machinery used in modern works is generally of the automatic type and requires little labour and supervision. Indian labour has been found quite satisfactory and as the scale of wages in this country is much lower than in Europe, there will in this respect be some advantage in favour of the Indian manufacturer. There is also abundance of cheap fuel in the country, particularly if the industry is located in or near the coalfields. Even when coal has to be carried over long distances, the price at the pithead is so low and freight on coal has been so reduced that fuel may also be regarded as cheap compared with the price in some parts of Europe and the United States. In the main, however, under modern conditions the successful establishment of the industry depends more on organization and output than on any relative economic advantage that the possession of natural resources, cheap labour or the like may confer.

Advantages of the indigenous industry.

23. One of the principal grounds on which the chemical industry may establish a claim to public assistance is that it is a key industry. Its products are used in most other industries, in the textile industry, the leather industry, the paper industry, the glass and porcelain industry, the rubber industry, in the making of artificial silk, of paints and varnishes, soap and candles, and in the purification of mineral and vegetable oils. Details of the imports of chemicals and of materials in the manufacture of which chemicals are most largely used are given in Appendix III and are shown in abstract in the following table:—

Chemical industry—a key industry.

	1913-14.	1927-28.
	Rs. lakhs.	Rs. lakhs.
Sodium compounds	33	112
Other chemicals	62	132
Explosives	16	27
Glass and glassware	194	248
Dyes	106	216
Soap	75	161
Fertilisers	9	42
Artificial silk	...	549
TOTAL	495	1487

The present large imports of artificial silk are striking and it is well known that this purely chemical industry has been extremely successful in other countries. Part of the increase shown in other

materials is due to higher values but making allowance for this the increase cannot be less than 50 per cent. This however is not the full increase in consumption in India, since in some cases the Indian production also has grown considerably. The demand for the products of all these industries is steadily increasing and with it the potential demand for the chemicals employed in their manufacture. If India is ever to become industrialised on any considerable scale the establishment of the chemical industry on a firm basis is clearly a matter of great importance.

Claim to protection on ground of national defence.

24. The importance of the chemical industry from a national point of view rests not merely on the fact that it is a key industry on which other industries are vitally dependent in normal times, but also on the fact that its products are indispensable for purposes of national defence. Sulphuric and nitric acids are the basis of high explosives and the industry is therefore of supreme importance in time of war. We reproduce an extract from letter No. 12378/1 (M. G. I. E.), dated 9th November 1928, from the Master General of Supply Branch, Army Headquarters, India, to the Eastern Chemical Company, Limited—

"It is a well known fact that the existence of a flourishing chemical industry has a vital bearing on the possibility of national preparedness for war.

My Directorate has from time to time purchased chemicals from you for the purpose of manufacture of ammunition. The fact that they have been accepted and paid for is sufficient proof that they are up to the standard required.

Details of your plant and its capacity are tabulated, as you are aware, in the office of my Directorate, with a view to our being able to use them effectively in war. Similar records are kept of the plant and capacity of certain other manufacturers".

In paragraph 106 of its report the Fiscal Commission deals with the question of the protection of industries considered not on ordinary economic grounds but on the broad ground of national safety. Clearly from this point of view an adequate supply of raw material is a qualification of great importance, since any interruption of supply in time of war may seriously prejudice the military position. But it must be remembered that in such a case economic considerations play a secondary part and the question of the cost of production hardly arises. Considering the case from this point of view, we think it necessary to state that in the matter of raw materials India is not unfavourably situated. It is true that sulphur has not yet been found in any quantity in India and in normal conditions must be imported. In this respect India is at no disadvantage as compared with most other countries, since Italy, the United States and Japan are the only countries having considerable deposits of sulphur. When however the cost of production is not the deciding factor, it is possible to manufacture

sulphuric acid from substances other than native sulphur. Among alternative sources the most important perhaps are zinc concentrates. About 60,000 tons of these are exported every year from Burma to Europe to be smelted. Each ton of these zinc concentrates, it is stated, would give one ton of chamber sulphuric acid as a by-product. In 1919-20 there was a proposal that these concentrates should be smelted in India and sulphuric acid recovered as a by-product. The proposition was then examined by the Burma Corporation, but abandoned owing to financial and other considerations. Possibly with the general development of industries it may be found that conditions have so changed as to render it more economical to undertake smelting in India than to export the concentrates to Europe for that purpose. In any case as a war measure the establishment of a smelting works in the country may well be feasible. Then again, very recently, substantial quantities of copper ore have been discovered in Singhbhum. It appeared to us *primâ facie* possible that the sulphides contained in the ores might form a basis for the manufacture of sulphuric acid. On this point we examined the Manager of the Copper Corporation: he expressed the opinion that the character of the ore was such that though the manufacture of sulphuric acid from it was theoretically possible, there was no process at present known which would make it a commercial proposition. It is possible however that with further research a practicable method may be discovered. Moreover there are large quantities of gypsum available in the country. Sulphuric acid was produced in Germany from gypsum during the war and, though the process is expensive, it should be possible to manufacture sulphuric acid out of gypsum as a temporary measure.

Absence of sulphur in India not an insuperable objection.

25. From the standpoint of national defence the absence of an indigenous source of sulphur is not perhaps so serious a factor as it might appear. It seems to us probable that the amount of sulphuric acid at present used in India in the preparation of explosives admits of very considerable reduction. Ammonia can be produced synthetically from hydrogen and atmospheric nitrogen. From this ammonia nitric acid can be made by oxidation. There is some difference of opinion whether synthetic nitrogen compounds can be produced in India on an economic scale. The materials required are hydrogen and atmospheric nitrogen. Hydrogen may be produced electrolytically, for example as a by-product in the manufacture of caustic soda, or alternatively the hydrogen contained in water gas or in coke oven gases may be used. The necessary materials therefore already exist in India but it has been suggested that there is at present no demand which would justify the erection of a plant. It is said that the unit must be capable of producing at least 100,000 tons per year. As we shall show in a later chapter, the size of the unit must depend largely on circumstances and it does not appear to be the experience of other countries that a unit with a capacity as large as 100,000 tons is

necessary. In most European countries there are now synthetic nitrogen plants of much smaller capacity. In France, for instance, there are 17 plants which together produce about 46,000 tons of ammonia in terms of nitrogen per year, and which, when they reach full capacity, are expected to produce about 100,000 tons. In Belgium, Italy, Poland, Spain and Japan there are also small plants at work. There is already in India a growing market for ammonium sulphate and in the next few years this may make the erection of a small plant an economic proposition. The synthesis of ammonia cannot be regarded only as a question of economics. It is also a question of national defence for, if synthetic ammonia were produced in India, as its conversion into nitric acid is relatively simple, the country would in case of war be assured of one of the essential materials for the manufacture of high explosives. In the present process of manufacture of nitric acid large quantities of sulphuric acid are necessary and, if synthetic nitric acid were substituted, some seventy per cent. of the present consumption of sulphuric acid, and hence of sulphur imports, would be saved. Such considerations have been very largely responsible for the erection of synthetic ammonia plants, though this does not imply that their value in peace is not of the highest importance as for example in the manufacture of artificial manures. It might thus pay India in the long run to insure itself against national emergencies by having within the country a synthetic ammonia plant. It appears to us therefore that the deficiency in sulphur is no insuperable difficulty in manufacturing from materials within the country sufficient sulphuric acid for the preparation of explosives in time of war.

Other raw materials.

26. Sodium nitrate has not so far been discovered in India in commercial quantities. In an emergency potassium nitrate, of which considerable quantities are available, could be used as a substitute. If synthetic ammonia is produced it will be possible to dispense altogether with sodium (or potassium) nitrate. Of salt, bauxite, magnesite, gypsum and limestone there are, according to the evidence of the Geological Survey of India, large quantities available in the country, and all these minerals " are found in qualities sufficiently pure for them to be utilisable in the chemical industry ". Zinc and copper ores and iron scrap are all also available in the country in sufficiently large quantities for the requirements of the chemical industry. Sulphate of potash has to be imported but in case of necessity potassium nitrate may be used as a substitute. It is also possible in alum manufacture to substitute ammonium sulphate for potassium sulphate, thus making ammonia alum in place of potash alum.

Importance of chemical research.

27. There is another point of view which also makes the industry one of national importance. During the last few years industrial advancement as well as the development of agriculture has been largely a question of applied chemistry. In every country there-

fore to-day more and more attention is paid to chemical research both for industrial and for agricultural purposes. The real foundations of industrial chemical research can never be laid in any country which does not possess a chemical industry; for though much knowledge may be acquired in laboratories, unless that knowledge is applied in practice to the needs of industry and agriculture, little or no advance is possible. The vast mineral, forest and agricultural resources of India cannot be exploited to their fullest extent unless opportunities are given to chemists to acquire practical knowledge in works where the processes of manufacture are in actual operation. In the more advanced European countries and in the United States of America though much research work is done in laboratories and Universities, practically every industry carries on its own research for the purpose of investigating new processes of manufacture or for the purpose of making chemicals available for the development of agriculture. The question of artificial fertilisers is one of paramount importance to India but, as the Agricultural Commission has pointed out, there is such a variety of soils, conditions and climate in the country that unless these fertilisers are produced after a careful study of the various soils under working conditions and in close consultation with those engaged in agriculture it is useless to look for the best results from their application. We are aware that much has been done by importers of fertilisers to study the soil conditions in consultation with the Directors of Agriculture, but in our opinion this method can only be regarded as a makeshift and unless there are manufacturers on the spot whom the Directors of Agriculture are able to advise, it is unlikely that satisfactory fertilisers will be made available to the ryot at an economic price. Similar arguments can be applied to industries. The varied raw materials of India require much more research for their proper utilisation. We found in some of our earlier enquiries that owing to the absence of facilities for research of this kind, raw materials had to be exported for experimental purposes to Europe but the results were far from satisfactory. Chemical research must be carried on on the spot if it is to be effective. Even in Europe and in the United States it is only within the last 30 or 40 years that the importance of chemical research has been realised and if India is to keep pace with modern conditions and to create its own industrial environment, it can adopt, in our opinion, no better measure than the establishment of an up-to-date chemical industry.

Claim to protection established on ground of national importance.

28. We find then that the establishment of the chemical industry is of great national importance in time of war. It is also a key industry and provides a training ground for research on which the success of so many other industries depend. In our opinion the case for protection of the chemical industry rests primarily on the fact that it is an industry of supreme national importance and even if the conditions laid down in paragraph 97 of the Fiscal Commission's report were not fulfilled,

we feel that it would be impossible for us, consistently with the public interest, to refuse the claim for protection of an industry on which so many national activities depend both in time of peace and in time of war. We are however far from accepting the position that the conditions laid down by the Fiscal Commission are not fulfilled. We have shown earlier in this chapter that where important raw materials such as sulphur are at present lacking in India, there are alternative sources of supply which, however uneconomical under present conditions of transport and scientific development, according to expert evidence offer a sufficiently promising field for experiment and research. If the chemical industry now in its initial stage in India, were allowed to disappear there would be little incentive for many years to come to undertake the necessary investigation. In considering whether an industry possesses natural advantages it is essential to take long views. To refuse the claim to protection of an industry because of the existence of difficulties which in the end may prove transitory, may do irreparable damage to the future industrial interests of the country.

Economic aspect of Fiscal Commission's conditions.

29. The condition which requires that an industry claiming protection should possess sufficient natural advantages, must not however be looked at by itself. We think it necessary to point out that, considered strictly from the economic point of view the first condition laid down by the Fiscal Commission is explanatory of and not distinct from the third condition. The matters therein referred to, such as an abundant supply of raw material, cheap power and a sufficient supply of labour, are intelligible only with reference to the costs of an industry and the intention clearly is to lay down the general conditions under which reductions in costs sufficient to offset the advantages enjoyed by competing countries may be expected. The existence of an abundant supply of raw materials does not necessarily imply a reduction in cost. Where the supply of raw materials, though abundant with reference to the industry concerned, is not sufficient for the needs of the whole country the price is fixed by the cost of import from abroad and is frequently higher than in other countries. A similar condition often exists where the sources of supply are in the hands of a single producer or a combination or a federation of producers. We may instance in this connection the price of copper, pig iron and petroleum products. But it has always been the practice of this Board, in considering whether the third condition of the Fiscal Commission is fulfilled, namely whether the industry will eventually be able to face world competition without protection, to attempt by a detailed and critical exposition of costs to set forth the position which the Indian manufacturer may reasonably be expected to attain within a measurable period. Obviously the matters referred to in the first condition laid down by the Fiscal Commission are reflected in the costs and the final reply to the question whether this condition is satisfied must wait until we have examined the costs.

CHAPTER III.

Present costs.

Existing sulphuric acid plants.

30. Since sulphuric acid is the foundation of that part of the heavy chemical industry with which we are concerned, our first task must be to form an estimate of the cost of manufacturing sulphuric acid in India. In addition to a number of small plants there are seven plants in India engaged at present in the manufacture of sulphuric acid on a fairly substantial scale, *viz.*:—

The Dharamsi Morarji Chemical Company, Limited, Ambernath.

The Eastern Chemical Company, Limited, Bombay.

Messrs. Parry and Company's Works, Ranipet.

Messrs. D. Waldie and Company, Limited, Calcutta.

The Bengal Chemical and Pharmaceutical Works, Limited, Calcutta.

The Tata Iron and Steel Company, Limited, Jamshedpur.

The Indian Iron and Steel Company, Limited.

We have examined the costs of all these companies and we believe that for the purpose of determining the present and future costs of manufacturing chemicals in India, our safest course is to base our estimates on the costs of the Dharamsi Morarji Works. This Company's plant is more recent than that of any of the other companies. It is true that the Bengal Chemical and Pharmaceutical Works are erecting new plant at Panihati near Calcutta but this is not yet in operation. The sulphuric acid plant of the Dharamsi Morarji Works has a maximum capacity of 8,000 tons of 100 per cent. acid. This is larger than that of other factories engaged exclusively in the manufacture of chemicals and may be regarded as a fairly economic unit. Its capacity for producing most of the salts which we are investigating is also on the whole larger than that of any other plant. Further it is equipped for the manufacture of fertilisers on a fairly large scale. The works are situated at Ambernath on the Great Indian Peninsula Railway, some forty miles from Bombay where the market for chemicals is considerable. The import of sulphur and other raw materials by sea is easy and the works may therefore be regarded as conveniently situated.

Method of procedure.

31. As sulphuric acid forms the basis of the chemicals which we are considering and the cost of producing this acid is to a large extent the test of the practicability of manufacturing the other chemicals at a profit, we think that the manufacture of sulphuric acid must be treated for the purpose of our investigation as a separate undertaking, that is to say, instead of taking the whole plant and treat-

ing it as a single unit for the purpose of manufacturing not only sulphuric acid but other chemicals, we propose to separate the sulphuric acid plant from the rest. We shall first of all determine the works cost and the fair selling price of sulphuric acid according to the principles usually applied by us. We shall then take the fair selling price of sulphuric acid thus obtained and each chemical will be debited with the cost of the sulphuric acid used per unit of production at that price excluding of course packing and selling charges. For the purpose of our investigation we have taken the 1926-27 costs of the Dharamsi Morarji Works, because the costs of 1927-28 were not complete and were affected considerably by a reduction in output.

Chamber acid : Sulphuric works cost.

32. The usual strength of chamber sulphuric acid is about 65 per cent., but for the sake of convenience we shall frame our estimate of the cost of manufacture on a 100 per cent. basis. The raw materials used per ton of sulphuric acid were:—

	Tons.
Sulphur	·36
Nitre (sodium nitrate)	·012
Sulphuric acid (for nitre decomposition)	·007

The cost as given by the Company on an output of 1,185 tons was as follows:—

	Rs.	Rs.
Raw materials—		
Sulphur	41·60	
Nitre	2·49	
Sulphuric acid	0·41	
		44·50
Labour	2·10	
Power and fuel	1·45	
Repairs and renewals	4·50	
General services and supervision	4·50	
Rent, taxes, insurance, etc.	1·00	
		13·55
Works cost (naked)		58·05

This figure of Rs. 58·05 however includes only the actual works cost incurred during the working period. An expenditure of nearly Rs. 31,000 was incurred by the Company during the non-working period, that is the period during which the works were wholly or partially closed owing to the intermittent nature of the demand for the various products, and this sum will have to be debited to each product in proportion to the direct charges incurred. The amount to be debited to sulphuric acid on this basis is Rs. 5·6 which makes the total of the works cost Rs. 63·65 per ton.

33. We have now to determine the overhead charges, that is to say, depreciation, interest on working capital, head office expenses and agents' commission. In order to determine the amount of depreciation we have first of all to ascertain the present day replacement value of the plant. The actual plant and equipment of the Dharamsi Morarji Works cost in 1919 just under Rs. 10 lakhs. We think that this is at present values too high a figure and the Dharamsi Morarji Chemical Company and the Eastern Chemical Company both agree that a plant of the capacity of 8,000 tons could be erected, equipped and housed for the sum of Rs. 5 lakhs. We think that this is a reasonable figure and we shall adopt it for the purpose of determining both the amount of depreciation and the manufacturer's profit. Although the plant has a capacity of 8,000 tons, the production in 1926-27 amounted only to about 1,200 tons. If we were to base the depreciation on the full capacity, we consider that we should not be making an adequate allowance: if on the other hand we were to determine the amount of the depreciation on the basis of the actual output we should undoubtedly be allowing the Company more than it can reasonably claim, because as we have stated in an earlier paragraph, there is at present room only for one plant in this part of India and the existence of two large plants—not to mention a number of small uneconomic units—has unduly restricted the output of each. We must therefore find some intermediate figure upon which the amount of depreciation should be based and we have decided to distribute the depreciation over the combined production of the two Bombay factories. This may be taken to be about 2,000 tons. Depreciation on Rs. 5 lakhs at the rate of $6\frac{1}{4}$ per cent. would amount to Rs. 31,250 per annum giving an incidence of Rs. 15·62 per ton.

Overhead Charges : Depreciation.

34. In the calculation of working capital both for present and future costs we propose to take the works cost for a period of six months. It is true that owing to interrupted production stocks both of sulphuric acid and of raw materials had to be maintained for a longer period than would normally be the case but, as the works cost includes an allowance for the non-working period, no further allowance is necessary. We therefore take the working capital as Rs. 38,000. Interest at $7\frac{1}{2}$ per cent. on this amount is Rs. 2,850 and the incidence per ton is Rs. 2·38.

Interest on working capital.

35. The actual head office expenses of the Dharamsi Morarji Chemical Company have averaged Rs. 16,000 a year for the whole of the Company's business and the agents are entitled to a minimum commission of Rs. 36,000 per annum. As manufacture has been carried on at a loss, the actual payment on account of agents' commission during the past eight years has been Rs. 57,000 only. We think that so far as sulphuric acid alone is concerned, an allowance of Rs. 25,000 per annum on an output of 2,000 tons both for head office expenses and agents' commission would be

Head office expenses and agents' commission.

reasonable. The incidence of this charge would be Rs. 12·5 per ton. The total overhead charges thus come to Rs. 30·5.

Manufacturer's profit.

36. In order to arrive at the fair selling price we have also to add manufacturer's profit. Although we have distributed the depreciation over an output of 2,000 tons, we propose in calculating the manufacturer's profit to take a different figure. A manufacturer cannot reasonably claim a return on the whole of his invested capital on a production much below that of which his plant is capable. On the other hand, if the profit were distributed over the full capacity of the plant, sufficient account would not be taken of the present conditions of the chemical industry in India. As we shall point out in a subsequent chapter, the probable average production of sulphuric acid in the next few years is 4,000 tons a year and we think that the manufacturer is entitled to a profit calculated on this output. Profit at 10 per cent. on the replacement value of Rs. 5 lakhs is Rs. 50,000 per annum and the incidence Rs. 12·5 per ton. The total charges to be added to the works cost are therefore Rs. 43·00 and the fair selling price amounts to Rs. 106·65 as follows:—

	Rs.
Works cost (naked)	63·65
Overhead charges and profit	43·00
	106·65

or in round figures Rs. 105 per ton. We now proceed to deal separately with each product.

Rectified oil of vitriol.

37. The only material used in the manufacture of rectified oil of vitriol is chamber sulphuric acid of which about 1·1 tons per ton is required. Taking chamber sulphuric acid at Rs. 105 per ton, the works cost comes to Rs. 205·88 as under:—

	Rs.	Rs.
Chamber acid	115·50	
		115·50
Labour	2·94	
Power and fuel	14·64	
General services and supervision . .	7·70	
Repairs and renewals	7·90	
Rent, taxes, insurance, etc. . . .	1·70	
Allocation for non-working period . .	15·50	
		50·38
Selling charges	30·00	
Packing (excluding cost of containers) .	10·00	
		40·00
Works cost (*ex* godown) .		205·88

The replacement value of the plant and building with a capacity of 1,500 tons may be taken as Rs. 1,00,000. The actual output in 1926-27 was 681 tons. This we think is a production upon which the whole of the depreciation may reasonably be distributed. The

incidence under the head of depreciation is therefore Rs. 9·18 per ton. Interest on working capital calculated on a six months' turnover on the works cost, excluding chamber sulphuric acid which has already been taken into account, is Rs. 3·37 per ton. For head office expenses and agents' commission we propose to allow a round figure of Rs. 50,000 for the whole business. Rs. 25,000 has already been allocated to sulphuric acid and the balance is approximately equivalent to $6\frac{1}{4}$ per cent. of the works costs of the remaining chemicals after deducting from the works cost of any chemical, in the manufacture of which sulphuric acid or hydrochloric acid is used, the value of that acid. On this basis the head office expenses and agents' commission amount to Rs. 5·62 per ton. For the reasons we have already given we think that the profit should be based not on the actual production of 1926-27 but on the probable production during the next few years, *viz.*, 1,500 tons. Profit will therefore amount to Rs. 6·66 per ton, and the fair selling price will be Rs. 230·71 as under:—

	Rs.
Works cost (*ex* godown)	205·88
Overhead charges and profit	24·83
Fair selling price .	230·71

38. In the production of nitric acid the raw materials used were nitre 1·13 tons, chamber sulphuric acid ·4 tons, rectified oil of vitriol ·67 tons and potassium nitrate ·02 tons. The works cost was as follows:—

Nitric Acid (70 per cent).

	Rs.	Rs.
Raw materials—		
Nitre	225·14	
Chamber sulphuric acid	42·00	
Rectified oil of vitriol	127·80	
Potassium nitrate	7·52	
		402·46
Labour	14·82	
Power and fuel	7·92	
Repairs and renewals	32·80	
General services and supervision . . .	32·00	
Rent, taxes, insurance, etc.	7·10	
		94·64
		497·10
Less nitre cake		11·28
		485·82
Allocation for non-working period . .		54·60
		540·42
Selling charges	123·40	
Packing (excluding cost of containers) .	13·00	
		136·40
Works cost (*ex* godown)		676·82

The replacement value of the plant and building may be taken at Rs. 45,000 for a capacity of 150 tons of 100 per cent. acid which is equivalent to 214 tons of 70 per cent. acid. The actual output was about 100 tons of 70 per cent. acid and we think that the depreciation should be distributed over the actual production. Depreciation at $6\frac{1}{4}$ per cent. on Rs. 45,000 will be Rs. 28·12 per ton. Excluding the cost of sulphuric acid from the works cost interest on working capital on six months turnover will be Rs. 19·01. Head office charges will be Rs. 31·69. The profit to be earned is Rs. 4,500 and we think this should be distributed over the full capacity, namely 214 tons giving an incidence of Rs. 21·03 a ton. The fair selling price is therefore—

	Rs.
Works cost (*ex* godown)	676·82
Overhead charges and profit	99·85
Fair selling price .	776·67

The above costs are for 70 per cent. acid. The fair selling price on a 100 per cent. basis will be Rs. 1,110.

Hydrochloric Acid (33 per cent).

39. The principal raw materials required for the production of hydrochloric acid are common salt and sulphuric acid. About 1·1 tons of salt and 1 ton of sulphuric acid were used for the production of a ton of 33 per cent. hydrochloric acid. The works cost is as follows:—

	Rs.	Rs.
Raw materials—		
Salt	16·50	
Sulphuric acid	105·00	
Nitre cake	10·70	
		132·20
Labour	33·33	
Power and fuel	75·41	
Repairs and renewals	18·60	
General services and supervision . . .	18·20	
Rent, taxes, insurance, etc.	4·40	
		149·94
		282·14
Allocation for non-working period . .		27·40
		309·54
Less salt cake		86·60
		222·94
Selling charges	70·00	
Packing (excluding cost of containers) . .	13·00	
		83·00
Works cost (*ex* godown)		305·94

The replacement value of the plant and building may be taken at Rs. 1,00,000 for the production of 900 tons of 33 per cent. hydrochloric acid. Production in 1926-27 however was only 60 tons. We think that this production was uneconomic and that depreciation should be distributed over at least 300 tons giving an incidence of Rs. 20·83 per ton. Excluding the cost of sulphuric acid, the works cost would amount to Rs. 200 per ton and on six months' turnover the incidence of the interest on working capital at 7½ per cent. would be Rs. 7·5.

The incidence of the head office charges at 6¼ per cent. on the works cost excluding the cost of sulphuric acid amounts to Rs. 12·5. The profit to be earned is Rs. 10,000 and we think this should also be distributed over a production of 300 tons. The incidence of the profit per ton is Rs. 33·33. The fair selling price is therefore—

	Rs.
Works cost (*ex* godown)	305·94
Overhead charges and profit	74·16
Fair selling price .	380·10

The above figure is for 33 per cent. acid. The fair selling price on a 100 per cent. basis will be Rs. 1,152.

Glauber's salts.

40. In the manufacture of Glauber's salts the principal raw material is salt cake which is a by-product obtained in the manufacture of hydrochloric acid. In calculating the present cost of hydrochloric acid credit has been taken for salt cake at Rs. 40 per ton. The works cost was as follows:—

	Rs.	Rs.
Raw materials—		
Salt cake	23·20	
Nitre cake	0·20	
Soda ash	10·80	
Lime	1·38	
		35·58
Labour	9·00	
Power and fuel	5·00	
Repairs and renewals	4·29	
General services and supervision . . .	4·17	
Rent, taxes, insurance, etc.	0·93	
		23·39
		58·97
Allocation for non-working period . .		5·80
		64·77
Selling charges	16·12	
Packing	7·00	
		23·12
Works cost (*ex* godown)		87·89

The replacement value of the plant and building may be taken at Rs. 15,000 for a capacity of 300 tons per annum. We think that in this case depreciation should be spread, over the full capacity though the actual production was only 100 tons. The incidence will be Rs. 3·12 per ton. The interest on the working capital amounts to Rs. 3·30 a ton and head office expenses amount to Rs. 5·50 per ton. The profit to be earned is Rs. 1,500 and this we think should also be spread over an output of 300 tons. Profit will therefore amount to Rs. 5 per ton and the fair selling price will be as follows:—

	Rs.
Works cost (*ex* godown)	87·89
Overhead charges and profit	16·92
Fair selling price	104·81

41. The principal raw materials used in the manufacture of epsom salts are magnesite and sulphuric acid. About ·515 tons of magnesite and ·54 tons of sulphuric acid were used per ton. The present works cost is Rs. 144·27 made up as follows:—

Epsom salts.

	Rs.	Rs.
Raw materials—		
Magnesite	23·30	
Sulphuric acid	56·70	
		80·00
Labour	4·62	
Power and fuel	6·00	
Repairs and renewals	6·10	
General services and supervision . . .	5·93	
Rent, taxes, insurance, etc.	1·32	
		23·97
Allocation for non-working period . .		10·50
Selling charges	22·80	
Packing	7·00	
		29·80
Works cost (*ex* godown) .		144·27

The replacement value of the plant and building may be taken at Rs. 25,000 for a capacity of 250 tons per annum. The actual production in 1926 amounted to about 130 tons or about half the maximum capacity, and we think that the depreciation should be distributed over the actual production. At $6\frac{1}{4}$ per cent. on Rs. 25,000 the incidence of the depreciation will amount to Rs. 12 per ton. The working capital required on a six months' turnover excluding the cost of sulphuric acid will amount to Rs. 5,692 and interest at $7\frac{1}{2}$ per cent. on this will be Rs. 3·28 per ton. Head office expenses and agents' commission will be Rs. 5·47 per ton. The overhead charges thus amount to Rs. 20·75. The profit to be

earned is Rs. 2,500 and we think that this should be distributed over the full capacity of the plant. The incidence of profit per ton is therefore Rs. 10 and the fair selling price of epsom salts will be Rs. 175·02 as under:—

	Rs.
Works cost (*ex* godown)	144·27
Overhead charges and profit	30·75
Fair selling price .	175·02

Copperas.

42. The raw materials used in the manufacture of copperas are iron scrap and sulphuric acid. The figures given by the manufacturers are ·21 tons iron scrap and ·36 tons sulphuric acid per ton of copperas, and the works cost on this basis amounts to Rs. 74·38 as under:—

	Rs.	Rs.
Raw materials—		
Iron scrap	2·40	
Sulphuric acid at Rs. 105 . . .	37·80	
		40·20
Labour	1·63	
Power and fuel	5·75	
Repairs and renewals	2·70	
General services and supervision . . .	2·60	
Rent, taxes, insurance, etc.	0·60	
		13·28
Allocation for non-working period . . .		5·60
Selling charges	10·30	
Packing	5·00	
		15·30
Works cost (*ex* godown)		74·38

The replacement value of the plant and building may be taken at Rs. 10,000 for a capacity of 200 to 300 tons. The actual production amounted to 215 tons in 1926-27 and we think that the depreciation should be distributed over this amount. The incidence will be Rs. 2·90 per ton. Interest on working capital will be Rs. 1·37 per ton and head office expenses and agents' commission Rs. 2·29. Overhead charges will therefore be Rs. 6·56. Profit at 10 per cent. on Rs. 10,000 distributed over 215 tons will amount to Rs. 4·65 per ton and the fair selling price will be Rs. 85·59 as under:—

	Rs.
Works cost (*ex* godown)	74·38
Overhead charges and profit	11·21
Fair selling price .	85·59

43. The principal raw materials used in the manufacture of copper sulphate are copper scrap and rectified oil of vitriol. The quantities used were ·27 tons and ·87 tons respectively per ton. The fair selling price of rectified oil of vitriol we have taken at Rs. 230·71. This however includes packing and selling charges amounting to Rs. 40 per ton: these charges will have to be deducted and the price to be charged to the manufacturer for rectified oil of vitriol is therefore Rs. 190·71 per ton. The works cost is as follows:—

Copper sulphate.

	Rs.	Rs.
Raw materials—		
Copper scrap	202·70	
Sulphuric acid	166·00	
Nitric acid	9·13	
	———	377·83
Labour, ...	12·85	
Power and fuel	2·52	
Repairs and renewals	33·00	
General services and supervision . . .	32·20	
Rent, taxes, insurance, etc.	7·20	
	———	87·77
Allocation for non-working period . .		61·60
Selling charges	124·00	
Packing	7·00	
	———	131·00
Works cost (*ex* godown) .		658·20

A plant, including buildings, of a capacity of 250 tons per annum can be erected for Rs. 14,000. The actual production during the year 1926-27 was 35 tons which we consider an uneconomic production. The depreciation should be spread over half the full capacity, namely 125 tons per annum. Depreciation will therefore be Rs. 7 per ton. Interest on working capital will be Rs. 18·11 and head office expenses and agents' commission Rs. 30·19. The profit to be earned is Rs. 1,400. This we also think ought to be distributed over 125 tons giving an incidence of Rs. 11·20. The fair selling price will be as under:—

	Rs.
Works cost (*ex* godown)	658·20
Overhead charges and profit	66·50
Fair selling price	

44. The raw materials used in the manufacture of alumino-ferric are bauxite and sulphuric acid: the quantities of which were ·36 tons and ·47 tons respectively per ton. The works cost is as follows:—

Alumino-ferric.

	Rs.	Rs.
Raw materials—		
Bauxite	7·92	
Sulphuric acid	49·35	
		57·27
Labour	10·80	
Power and fuel	11·38	
Repairs and renewals	4·80	
General services and supervision	4·70	
Rent, taxes, insurance, etc.	1·40	
Allocation for non-working period	9·40	
		42·48
Selling charges	18·00	
Packing	1·00	
		19·00
Works cost (*ex* godown)		118·75

The plant required for the manufacture of this chemical is very simple and for a capacity of 500 tons the cost should not exceed Rs. 5,000. The actual production was very small in 1926-27, namely 65 tons. We think that the depreciation should be spread over an output equal to half the full capacity, namely 250 tons. The incidence per ton for depreciation will therefore be Rs. 1·25. Interest on working capital will be Rs. 2·59 and head office expenses and agents' commission Rs. 4·31 per ton. The profit to be earned is Rs. 500 which we think should be distributed over half the maximum output, namely 250 tons, giving an incidence of Rs. 2 per ton. The fair selling price will be as follows:—

	Rs.
Works cost (*ex* godown)	118·75
Overhead charges and profit	10·15
Fair selling price	128·90

45. The raw materials used in the manufacture of potash alum are bauxite, sulphuric acid and potassium sulphate. The quantities used per ton were bauxite ·29 tons, sulphuric acid ·39 tons and potassium sulphate ·32 tons. The works cost was as follows:—

Potash alum.

	Rs.	Rs.
Raw materials—		
Bauxite	6·36	
Sulphuric acid	40·95	
Potassium sulphate	37·96	
		85·27
Labour	24·57	
Power and fuel	17·38	
Repairs and renewals	9·02	
General services and supervision	8·80	
Rent, taxes, insurance, etc.	1·90	
Allocation for non-working period	14·60	
		76·27
Selling charges	34·00	
Packing	7·00	
		41·00
Works cost (*ex* godown)		202·54

The replacement value of a plant of a capacity of 500 or 600 tons may be taken at Rs. 50,000. The actual production however amounted to 350 tons. We think that the depreciation should be distributed over the actual production which was more than half the full capacity. Depreciation will be Rs. 8·93 per ton. Interest on working capital will be Rs. 6 and head office expenses and agents' commission Rs. 10·00 per ton. The profit to be earned is Rs. 5,000 per annum which we think ought to be distributed over the actual production. The incidence per ton for profit will be Rs. 14·28. The fair selling price will be Rs. 241·75 made up as follows:—

	Rs.
Works cost (*ex* godown)	202·54
Overhead charges and profit	39·21
Fair selling price	241·75

46. There are two other chemicals in respect of which Messrs. Dharamsi Morarji Chemical Company have applied for protection. These are sodium sulphide and zinc chloride. Up to the present, however, these chemicals have been made in such small quantities that no useful results can be obtained from the present works costs and we therefore do not propose to examine them.

Sodium sulphide and zinc chloride.

47. In the preceding paragraphs we have accepted the actual works costs of the Company and by adding what we consider reasonable amounts for overhead charges and profit, have arrived at the present fair selling price of each of the chemicals under investigation. We are now in a position to see whether the industry fulfils the second condition of the Fiscal Commission, namely whether the industry is one which without protection is not likely to develop at all or is not likely to develop as rapidly as is desirable in the interests of the country. For this purpose we propose to compare the fair selling prices with the actual realised prices, as given in the applicants' replies to our questionnaire. The following table gives the necessary figures. Chamber acid has not been included as it is not sold as such except in very small quantities:—

Second condition of Fiscal Commission fulfilled.

Chemicals.	Production.	Works cost per ton.	Realised market price per ton.	Difference between columns 3 and 4.	Loss or profit.	Fair selling price.	Difference between fair selling price and the market price: Columns 4 and 7.	Total loss or profit.
1	2	3	4	5	6	7	8	9
	Tons.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Rectified oil of vitriol .	681*	206*	196*	—10	—6,810	231	—35	—23,835
Nitric acid . .	70*	967*	790*	—177	—12,390	1,110*	—320	—22,400
Hydrochloric acid .	20*	927*	1,182*	+255	+5,100	1,152*	+30	+600
Glauber's salts . .	100	88	66	—22	—2,200	105	—39	—3,900
Epsom salts . .	130	144	81	—63	—8,190	175	—94	—12,220
Copperas . . .	215	74	81	+7	+1,505	86	—5	—1,075
Copper sulphate .	35	658	420	—238	—8,330	724	—304	—10,640
Alumino ferric . .	65	119	90	—29	—1,885	129	—39	—2,535
Potashalum . .	350	203	142	—61	—21,350	242	—100	—35,000
					—54,550			—1,11,005

* Calculated on 100 per cent. basis.

From the above figures it will be seen that if sulphuric acid is taken at Rs. 105 per ton, that is to say, at a price which after covering all the charges would leave the manufacturer a reasonable profit, the only chemicals of which the present market prices will cover the bare works costs are copperas and hydrochloric acid, and therefore even with the existing revenue duties the industry is manufacturing at a heavy loss. The total loss of the industry without allowing for overhead charges would amount to Rs. 54,550. In our estimate we have allowed for a profit of Rs. 12·5 per ton on the sulphuric acid used in the manufacture of the other chemicals. The

quantity of sulphuric acid manufactured by this Company in 1926-27 was about 1,200 tons and the profit on this would amount to Rs. 15,000. If the whole of this profit were credited to the other chemicals, there would still be a net loss of Rs. 39,550 on the works costs alone. But, if an industry is to develop or to continue to exist for any considerable period, it must earn in addition to the works cost at least the overhead charges. On the year's output the profit included by us in our fair selling prices of chemicals other than chamber acid would amount to Rs. 17,000 and the net loss therefore to the industry would amount to Rs. 79,000, *i.e.*, Rs. 1,11,000 less (Rs. 17,000+15,000). This, however, is not the full measure of the loss for it must be recollected that both in the case of depreciation and profit we have based our calculations not upon the actual production, but upon such a production as would in our opinion have represented an economic output, though in fact the quantities produced fell in many cases far short of that amount. In these circumstances it is quite certain that the industry cannot possibly develop and would in the natural course cease to exist if no protection were granted. It is clear, therefore, that the second condition of the Fiscal Commission is substantially fulfilled.

Present costs no basis for proposals.

48. We have now to consider whether it is possible to formulate any proposals for protection on the basis of the costs of the industry as organised at present. As regards the three acids, sulphuric acid, nitric acid and hydrochloric acid, there is no serious application for protection, because the imports of these acids have so far been negligible. It is true that in the course of the oral examination evidence was given that recently His Majesty's Mint in Bombay had purchased 200 tons of nitric acid from Germany at Rs. 490 per ton 100 per cent. acid delivered at the Mint, a price that is so low as to render it impossible for any Indian factory to compete. It appears, however, that difficulties were experienced in decanting the acid from the metal containers in which it was imported and as a result orders have recently been placed with the Eastern Chemical Company for nitric acid at Rs. 750 per ton. As regards the remaining chemicals, however, the position is very different and large quantities are imported. The following table shows the fair selling prices, the latest c.i.f. landed prices, and the specific duty required per ton to equalise the two:—

	Fair selling price.	C.i.f. landed price.	Specific duty.
	Rs.	Rs.	Rs.
Glauber's salts	105	37	68
Epsom salts	175	57	118
Copperas	86	71	15
Copper sulphate	724	382	342
Alumino-ferric	129	66	63
Potash alum	242	120	122

It will be seen that the lowest duty required is over 20 per cent. and the highest over 200 per cent. Even in the case of a key industry we could not contemplate the imposition of protective duties on this scale nor would it be fair to the numerous industries dependent on the use of chemicals to inflict so heavy a burden on them. But apart from this the imposition of duties on this scale would tend to perpetuate the organization of the industry in small units which we hold to be uneconomic and contrary to modern principles of manufacture.

Causes of present small scale production.

49. The position will be made clearer if we set forth at this point the causes which have led to the constitution of small units of manufacture or, where larger units have been constituted, to restriction of output within small limits. The first cause is, as we have indicated in our opening chapter, the high natural protection afforded by the heavy sea freights on acids. It has proved profitable to manufacture acids at a high cost which in relation to the manufacture of the other chemicals which we are considering is definitely uneconomic. For the same reason it has been considered advantageous by the larger factories to divide a limited market among themselves. Thus, although either the Eastern Chemical Company or the Dharamsi Morarji Chemical Company is capable of supplying the whole of the Bombay market, by arrangement the market is divided between them, each producing a limited amount of chemicals at a high cost. Obviously it would be impossible to base any measure of protection on artificial arrangements of this nature. The second cause is the high inland freight, particularly on acids, which has made it difficult for the larger factories at the ports to compete in up-country markets with local units and so to increase their output. The third reason is the fall in price of imported chemicals which has created a feeling of uncertainty and induced a cautious and hesitating attitude on the part of manufacturers. The present difficulties of the chemical industry are also partly the result of misconception of the possibilities of the industry which we trust our report will do something to remove. We wish to say definitely that in our opinion the chemical industry in India can have no future so long as manufacture is carried on in small units with low production. As regards high inland freight, we shall have more to say in a later chapter. The feeling of insecurity as to the future can be removed by the grant of protection and an assurance that, if necessary, steps will be taken to prevent the dumping of chemicals by foreign countries. In the next chapter we propose to consider what production an Indian manufacturer can reasonably expect to attain in the immediate future if protection is granted and at what cost each chemical could then be produced.

CHAPTER IV.

Estimate of future costs.

Basis of estimates.

50. We have taken the costs of the Dharamsi Morarji Works as typical of the present cost of the manufacture of chemicals in India and we propose in framing our estimates of the future costs to confine ourselves in this chapter to a consideration of the market in Western India. In Chapter II we discussed the market for chemicals in India and found that the demand in the Bombay Presidency for the chemicals that we are considering amounted to about 6,000 tons in terms of sulphuric acid. The present manufacture in Bombay and Ambernath amounts to about 2,000 tons. If protection were granted, we consider that during the period of protection the industry should attain an average annual production of 4,000 tons. For the reasons already given we propose to frame our estimates on the assumption that a single factory supplies the whole demand. Though it is possible to make some estimate of the quantity of sulphuric acid which on an average may be produced in this part of India in the next few years, we think that no reasonable estimate is possible of the proportion in which the production of each of the other chemicals will increase during the period. Clearly the object of the manufacturer will be to increase his output of sulphuric acid and consequently to reduce the cost both of this acid and of the chemicals made from it. For this purpose the manufacturer may find it to his advantage to concentrate for a time on the production of some chemicals to the exclusion of others. In estimating the future cost we propose to assume that the average production of sulphuric acid will be 4,000 tons but that as regards other chemicals the production of each will be on such a scale as to absorb the whole available market for that chemical.

Anticipated economies and other modifications.

51. In making our future estimates we have given full weight to the opinions of the two principal applicants. We have also had the opportunity of ascertaining the views of other manufacturers. The figures which we give have been generally accepted by the applicants as reasonable. In the majority of cases we have allowed for a saving in cost owing to improved practice and consequent economy in raw materials, fuel or both. In some instances the saving anticipated is very large. For example in the manufacture of hydrochloric acid (100 per cent. basis) the consumption of salt

is reduced from 3·3 tons to 2·2 tons and that of sulphuric acid from 3·0 tons to 1·5 tons. These new figures have been accepted by the manufacturers in Bombay and appear to be reasonable. They are in fact, even on this reduced basis, somewhat behind good European practice. The very large saving is due partly to the fact that we expect greater efficiency in the recovery of hydrochloric acid and partly because it is essential for economic working that more effective utilisation than has been effected up to the present should be made of the sulphuric acid used in this process. This can be effected by means of a higher temperature of working than has apparently hitherto been usual in this country. By this means not only will less sulphuric acid be used but the salt cake will be of better quality, *i.e.*, it will be a nearly neutral salt cake instead of the highly acid salt cake at prseent made. As a consequence of this it may be possible in future to find a market for salt cake, for example for the manufacture of glass and, even if this is not so, the salt cake will be much better adapted for the manufacture of sodium sulphide and Glauber's salts. In the latter case almost all the soda ash at present used in neutralising the cake will be saved, resulting in a considerably lower price for the salts. An analogous saving may be expected in the case of nitre cake from nitric acid manufacture. Although it is not possible to obtain a neutral nitre cake in this process, it is quite practicable to transfer the acid nitre cake to the hydrochloric acid plant, thus effectively utilising the sulphuric acid that it contains and in this instance also obtaining eventually a neutral salt cake. This makes it possible to allow a considerable credit for the nitre cake remaining in the nitric acid stills and thus to reduce the cost of nitric acid by nearly ten per cent. In our estimate of the cost of manufacture of copper sulphate we have again taken only half the quantity of sulphuric acid now used. The present method is admitted to be wasteful of sulphuric acid and it has been agreed that this saving is feasible. On the other hand in certain cases the figures proposed by the manufacturers appear to us to be too low and we have thought it necessary to raise them somewhat. The applicants, for instance, claim selling charges that amount on the whole output to less than Rs. 30,000. We think that the total allowance on account of selling charges should not be less than Rs. 50,000. In some cases the incidence of these charges, even on this enhanced basis, may appear very low in comparison with the incidence of the present charges given in Chapter III. This is due to the fact that these present charges are extremely high and have had to be distributed over a very small output. As regards overhead charges and profit we have taken depreciation as usual at 6¼ per cent. on the block value and interest at 7½ per cent. on the working capital on a six months turnover, excluding as previously explained the cost of the sulphuric or hydrochloric acid used in the manufacture of any chemical. For head office expenses and agents' commission we have as before taken a lump sum of Rs. 25,000 for chamber sulphuric acid, and for other chemicals, as explained in Chapter III, 6¼ per cent. of the works cost.

Chamber sulphuric acid.

52. Our estimate of the future cost of chamber sulphuric acid on an average production of 4,000 tons is as follows:—

	Rs.	Rs.
Raw materials—		
Sulphur ·35 ton at Rs. 105	36·75	
Nitre ·01 ton at Rs. 180	1·80	
		38·55
Labour	·87	
Power and fuel	1·45	
Repairs and renewals	2·00	
General services and supervision . . .	2·50	
Rent, taxes, insurance, etc.	·50	
		7·32
Works cost (naked)		45·87

A comparison with the estimate in paragraph 32 will show that there are substantial reductions both in the cost of the raw materials and in the cost above raw materials when the production increases from 1,200 tons to 4,000 tons per annum. The cost of sulphur falls from Rs. 41·60 to Rs. 36·75. This is due partly to a reduction in the price of sulphur from Rs. 116 to Rs. 105 delivered at the works, but partly also to less wastage resulting from continuous working of the plant. Sulphur purchased in small quantities and at long intervals necessarily implies a higher price than if it is purchased in large quantities over definite periods. The same arguments apply to the reduction in the cost of nitre which falls from Rs. 2·49 to Rs. 1·80. The largest economies, however, occur in the cost above materials. In 1926-27 as a result of interrupted working extra expenditure of Rs. 31,000 was incurred. The allocation to sulphuric acid on this account was Rs. 5·6 per ton and no such allowance is necessary in our estimate of the future cost either of sulphuric acid or of any other chemical. In labour also there is a substantial saving largely owing to the fact that there will be little increase in the labour force though the production will increase to three times the present output. As regards repairs and renewals sulphuric acid plant deteriorates considerably during the period of disuse. With a production of 4,000 tons working will be continuous and we have therefore reduced the incidence per ton under repairs and renewals from Rs. 4·50 to Rs. 2. General services and supervision charges have been reduced by half since there will be little or no additional expenditure in consequence of the increase

in production. In order to obtain the fair selling price of sulphuric acid we have to make the following additions:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 5,00,000	31,250
Interest on working capital, 7½ per cent. on Rs. 1,00,000	7,500
Head office expenses and agents' commission	25,000
Profit, 10 per cent. on Rs. 5,00,000	50,000
	1,13,750

	Rs.
Incidence per ton	28·44
Works cost (naked)	45·87
Fair selling price	74·31

or say in round figures Rs. 75 per ton.

It is frequently stated that the works cost of sulphuric acid in Europe is about £2 a ton and it may be thought that the figure at which we have arrived therefore compares very unfavourably with European costs. In making any such comparison it is, however, necessary to bear in mind that the European cost is for chamber acid of about 65 per cent. strength, while our estimate is for acid on a 100 per cent. basis. £2 a ton for 65 per cent. acid corresponds to £3-1-6 (or Rs. 41) on a 100 per cent. basis.

Rectified oil of vitriol.

53. The production of rectified oil of vitriol in 1926-27 was 681 tons. Our estimate of the market is not less than 1,500 tons per annum. Our estimate of the future works cost is as follows:—

	Rs.	Rs.
Raw materials—		
Chamber sulphuric acid, 1·1 ton at Rs. 75 per ton	82·50	
		82·50
Labour	3·00	
Power and fuel	6·50	
Repairs and renewals	5·00	
General services and supervision, rent, taxes, insurance, etc.	3·00	
		17·50
Selling charges	8·00	
Packing (excluding cost of containers)	10·00	
		18·00
Works cost (*ex* godown)		118·00

The following charges have to be added in order to arrive at the fair selling price:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 1,00,000	6,250
Interest on working capital, 7½ per cent. on Rs. 27,000	2,025
Head office expenses and agents' commission	3,375
Profit, 10 per cent. on Rs. 1,00,000	10,000
	21,650

	Rs.
Incidence per ton	14·43
Works cost (*ex* godown)	118·00
Fair selling price	132·43

With increased production the fair selling price comes down from Rs. 230·71 to Rs. 132·43. This is largely due to the reduction of the cost of chamber acid and of the selling charges. There are also substantial economies in power and fuel and there is no allocation for the non-working period.

Nitric acid.

54. The production of nitric acid of 70 per cent. strength in 1926-27 was 100 tons. We are, however, calculating our future costs on a 100 per cent. basis and according to our estimate the total market available is about 150 tons excluding the requirements of His Majesty's Mint, Bombay. Our estimate of the future cost is as follows:—

	Rs.	Rs.
Raw materials—		
Nitre 1·43 tons at Rs. 180	257·40	
Sulphuric acid 1·52 tons at Rs. 75	114·00	
		371·40
Labour	22·00	
Power and fuel	25·00	
Repairs and renewals	25·00	
General services and supervision, rent, taxes, insurance, etc.	60·00	
		132·00
Selling charges	8·00	
Packing (excluding cost of containers)	13·00	
		21·00
		524·40
Less 1·8 tons nitre cake at Rs. 32		57·60
Works cost (*ex* godown)		466·80

It will be seen that the cost of materials has fallen by about Rs. 200. This reduction is mainly due to the lower price of sulphuric acid and to the fact that we have taken Glover tower acid in place of rectified oil of vitriol the use of which is unnecessary in the manufacture of nitric acid of so low a strength as 70 per cent. The remainder of the reduction is due to an estimated lower price for nitre, *viz.*, Rs. 180 in place of Rs. 200. There is no allocation for non-working period. Selling charges are reduced from Rs. 176 to Rs. 8. Overhead charges and profit decrease with the increased output from Rs. 143 to Rs. 86 as follows:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 45,000 . . .	2,812
Interest on working capitals, 7½ per cent. on Rs. 28,000	2,100
Head office expenses and agents' commission . .	3,500
Profit, 10 per cent. on Rs. 45,000	4,500
	12,912

	Rs.
Incidence per ton	86·08
Works cost (*ex* godown) . . .	466·80
Fair selling price .	552·88

Hydrochloric acid.

55. The production of hydrochloric acid (33 per cent. strength) in 1926-27 was only 60 tons which is equal to 20 tons on a 100 per cent. basis. The total market for hydrochloric acid sold as such in this part of India is probably 75 tons on a 100 per cent. basis. Our estimate of the future production is 600 tons on the assumption that Glauber's salts, sodium sulphide and zinc chloride are also manufactured. For the production of Glauber's salts and sodium sulphide the principal raw material is salt cake and for zinc chloride the principal raw material is hydrochloric acid. If 600 tons of hydrochloric acid are manufactured from salt and sulphuric acid, about 1,320 tons of salt cake will be obtained. If, however, as we anticipate, part of this acid is made by utilising the nitre cake from the nitric acid stills, the output of salt cake will be somewhat increased, since the nitre cake contains some 60 per cent. of sodium sulphate. We have allowed for a production of 150 tons of nitric acid and the nitre cake corresponding to this will cause an increase of about 165 tons in the production of salt cake, making 1,485 tons in all. The manufacture of 1,000 tons of sodium sulphide will absorb about 1,300 tons of salt cake while 300 tons of Glauber's salts will require 165 tons of salt cake, or 1,465 tons in all, an

amount approximately equal to the expected salt cake production. Our estimate of the future cost is as follows:—

	Rs.	Rs.
Raw materials—		
Salt 2·2 tons at Rs. 12 per ton	26·40	
Sulphuric acid 1·5 tons at Rs. 75 per ton	112·50	
		138·90
Labour	25·00	
Power and fuel	50·00	
Repairs and renewals	25·00	
General services and supervision, rent, taxes, insurance, etc.	5·00	
		105·00
Selling charges	4·00	
Packing	30·00	
		34·00
		277·90
Less Salt cake 2·2 tons at Rs. 20 per ton		44·00
Works cost (*ex* godown)		233·90

Although in good European practice the amount of salt used would not be more than 2·0 tons we have allowed 2·2 tons. We consider this allowance necessary as the grade of salt used in Bombay contains considerably more moisture and other impurities than the salt generally used in Europe. The cost of materials fell from Rs. 400 to Rs. 139 and the cost above materials from Rs. 455 to Rs. 105. We have already explained the reason for the fall in the cost of materials and the fall in costs above materials is mainly due to the economy expected under the heading "power and fuel" as a result of continuous working. There is no allocation for non-working period and the selling charges have been reduced from Rs. 210 to Rs. 4. The following charges must be added to arrive at the fair selling price:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 1,50,000	9,375
Interest on working capital, 7½ per cent. on Rs. 36,000	2,700
Head office expenses and agents' commission	4,500
Profit, 10 per cent. on Rs. 1,50,000	15,000
	31,575

	Rs.
Incidence per ton	52·63
Works cost (*ex* godown)	233·90
Fair selling price	286·53

56. The production of Glauber's salts in 1926-27 was 100 tons. Our estimate of the market is 300 tons and our estimate of the future works cost is as follows:—

Glauber's salts.

	Rs.	Rs.
Raw materials—		
Salt cake ·50 ton at Rs. 20 per ton	10·00	
Soda ash ·01 ton at Rs. 140 per ton	1·40	
Lime ·02 ton at Rs. 60 per ton	1·20	
Bleaching powder ·004 ton at Rs. 125 per ton	·50	
		13·10
Labour	2·00	
Power and fuel	5·00	
Repairs and renewals	1·00	
General services and supervision	2·00	
Rent, taxes, insurance, etc.	·36	
		10·36
Selling charges	4·00	
Packing	5·00	
		9·00
Works cost (*ex* godown)		32·46

A comparison with the estimate in paragraph 40 will show that the cost has come down from Rs. 88 to Rs. 32. The cost of materials shows a reduction of Rs. 22 per ton. This is due to the fact that we have taken credit for salt cake at the rate of Rs. 20 per ton in place of Rs. 40 previously taken. Rs. 40 appears to us an excessive amount to allow in view of the fact that in India salt cake is a by-product for which there is at present no market. In England where salt cake is not a by-product but the main product, the market price is only £2-10-0 and it appears to us that in India we should allow considerably less. A further economy is anticipated owing to a very large reduction in the amount of soda ash used. As has been previously explained, this is due to the use of a nearly neutral salt cake in place of the highly acid salt cake made at present. A small quantity of bleaching powder has been added to allow of the oxidization of iron present in the salt cake preparatory to its precipitation with lime. A substantial reduction has also been made in the selling charges, which are reduced from Rs. 16 to Rs. 4. In order to arrive at the fair selling price the following charges have to be added:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 15,000	937
Interest on working capital, 7½ per cent. on Rs. 4,875	365
Head office expenses and agents' commission	609
Profit, 10 per cent. on Rs. 15,000	1,500
	3,411

	Rs.
Incidence per ton	11·37
Works cost (*ex* godown)	32·46
Fair selling price	43·83

Sodium sulphide.

57. The production of sodium sulphide in 1926-27 was small. Our estimate of the future market is 1,400 tons but in the manufacture of this amount more salt cake would be required than will be available from the manufacture of 600 tons of hydrochloric acid, and we propose, therefore, to base our estimate on a production of 1,000 tons only. Our estimate of the future cost is as follows:—

	Rs.	Rs.
Raw materials—		
Salt cake 1·3 tons at Rs. 20 per ton . .	26·00	
Coal dust ·7 ton at Rs. 20 per ton . .	14·00	
		40·00
Labour	12·00	
Power and fuel	35·00	
Repairs and renewals	4·00	
General services and supervision, rent, taxes, insurance, etc.	5·00	
		56·00
Selling charges	4·00	
Packing	15·00	
		19·00
Works cost (*ex* godown) .		115·00

The following charges must be added in order to get the fair selling price:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 1,00,000 . . .	6,250
Interest on working capital, 7½ per cent. on Rs. 57,500	4,313
Head office expenses and agents' commission . .	7,187
Profit, 10 per cent. on Rs. 1,00,000	10,000
	27,750

	Rs.
Incidence per ton	27·75
Works cost (*ex* godown)	115·00
Fair selling price .	142·75

Zinc chloride.

58. The production of zinc chloride in 1926-27 was very small. Our estimate of the future market for this chemical is 1,000 tons. We anticipate that it will be possible to obtain zinc for the manufacture of zinc chloride from by-products of the galvanizing industry. The Tata Iron and Steel Company, Limited, estimates that about 200 tons of skimmings and 100 tons of zinc ash are likely to be available. These contain about 65 per cent. and 50 per cent. respectively of zinc. The balance may be made up from zinc dross containing about 93 per cent. of zinc. From information given us we calculate

that the average price of the zinc used will in these circumstances be Rs. 272 per ton. Our estimate of the future cost is as follows:—

	Rs.	Rs.
Raw materials—		
Zinc ·50 ton at Rs. 272 per ton . .	136·00	
Hydrochloric acid ·57 ton at Rs. 253 per ton	144·21	
		280·21
Labour	4·50	
Power and fuel	5·00	
Repairs and renewals	1·00	
General services and supervision, rent, taxes, insurance, etc.	2·50	
		13·00
Selling charges	4·00	
Packing	15·00	
		19·00
Works cost (*ex* godown) .		312·21

In order to obtain the fair selling price, the following charges have to be added:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 60,000 . . .	3,750
Interest on working capital, 7½ per cent. on Rs. 84,000	6,300
Head office expenses and agents' commission . .	10,500
Profit, 10 per cent. on Rs. 60,000	6,000
	26,550

	Rs.
Incidence per ton	26·55
Works cost (*ex* godown)	312·21
Fair selling price .	338·76

59. The total production of epsom salts in 1926-27 was only 130 tons. Our estimate of the total demand is 2,000 tons and our estimate of the future cost is as follows:—

Epsom salts.

	Rs.	Rs.
Raw materials—		
Magnesite ·38 ton at Rs. 40 per ton . .	15·20	
Sulphuric acid ·42 ton at Rs. 75 per ton .	31·50	
		46·70
Labour	3·00	
Power and fuel	7·50	
Repairs and renewals	2·50	
General services and supervision . . .	2·00	
Rent, taxes, insurance, etc.	·50	
		15·50
Selling charges	4·00	
Packing	5·00	
		9·00
Works cost (*ex* godown) . .		71·20

A comparison with the estimate in paragraph 41 will show that, when the plant reaches its full output, the cost will be reduced from Rs. 144·27 to Rs. 71·20. During 1926-27 owing to the small production there was a considerable waste of raw materials and although we take our raw materials at slightly cheaper rates, the main reduction in the cost of materials from Rs. 80 to Rs. 47 is due to more economical working. In the cost above materials also there is a reduction of nearly Rs. 20, from Rs. 34·47 to Rs. 15·5. The following charges have to be added to the works cost to arrive at the fair selling price:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 80,000	5,000
Interest on working capital, 7½ per cent. on Rs. 40,000	3,000
Head office expenses and agents' commission	5,000
Profit, 10 per cent. on Rs. 80,000	8,000
	21,000

	Rs.
Incidence per ton	10·50
Works cost (*ex* godown)	71·20
Fair selling price	81·70

60. The production of copperas in 1926-27 was 215 tons but the demand according to our estimate is 500 tons. Our estimate of the future cost is as follows:—

Copperas.

	Rs.	Rs.
Raw materials—		
Iron scrap ·25 ton at Rs. 10 per ton	2·50	
Sulphuric acid ·4 ton at Rs. 75 per ton	30·00	
		32·50
Labour	1·50	
Power and fuel	11·00	
Repairs and renewals	2·00	
General services and supervision	2·50	
Rent, taxes, insurance, etc.	0·30	
		17·30
Selling charges	4·00	
Packing	5·00	
		9·00
Works cost (*ex* godown)		58·80

Owing to the increased production there will be a reduction of about Rs. 16 per ton. This is mainly due to the reduction in the cost of sulphuric acid and to the lower selling charges. No economy in materials can be expected. On the contrary we have allowed somewhat greater quantities of raw materials than those given for present practice. The latter figures approximate closely

to theoretical requirements and it does not appear possible to us for manufacturers to obtain so high an efficiency particularly in working with a material such as scrap iron. In order to arrive at the fair selling price we have to make the following additions:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 15,000	937
Interest on working capital, 7½ per cent. on Rs. 7,200	540
Head office expenses and agents' commission	900
Profit, 10 per cent. on Rs. 15,000	1,500
	3,877

	Rs.
Incidence per ton	7·75
Works cost (*ex* godown)	58·80
Fair selling price	66·55

61. The production of copper sulphate in 1926-27 amounted to only 35 tons, but our estimate of the market is 250 tons. Our estimate of the future works cost is as follows:—

Copper sulphate.

	Rs.	Rs.
Raw materials—		
Copper scrap ·27 ton at Rs. 900 per ton	243·00	
Sulphuric acid R. O. V. ·44 ton at Rs. 115 per ton	50·60	
		293·60
Labour	10·00	
Power of fuel	10·00	
Repairs and renewals	3·50	
General services and supervision	5·00	
Rent, taxes, insurance, etc.	1·50	
		30·00
Selling charges	32·00	
Packing	5·00	
		37·00
Works cost (*ex* godown)		360·60

A comparison of the above estimate with that in paragraph 43 will show that there is a drop of nearly Rs. 300 in the works cost. The cost of materials has fallen by more than Rs. 80 in spite of the fact that a considerably higher price has been allowed for copper scrap. The price of the copper scrap actually used in 1926-27 was exceptionally low, *viz.*, Rs. 765 a ton. In our estimate for the future we assume a price of Rs. 900 a ton. The lower cost of materials is due to the lower price of rectified oil of vitriol and the fact that the quantity required has been reduced by approximately fifty per cent. The cost above materials has dropped from

Rs. 149·37 to Rs. 30. More than half of this difference is due to the absence of any allocation for a non-working period. In the selling charges there is a difference of Rs. 92. The following charges have to be added in order to arrive at the fair selling price:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 14,000	875
Interest on working capital, 7½ per cent. on Rs. 38,750	2,906
Head office expenses and agents' commission	4,844
Profit, 10 per cent. on Rs. 14,000	1,400
	10,025

	Rs.
Incidence per ton	40·10
Works cost (*ex* godown)	360·60
Fair selling price	400·70

62. The production of alumino-ferric in 1926-27 was 65 tons. Our estimate of the market is 500 tons and the future works cost may be estimated as follows:—

Alumino-ferric.

	Rs.	Rs.
Raw materials—		
Bauxite ·36 ton at Rs. 16 per ton	5·76	
Sulphuric acid ·47 ton at Rs. 75 per ton	35·25	
		41·01
Labour	10·00	
Power and fuel	11·00	
Repairs and renewals	3·50	
General services and supervision	1·00	
Rent, taxes, insurance, etc.	0·20	
		25·70
Selling charges	4·00	
Packing	1·00	
		5·00
Works cost (*ex* godown)		71·71

Owing to increased production the works cost comes down from Rs. 118·75 to Rs. 71·71. This is largely due to there being no allocation for a non-working period, to the reduction in the cost of sulphuric acid and to the lower selling charges. The following charges have to be added in order to obtain the fair selling price:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 5,000	312
Interest on working capital, 7½ per cent. on Rs. 9,000	675
Head office expenses and agents' commission	1,125
Profit, 10 per cent. on Rs. 5,000	500
	2,612

	Rs.
Incidence per ton	5·22
Works cost (*ex* godown)	71·71
Fair selling price	76·93

63. The production of potash alum in 1926-27 was 350 tons. Our estimate of the market is 2,000 tons and our estimate of the future cost is as follows:—

Potash alum.

	Rs.	Rs.
Raw materials—		
Bauxite ·30 ton at Rs. 16 per ton	4·80	
Sulphuric acid ·38 ton at Rs. 75 per ton	28·50	
Potassium sulphate ·21 ton at Rs. 165 per ton	34·65	
		67·95
Labour	10·00	
Power and fuel	15·00	
Repairs and renewals	5·00	
General services and supervision	2·00	
Rent, taxes, insurance, etc.	·66	
		32·66
Selling charges	4·00	
Packing	5·00	
		9·00
Works cost (*ex* godown)		109·61

A comparison with the estimate in paragraph 45 will show that with the increased output the works cost comes down from Rs. 202·54 to 109·61. The fall in the cost of raw materials is due to the reduction in the cost of sulphuric acid and lower railway freight on bauxite. The largest reductions however are in the cost above materials and in the selling charges. These are due to the increased output. In labour alone there is a saving of more than Rs. 14 and in the selling charges of Rs. 30 per ton. In order to obtain the fair selling price the following charges have to be added:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 1,00,000	6,250
Interest on working capital, 7½ per cent. on Rs. 80,000	6,000
Head office expenses and agents' commission	10,000
Profit, 10 per cent. on Rs. 1,00,000	10,000
	32,250

	Rs.
Incidence per ton	16·12
Works cost (*ex* godown)	109·61
Fair selling price	125·73

64. We are now in a position to determine whether an output of 4,000 tons which the industry should reach in the next few years if adequate protection is granted, affords a reasonable basis for submitting proposals to Government. For this purpose it is necessary to make

Assistance required.

a comparison between our estimate of the future fair selling prices and the c.i.f. landed prices of the various chemicals. The prices given in column 3 of the following table are the latest available figures based either on actual transactions or on c.i.f. prices supplied to us by the principal importers. In the latter cases we have added Rs. 5-8-0 per ton to cover landing, clearing and cartage charges. We have made no addition for importers' commission as we understand that this commission is included in the c.i.f. price.

Chemicals.	Fair selling price.	C.i.f. landed price.	Assistance required per ton.	*Ad valorem* duty.
	2	3	4	5
	Rs.	Rs.	Rs.	Per cent.
Glauber's salts	43·83	37·00	6·83	19
Sodium sulphide	142·75	115·00	27·75	24
Zinc chloride	338·76	252·20	86·56	34
Epsom salts	81·70	56·80	24·90	44
Copperas	66·55	70·80	*nil.*	*nil.*
Copper sulphate	400·70	382·10	18·60	5
Alumino-ferric	76·93	66·00	10·93	17
Potash alum	125·73	120·50	5·23	4

The figures given in the table above show that copperas requires no protection: in the case of copper sulphate and potash alum the existing revenue duty of 15 per cent. will more than suffice: in the case of Glauber's salts, sodium sulphide and alumino-ferric a small addition to the duty would be necessary to afford full protection. Epsom salts and zinc chloride however stand on a different footing and the duties indicated are 44 and 34 per cent. respectively. We have considered whether in view of the present prices of acids, some reduction in the duty on these two chemicals may not be feasible. It is true that at present profits considerably in excess of the 10 per cent. on the capital outlay which has been allowed in the fair selling prices are obtained from the sale of acids. But in the process of reorganization of the industry, involving as it will, the elimination of the smaller units, considerable competition is inevitable and we anticipate that the present prices for acids will not be maintained. Indeed we consider that both in the interest of the industry and of the country, an appreciable reduction in price is desirable. Already a quotation as low as Rs. 490 a ton for imported nitric acid (100 per cent. basis) has been noted in Bombay while the c.i.f. price of imported rectified oil of vitriol has fallen to Rs. 160. In Calcutta the market price of rectified oil of vitriol has already fallen as low as Rs. 140 per ton. We have estimated the output of zinc chloride at 1,000 tons per annum which would require some 570 tons of hydrochloric acid for its manufacture. If the duty were not sufficient to ensure the manufacture of zinc chloride the output of hydrochloric acid would decline to some 70 tons per annum. The cost of making this acid would increase very largely in consequence and the profit from the

sale of it as such would decline. Further, no salt cake would be available for the manufacture of sodium sulphide and Glauber's salts and it is probable that the manufacture of these chemicals would also be discontinued. Moreover if there were no inducement to make epsom salts or zinc chloride, the output of sulphuric acid would decline; the cost of producing this acid would increase and in consequence the costs of all other chemicals in the production of which sulphuric acid forms an important constituent would rise. In this connection we desire to draw attention to paragraph 166 of our Report on the Steel Industry (1926) in which we emphasized the inter-connection of the duties which we proposed on the various classes of steel products. The position as regards chemicals is not dissimilar and the alteration of even one of the proposed duties may have unforeseen consequences both on the output and the cost of production of the other chemicals, thus vitiating the whole scheme of protection. For these reasons we consider that no reduction save such small alterations as may be required for rounding should be made in the scale of duties which our estimates indicate as suitable for epsom salts and zinc chloride. With regard to the other chemicals our estimates show that a duty approximating to the existing revenue duty would be suitable in the case of most of them. Potash alum and copper sulphate could be fully protected with a smaller duty and copperas does not require any protection. We do not however propose to recommend any reduction in the existing duties on these three chemicals. The existing duty on copperas is only $2\frac{1}{2}$ per cent. *ad valorem*. In a later chapter we have considered representations regarding the removal or reduction of the existing duties and have satisfied ourselves that such reductions as appear possible would have no appreciable effect on the costs of the industries in which these chemicals are used. Moreover as we recommend that the present revenue duty on chemicals in general should be retained, it would be anomalous to differentiate against these chemicals in respect of which we have received specific applications for protection. On the whole, therefore, we think that if on further examination it appears that the industry qualifies for protection, protective duties approximating to the present revenue duties are suitable except in the case of epsom salts and zinc chloride where the duty should be raised to 44 and 34 per cent. *ad valorem* respectively. In view of the severe foreign competition and the constant fall in prices we also recommend that in each case the *ad valorem* duty should be converted into a specific duty on the basis of the present c.i.f. landed price.

CHAPTER V.

Third condition of the Fiscal Commission.

65. It will appear from the last chapter that when an output of 4,000 tons of chemicals in terms of sulphuric acid is attained, the duties required to protect the industry would not, except in the case of epsom salts and zinc chloride, be much higher than the existing revenue duties. We have little doubt that in the course of the next few years it should with proper organization be possible to secure a market for this amount. Eventually, as we have explained in Chapter II, the market for chemicals of the kind we are considering should reach at least 8,000 tons in terms of sulphuric acid. We propose now to consider whether when this output is attained the industry will be able to dispense with protection thus fulfilling the third condition of the Fiscal Commission. We cannot say to what extent the output of each chemical will be increased and, to ensure that our estimate shall be on conservative lines, we propose for our present purpose to take into account only the reductions in cost resulting from the increase in the output of sulphuric acid. With double the output substantial economies may be expected: sulphur and nitre will be purchased in larger quantities and there should be some reduction in their costs: with continuous working at full capacity we may reasonably expect further improvement in working practice, and some slight further reduction in the quantities of raw materials required per ton of acid. There should be little or no increase on account of repairs and renewals and general services; the total of these charges may therefore be reduced from Rs. 4·5 to Rs. 2·5. Under the headings 'labour' and 'power and fuel' some slight reduction may be expected which we estimate at ·5 of a rupee. The incidence of rent will be reduced by half and the reduction under that head will amount to Re. ·25. Our estimate of the fair selling price will be as follows:—

Cost of sulphuric acid on 8,000 ton output.

	Rs.	Rs.
Raw materials—		
Sulphur ·34 ton at Rs. 100 per ton	34·00	
Nitre ·008 ton at Rs. 180 per ton	1·44	
		35·44
Labour	·70	
Power and fuel	1·12	
Repairs and renewals	1·00	
General services and supervision	1·50	
Rent, taxes, insurance, etc.	·25	
		4·57
Works cost (naked)	...	40·01

	Rs.
Depreciation, 6¼ per cent. on Rs. 5,00,000	31,250
Interest on working capital, 7½ per cent. on Rs. 1,60,000	12,000
Head office expenses and agents' commission	25,000
Profit, 10 per cent. on Rs. 5,00,000	50,000
TOTAL	1,18,250

	Rs.
Incidence per ton	14·78
Works cost (naked)	40·01
Fair selling price (naked)	54·79

The fair selling price of sulphuric acid (naked) will therefore be Rs. 54·79 or in round figures Rs. 55 per ton, a reduction of Rs. 20 per ton compared with the previous period.

Reduction in cost of other chemicals.

66. The fair selling prices of other chemicals will be reduced but it is difficult to make precise estimates of the extent. Except in the case of zinc chloride therefore where there are special circumstances which justify a further reduction, we propose to take into account merely the reduction which will result from the lower costs of the sulphuric acid, salt cake or nitre cake used. In our estimate of the fair selling price of zinc chloride on an output of 4,000 tons we have assumed that zinc ash and zinc skimmings will be used to an extent equivalent to 165 tons of zinc, the balance of the zinc required being obtained from zinc dross. The present outturn of galvanized sheets in the Tata Iron and Steel Company's works is about 17,000 tons while the market in India is about 350,000 tons. Unless the present policy of Government in regard to the protection of industries is to prove ineffective we must assume that eventually the steel industry will be firmly established and that the greater portion of the market for galvanized sheets will be supplied by the Indian manufacturer. It should then be possible to obtain all the zinc required for the manufacture of sufficient zinc chloride to meet the total demand of India from zinc ash and zinc skimmings and the average price per ton of zinc would fall from Rs. 272 to Rs. 139. The reduction in the works cost of zinc chloride which will result from the lower cost both of zinc and hydrochloric acid will be Rs. 77 and with a further reduction of Rs. 6-8-0 in the overhead charges the fair selling price will be reduced to

Rs. 254·63. When these reductions have been made the fair selling prices of the various chemicals will be as follows:—

Chemical.	Fair selling price on basis of 4,000 tons Sulphuric Acid.	Increase or reduction on account of			Net reduction.	Fair selling price on basis of 8,000 tons Sulphuric Acid.
		Sulphuric Acid.	Salt cake.	Nitre cake.		
Rectified oil of vitriol .	132·43	−22·0	...	...	−22·0	110·43
Nitric acid .	552·88	−30·4	...	+14·4	−16·0	536·88
Hydrochloric acid .	286·53	−30·0	+11·0	...	−19·0	267·53
Glauber's salts	43·83	...	− 2·75	...	− 2·75	41·08
Sodium sulphide .	142·75	...	− 6·5	...	− 6·5	136·25
Zinc chloride	338·76	...	...	...	...*	254·63*
Epsom salts .	81·70	− 8·4	...	...	− 8·4	73·30
Copperas .	66·55	− 8·0	...	...	− 8·0	58·55
Copper sulphate .	400·70	− 9·68	...	...	− 9·68	391·02
Alumino-ferric	76·93	− 9·4	...	...	− 9·4	67·53
Potash alum	125·73	− 7·6	...	...	− 7·6	118·13

N.B.—In 4,000 tons estimate credit for salt cake and nitre cake was taken at Rs. 20 and Rs. 32 respectively per ton: a reduction proportionate to the fall in price of sulphuric acid must be assumed and in the above table credit is taken at Rs. 15 and Rs. 24 respectively.

Ability of industry to dispense with protection.

67. We now propose to examine how the industry would stand if the full output of 8,000 tons of sulphuric acid were reached. In the following table we give the fair selling prices and c.i.f. landed prices:—

Product.	Fair selling price.	C.i.f. landed price.	Difference.
	Rs.	Rs.	Rs.
Rectified oil of vitriol . . .	110·43	...	...
Nitric acid	536·88	...	...
Hydrochloric acid	267·53	...	...
Glauber's salts	41·08	37·00	− 4·08
Sodium sulphide	136·25	115·00	− 21·25
Zinc chloride	254·63	252·20	− 2·43
Epsom salts	73·30	56·80	− 16·50
Copperas	58·55	70·80	+12·25
Copper sulphate	391·02	382·10	− 8·92
Alumino-ferric	67·53	66·00	− 1·53
Potash alum	118·13	120·50	+ 2·37

* Allowance, as explained in the text, has been made for the reduction

It will be seen from the above table that the fair selling prices of copperas and potash alum are below the c.i.f. landed prices: the fair selling prices of alumino-ferric, copper sulphate and zinc chloride are very nearly equal to the c.i.f. landed prices. These five chemicals, therefore, will require no protection even if in the future it proves feasible to remove the revenue duties. Epsom salts will still require protection of about Rs. 17 per ton but it must be recollected that the freight on magnesite at present amounts to Rs. 25 per ton which, as we shall point out later on, might well be reduced. Assuming a reduction of about Rs. 13 per ton there will be a fall in the cost of epsom salts of about Rs. 8 per ton thus reducing the amount of protection required to about Rs. 9 per ton. Sodium sulphide will require a duty of Rs. 21 per ton which amounts to a little over 18 per cent. *ad valorem;* and Glauber's salts a duty of Rs. 4 or 11 per cent. *ad valorem.* The position then is that when an output of 8,000 tons in terms of sulphuric acid is attained, out of the 11 chemicals which we are considering, the three acids and five of the eight salts will require no protection. Of the remaining salts one would require a duty well below the existing revenue duty. In the case of two only would a duty in excess of the revenue duty be required. We desire, however, to point out that our estimates take into account only reductions resulting from increased output of sulphuric acid and not of further economies which may result from an increased output of each chemical. It is impossible to estimate these since output is uncertain but it is obvious that they may be considerable. It appears to us therefore that if allowance is made for improved practice and economies resulting from increased output other than those in the manufacture of sulphuric acid which we have taken into account, it may fairly be claimed that when an 8,000 ton output is reached, the industry will be able to dispense with protection. Even if it appears on the estimates that in the case of one or two chemicals a portion of the revenue duty should still be retained, it does not necessarily follow that the industry considered as a whole could not dispense with protection. For at this stage when the industry is firmly established a manufacturer might well find it to his advantage in order to maintain his output, to surrender his profit on such chemicals and on the acids used in their manufacture, making good such deficit by the additional profit obtainable on the sale of other salts and of the acids. We think therefore that taking a broad view, even on an output of 8,000 tons of chemicals in terms of sulphuric acid, it may reasonably be held that the industry will be able to dispense with protection, while if the industry is reorganised on the lines suggested later, and a 16,000 ton output obtained, the position is even more favourable. We consider therefore that the conditions of the Fiscal Commission are fulfilled and that the Chemical industry qualifies for protection.

CHAPTER VI.

Main Proposals.

68. In paragraph 64 we have indicated the rates of protection required. Except in two cases where the specific duties proposed work out at 44 and 34 per cent. *ad valorem*, it is not proposed to exceed the present revenue duties to any great extent. We consider therefore that the rates are moderate and for a key industry such as the chemical industry we should be disposed to recommend them even if the Fiscal Commission's conditions were not strictly fulfilled. The specific duties required are set forth in the following table which also gives the equivalent *ad valorem* percentage on present c.i.f. landed prices.

Specific duties.

Product.	Specific duty per ton.	*Ad valorem* equivalent.
	Rs.	Per cent.
Sulphuric acid Nitric acid Hydrochloric acid	...	15
Glauber's salts	7	19
Sodium sulphide	28	24
Zinc chloride	86	34
Epsom salts	25	44
Copperas	2	2½
Copper sulphate	60	15
Alumino-ferric	11	17
Aluminium sulphate	...	17
Potash alum	18	15

We have stated elsewhere that there is no ground for the removal or reduction of the revenue duties. We therefore propose to retain specific duties on copper sulphate, potash alum, and copperas corresponding to the present revenue duties, *viz.*, Rs. 60, 18 and 2 per ton respectively.

Detailed recommendations.

69. Our detailed recommendations are as follows:—

Acids: we recommend specific duties equal to the present revenue duties on the commoner commercial varieties of the acids. In addition to these varieties, the acids appear on the market in various more expensive forms, on which it is not practicable to

levy appropriate specific duties. There are for example purified acids of various qualities, of which considerable quantities are sold. Sulphuric acid also appears on the market in what are conventionally known as strengths in excess of 100 per cent. (*i.e.*, containing free sulphur tri-oxide) and nitric acid is sold in the form of "fuming" acid. In view of these variations, we propose to retain the *ad valorem* duty of 15 per cent. in cases in which this is higher than the specific duty. An *ad valorem* duty alone is in our opinion inadvisable in view of the exceptionally low price at which nitric acid has recently been imported and of the possibility that other acids may also be imported at equally low rates.

Sodium sulphate: sodium sulphate is imported in two forms, *viz.*, dehydrated sodium sulphate and Glauber's salts or decahydrated sodium sulphate. The latter is the form in which the salt is manufactured in India and we propose a specific duty of Rs. 7 per ton thereon. The former is approximately 100 per cent. sodium sulphate as against 44 per cent. for the latter. The duty must be increased accordingly to Rs. 16. We propose that partially dehydrated sodium sulphate containing more than 50 per cent. of the anhydrous salt should bear the higher duty.

Sodium sulphide: sodium sulphide is imported mainly in the fused form. We propose the same duty for all forms, *viz.*, Rs. 28 per ton.

Zinc chloride: the ordinary commercial form of zinc chloride is approximately 100 per cent. pure and on this we propose a specific duty of Rs. 86. Zinc chloride is also sold in the form of solution. As such solutions may be very highly concentrated, we consider that they should bear the same duty as the solid salt.

Magnesium sulphate: the commercial form of this salt is the hydrated crystalline variety, epsom salts, on which we propose a protective duty of Rs. 25. It may however be imported in a dehydrated form. We therefore propose a higher duty of Rs. 50 on wholly or partially dehydrated salt.

Copperas: we propose to convert the existing revenue duty of $2\frac{1}{2}$ per cent. *ad valorem* into a specific protective duty of Rs. 2 per ton.

Copper sulphate: the commercial form of copper sulphate is the hydrated variety on which we propose a specific duty corresponding to the present revenue duty, *viz.*, Rs. 60. This is sufficiently high to cover possible evasion of the duty by the import of the dehydrated salt.

Aluminium sulphate: since iron free aluminium sulphate is chemically similar to alumino-ferric and the method of manufacture is also generally similar, we have not considered it necessary to make any separate examination of the cost of manufacture, but

we think that it should be protected. It will require a duty on the same basis as alumino-ferric, *viz.*, 17 per cent. *ad valorem*, or Rs. 16 per ton. We propose therefore separate specific duties for these two chemicals, distinguishing between them according to the iron content.

Potash alum: we recommend a specific duty corresponding to the present revenue duty of 15 per cent. *ad valorem*, *viz.*, Rs. 18. We propose the extension of the duty to ammonia alum and soda alum which may be used for the same purposes.

We show in Appendix I the amendments which will be necessary in Schedule II of the Indian Tariff Act if our recommendations are accepted.

Future course of import prices uncertain.

70. It will be observed that in case of only two chemicals, *viz.*, epsom salts and zinc chloride, are protective duties proposed considerably in excess of the present revenue duties. On these the high level of the duties has been rendered necessary by the very rapid fall in the price of the imported articles. For example in 1924-25 the value of epsom salts as recorded in the Seaborne trade returns stood as high as Rs. 155 per ton and that of zinc chloride at Rs. 369 as against the present landed prices of Rs. 57 and Rs. 252 respectively. Our proposals are based on the assumption that the import prices on which the measure of protection depends will not shew any substantial decline in future and may be expected to remain fairly stable. This assumption is not supported by the evidence. On the contrary the indications are that the future course of prices is entirely uncertain and that no reliable forecast is possible. This uncertainty regarding the course of prices may be ascribed in the main to two causes namely overproduction in European countries and the existence of combines in the chemical industry. The former has led to a general decline in the prices of chemicals throughout the world, while the latter is responsible for the specially low prices which are sometimes quoted in the Indian market as compared with other countries.

Overproduction in Europe.

71. Overproduction in Europe is the result very largely of the increase in the manufacturing capacity of the chemical industry during the war to meet the demand for munitions. Although many of the less efficient plants have since been closed, it is still true that the total sulphuric acid plant in European countries is very materially in excess of their requirements. Meanwhile the productive capacity of the larger plants is increasing as a result of improved processes and technique. Further though there is a larger demand for chemicals from such industries as the artificial silk industry, the motor, electrical engineering and fertiliser industries, some of the principal consuming industries are still in a state of depression. A natural result of this overproduction has been a rapid decline in prices and intense competition in foreign

markets. This is illustrated by the downward trend of import prices since 1922. The following table shows the Customs valuations for certain chemicals imported into India—

	1922-23 Rs. per ton.	1923-24 Rs. per ton.	1924-25 Rs. per ton.	1925-26 Rs. per ton.	1926-27 Rs. per ton.	1927-28 Rs. per ton.	Percentage of variation from highest to lowest prices.
Sodium sulphide . .	338	258	202	176	146	150	57
Zinc chloride . .	414	406	369	330	300	290	30
Epsom salts . . .	92	66	155	80	70	63	59
Copperas . . .	95	79	86	98	90	98	17
Copper sulphate . .	498	409	363	349	368	366	29
Aluminium sulphate .	154	136	99	75	80	78	51
Alum	225	189	161	141	130	128	43

Trusts.

72. Looking at the chemical industry in Europe as a whole the most striking feature is the dominating position of the two great combines namely Imperial Chemical Industries Limited in England, and the I. G. Farbenindustrie Aktiengesellschaft, Frankfurt in Germany. The policy of large amalgamations of this kind which cater for a world market, is to regulate prices in such a way that, while yielding a reasonable profit on the whole business, the prices vary in different countries according to local conditions, including local competition. We found in the case of the match industry that it was the policy of the Swedish Match Company to charge different prices in different markets and that in India where the competition of the local industry was felt chiefly in half size matches, imported matches of this class were sold at abnormally low prices. An illustration of similar methods is afforded by the practice of the German Magnesium Chloride Syndicate which in view of the competition of the Indian industry charges lower prices in India than in the United Kingdom in spite of the obvious large difference in freight to these two countries.

Effect on Indian prices.

73. For the chemical industry India offers a potential market capable of enormous development. The tendency to low import prices will become accentuated if the chemical industry is declared protected. So far Imperial Chemical Industries Limited and the I. G. Farbenindustrie Aktiengesellschaft have apparently not taken an active share in the trade with India in the chemicals which we are considering. The course of possible development is indicated by the figures in the table given below which has been supplied to us by the Dharamsi Morarji Chemical Company, Limited.

Materials.	English Quotations per ton.										C.I.F. Prices Bombay Port.									
	1924.			1925.			1926.			1927.			1928.			1924.			1925.			1926.			1927.			1928.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Potash Alum . . .	10	14	0	9	1	0	7	16	0	8	5	0	8	6	0	8	7	6	8	16	0	8	7	0	8	10	0	8	17	6
Alumina Sulphate 17-18 per cent.	9	2	0	6	14	0	5	9	0	5	10	0	5	8	0	7	18	3	7	7	0	5	18	9	5	17	0	7	2	6
Copperas	2	15	0	3	6	0	4	0	0	4	12	6	4	12	6	5	12	9	5	16	6	5	15	0	5	16	3	5	15	0
Copper Sulphate . . .	24	15	0	23	14	0	23	7	6	23	3	0	23	8	0	23	0	0	24	2	6	24	10	0	26	5	0	24	0	7
Zinc Chloride (solid) . .	24	7	0	23	15	0	23	15	0	24	15	0	24	15	0	24	10	0	27	5	0	22	15	0	22	0	0	20	10	0
Glauber's Salts . . .	3	18	0	4	0	0	4	0	0	4	0	0	4	0	0	5	0	0	4	10	3	4	15	0	4	6	3	4	0	0
Soda Sulphide (60-62 per cent.)	15	1	0	14	1	0	13	5	0	10	10	0	9	1	0	13	0	0	12	3	6	10	17	6	11	0	9	9	9	3
Epsom Salts . .	7	7	0	5	15	0	5	15	0	..			..			5	0	0	4	10	6	4	0	0	3	13	3	4	4	0

N.B.—In the above table the English prices for zinc chloride are for powdered zinc chloride which is approximately £1 per ton dearer than the fused variety imported into India.

If allowance is made for the freight to Bombay these figures indicate that much lower prices are generally charged for export to India for most of these chemicals. It may be argued that it is not an uncommon practice to fix export prices at a lower level than current internal prices and that this does not necessarily indicate unfair competition. But it will be seen from the table that in the case of the two chemicals on which we have had to propose substantial increases in duty, *viz.*, zinc chloride and epsom salts, the export prices are so low in comparison as to constitute strong *primâ facie* evidence of unfair competition. In any case whether the competition is unfair or not, the practice of selling at very low prices for the Indian market, if pursued, may seriously endanger the purpose which we have in view, namely, the establishment of the chemical industry in India.

Imposition of off-setting duties.

74. In our first Report on the Steel industry, paragraphs 33-38, we discussed the question of imposing additional duties if the import prices of steel fell below those on which the scheme of protection was based. The recommendations made in that Report were accepted by the Legislature in the Steel Industry (Protection) Act of 1924 and subsequently reaffirmed in the Act of 1927, and they are in our view applicable also to the chemical industry in its present state of development. We therefore propose that in any legislation undertaken to give effect to our proposals power should be conferred on the Governor General in Council, on being satisfied that chemicals are entering India at such prices as are likely to render the protection given ineffective, to impose such additional duties as he may consider necessary.

Period of protection.

75. It is not easy to determine what period of protection is required. As we have explained, in its present condition the industry is unable to meet foreign competition even with the scale of protection which we have proposed and considerable reorganization is required if the industry is to survive. The market also requires development and in view of the present depressed condition of the textile industry it is impossible to foresee the rate at which it will expand. Nor is it possible to forecast the course of foreign competition. The existence of large combines in Western Countries and the general depression in the chemical trade resulting from overproduction in Europe may not improbably necessitate a somewhat longer period of protection than would normally be required. On the whole therefore it appears to us desirable to propose no definite period of protection but to recommend that after seven years a fresh enquiry be held. At the end of that period it should be possible to forecast with greater certainty the prospects of the chemical industry in India, while the position of the industry in the main competing countries should by that time be stabilised.

CHAPTER VII.

Artificial Manures.

76. As we have stated elsewhere, there is a close connection between the heavy chemicals which we are considering in this report and two principal classes of artificial manures, namely, superphosphate and ammonium sulphate. It is primarily for this reason that we have decided to include in our report certain proposals regarding the manufacture of these fertilisers. But apart from its connection with the chemical industry, the production of artificial manures such as superphosphate and ammonium sulphate has a most important bearing on the development of Indian agriculture. This is an aspect of the question on which we desire to lay special emphasis. We think, therefore, that it may be useful, before explaining our proposals, to indicate briefly the essential part played in agriculture by these two fertilisers, particularly with reference to Indian conditions.

Connection with chemical industry.

77. A supply of nitrogen is essential for the growth of both animals and plants. The nitrogen required by plants is under natural conditions obtained from the air. In some cases nitrogen is absorbed directly from the air but more usually indirectly through the soil. Electrical discharges in the atmosphere form nitrogen oxides that are carried to the soil by means of rain. The world's requirements of crops are, however, more than can be obtained under these conditions. The nitrogen supply is in practice increased by manuring. Manuring with animal refuse returns to the soil a portion of the nitrogen taken from it but this is not sufficient and it is usual to supplement natural manures with artificial manures or fertilisers. The most important nitrogen-containing fertilisers are nitre (sodium nitrate) obtained principally from the deposits in Chili, cyanamide, an artificial product, and ammonium sulphate obtained by the combination of sulphuric acid with ammonia. Of these fertilisers that with which we are now concerned is ammonium sulphate. This is the most important of the fertilisers used in India. It contains a higher percentage of nitrogen than sodium nitrate. Further it can be and is already made in the country. In addition to nitrogen, plants require supplies of phosphoric acid. Plant growth is increased by supplying phosphoric acid in some available form. The fertiliser generally used is ' superhosphate '. This is made by the action of sulphuric acid on calcium phosphate. The calcium phosphate is thus converted into an acid phosphate, a material which is soluble in water and hence readily assimilable by the plant.

Use of artificial manures.

78. Indian soils do not appear to be exceptional as regards their requirements of these fertilisers. The Royal Commission on Agriculture found that all Indian soils were generally deficient in nitrogen. They ex-

Conditions in India.

plained that this deficiency was largely due to the failure of the ryot to utilise fully organic fertilisers, such as farmyard manure and green leaf, and also to the heavy rainfall which removes from the soil large quantities of nitrogenous matter. The Royal Commission on Agriculture also found that the laterite soils of India especially in the Peninsula and in Burma, which have been used for generations for the cultivation of rice, were particularly deficient in phosphates. When it is mentioned that there are in India nearly 80 million acres under rice, representing more than 35 per cent. of the land under cultivation, it will be realised what effect the deficiency of phosphates has on the prosperity of the country. A considerable amount of evidence on this point had been collected before the Royal Commission reported. Since its proceedings, a still larger volume of evidence has been collected which shows that the cropping value of Indian soil can be increased by a judicious use of artificial fertilisers. As far back as 1917 the Board of Agriculture appointed a Committee, upon which most of the principal provinces of India were represented, to enquire into the efficacy of manuring soil with phosphates and the possibility of procuring superphosphate in India at a figure which would render its application profitable to the cultivator. The Committee unanimously reported that a considerable amount of evidence had been collected with regard to the effects of phosphatic manuring in different provinces. It reported that in some of the provinces particularly Bengal, Assam, Burma and Madras there was a marked deficiency of phosphates and experiments with phosphatic manuring had resulted in very beneficial results to agriculture particularly in respect of paddy. The Committee also reported that, where sufficient supplies of phosphatic manures were not available, the supply of superphosphate in the immediate future appeared to be important and they recommended that special facilities should be considered to expedite either local manufacture or the import of this commodity. The report of the Committee is dated 28th February, 1918. Since that date experiments have been carried on at Pusa and in the principal provinces of India, notably in Madras, Burma and Bihar. We have examined the evidence recorded by the Royal Commission bearing on this point. We have also had the advantage of examining Dr. Clouston, Agricultural Adviser to the Government of India, Mr. Anstead, Director of Agriculture, Madras, and Mr. Hutchinson, Chief Scientific Adviser to the Imperial Chemical Industries in India, all of whom are officers of extensive experience. Subject to variation in local conditions for which due allowance must be made, the conclusions arrived at from an examination of the evidence may be briefly summarised as follows:—

(1) A combination of organic nitrogen, such as green manure, with superphosphate gives the highest yield.

(2) The continuous use of cattle manure greatly increases the cropping value of the land.

(3) Where green manure and cattle manure are not available, the use of artificial fertilisers has been found to be of great value particularly in respect of paddy, sugarcane, tea and rubber.

(4) By the use of superphosphate alone, the productivity of the soil has been increased by 30 to 40 per cent. which according to the value of the crop may represent a net profit per acre of several rupees.

(5) As regards artificial fertilisers the best results are obtained by the combined application of nitrogen and phosphoric acid in a soluble form and an increase of as much as 103 per cent. has been obtained in Burma on the Government experimental farm at Hmawbi representing a profit of more than Rs. 23 per acre.

Results of experiments.

79. In appendix IV we give the information supplied to us by Dr. Clouston in connection with the result of experiments with phosphatic manures in India. In appendix V we reproduce extracts from statements prepared by Mr. Anstead for the Royal Commission on Agriculture. In appendix VI we give a summary of the results obtained by Imperial Chemical Industries, Limited. An examination of these figures proves that even with the prices of artificial fertilisers at their present level, the benefit to the agriculturist is substantial. The points on which there is room for more satisfactory evidence are the proportions in which the two artificial fertilisers should be used, the times at which they should be applied and the manner of their application. The absence of exact information on these points does not affect the proposition that if artificial fertilisers are made available to the agriculturist at a reasonable price, the agricultural prosperity of India is likely to be rapidly advanced.

Ammonium sulphate.

80. Ammonium sulphate and superphosphate are used in agriculture throughout the world on a very extensive scale. The world's production of ammonium sulphate is about 3,500,000 tons and that of superphosphate about 14,000,000 tons. Their manufacture involves the consumption of 76 per cent. of the world's production of sulphuric acid. We have received no application for protection of ammonium sulphate and we should not therefore ordinarily consider this branch of the industry. The use of ammonium sulphate as a fertiliser is however closely connected with that of superphosphate. Some discussion of ammonium sulphate therefore appears necessary, if our survey of the subject is to be complete. Various processes are in use for the manufacture of ammonium sulphate. It can be produced by the action of ammonia (whether produced synthetically from the atmosphere or as a by-product) and carbon dioxide on gypsum. But the most common process and that exclusively in use in India is by scrubbing coke oven gases with sulphuric acid, thus removing the ammonia found free in such gases. The total

production of ammonium sulphate from Indian coke oven gases has now reached 15,000 tons annually and the total consumption of the country is now about double that figure. The use of this form of fertiliser has rapidly extended in recent years and the figures for the past five years are as follows:—

	1924	1925	1926	1927	1928
	Tons.	Tons.	Tons.	Tons.	Tons.
Local production . . .	12,555	13.340	14,555	13,451	15,082
Imports*	203	4,724	2,684	3,915	17,993
	12,758	18,064	17,239	17,366	33,075
Less exports* . . .	10,253	4,279	4,304	3,756	10
Approximate consumption .	2,505	13,785	12,935	13,610	33,065
	Rs.	Rs.	Rs.	Rs.	Rs.
Market price . . .	186	177	180	174	160

In the above table are included the average prices in each year. It will be observed that prices have been steadily falling and with this decline in prices the use of ammonium sulphate has been correspondingly increased. We wish to emphasise this aspect of the case since it is of the utmost importance to recognise that in a country where the majority of the inhabitants are small agriculturists of straitened means, the price at which artificial manures can be obtained is one of the main factors in the extension of their use. In fact it may safely be held that a reduction in price is one of the best forms of propaganda. There is no doubt that the scope for the use of artificial manures is immense. The demand for ammonium sulphate is rapidly increasing and so far as we can judge, there is practically no limit to the amount which India can absorb. Provided that it can be supplied at a reasonable price, it is probable that even within a few years at least 100,000 tons per annum will be required.

Organization of market.

81. Ammonium sulphate in India was sold formerly by the British Sulphate of Ammonia Federation and is now sold on behalf of a combine by Nitram, Limited. The combine consists largely of British manufacturers but the majority of firms operating coke oven plants in India including all the Steel and Iron works are also members of the combine. The whole production is marketed by Nitram, Limited, and prices are fixed for various countries according to the conditions of competition. The manufacturers are paid the average price realised per ton in all the markets whether at home or abroad. Foreign prices would ordinarily approximate to what may be called world parity prices, though the manufacturer on an average will receive very much less because average freight and marketing charges for ammonium sulphate sold abroad must

* The figures given above for annual imports and exports are taken from the Annual Statement of Sea-borne Trade of British India and are for the official financial year 1st April to 31st March.

be met. An examination of the prices in India and the net return to the Indian manufacturer reveals a somewhat curious position. The average price in India—f.o.r. any port—was in December, 1928, Rs. 160 per ton, but the average price paid to the manufacturer was £7-10-3 for ordinary quality, that is to say about Rs. 100. It will thus be seen that though the Indian manufacturer gets only Rs. 100 per ton at the works, the ryot has to pay Rs. 160 per ton at the port. In the same month the price of sulphate of ammonia in England amounted to £10-4-0 or Rs. 136 per ton delivered to the consumer. So far as the Indian manufacturer is concerned, it is possible, as we have been informed by Imperial Chemical Industries (India), Limited, that the difference between the average price received by the Indian manufacture and the price charged in the Indian market may be covered in part by freight, marketing and expenses on account of propaganda which if undertaken by a single manufacturer might be exceedingly heavy. Further he has the certainty of disposing of the whole of his output. But the Indian agriculturist appears to derive little benefit from the establishment of the ammonium sulphate industry in India. Though far less able to bear the expense, he has to pay Rs. 160 *plus* freight and other charges per ton of ammonium sulphate as compared with Rs. 136 per ton paid at destination by the farmer in England. We bring this matter to notice, because it does appear to us that the essential conditions of the Indian market have been overlooked by the combine. If the market for fertilisers is to be extended in India, which we understand is the aim of the combine, it is imperative that prices should be reduced and in view of the poverty of the average Indian agriculturist, it would appear not unreasonable to expect the combine so to average its world prices as to charge a somewhat lower price for ammonium sulphate in India than it does in other more advanced countries.

Superphosphate.

82. We turn now to a consideration of the second important fertiliser namely superphosphate. As we have stated the use of this fertiliser is particularly advantageous for rice crops, for sugarcane and on tea and rubber estates. It is probable that it can be applied with advantage to the majority of soils, since even where no immediate result is apparent, its application constitutes an insurance against soil deterioration. On tea and rubber estates it is used on a considerable scale in conjunction with green manure. It is also commonly applied with ammonium sulphate, or farmyard manure. The greatest advance in the use of superphosphate has been made in the Madras Presidency largely under the guidance of the Agricultural Department and of the total consumption in India of approximately 10,000 tons of superphosphate, far the greater portion is used in Southern India. As in the case of ammonium sulphate, we anticipate a rapid increase in the demand for superphosphate provided that it can be obtained at a reasonable price and it is not improbable that within a comparatively short period some 30,000 tons will be required annually.

Manufacture of superphosphate.

83. The principal raw materials required for the manufacture of superphosphate are sulphuric acid and bones or phosphate rock. There are large quantities of bones available in India, but they command a higher price in foreign markets for use in the preparation of commodities other than artificial manure than is charged for rock superphosphate in India. The balance of advantage therefore appears to lie in the export of bones and the purchase or manufacture of rock superphosphate. Indeed a reduction in the price of bones of at least Rs. 30 or Rs. 40 a ton is necessary before the manufacture of bone superphosphate in India becomes a practical proposition. We do not therefore propose to discuss bone superphosphate in detail though it is possible in the case of war that bones, of which about 100,000 tons are exported annually, might form an important material for the manufacture of superphosphate. The principal sources of supply of rock phosphate are the United States of America and the north and east coasts of Africa. Nearly 70 per cent. of Europe's requirements are supplied by Africa. In India rock phosphate is at present found in Singhbhum and Trichinopoly, but the evidence does not justify the expectation that it can be used in the manufacture of superphosphate in the immediate future. It is evident that until more investigation has been carried out, India will have to depend upon imported rock phosphate. In this respect the manufacturer in India would be at no disadvantage compared with the foreign manufacturer since the latter also has to buy his rock phosphate from equally distant sources. Rock phosphates have a world price and are sold on the basis of their content of calcium phosphate. We have ascertained the freight from Africa to European and Indian ports. For small quantities the freights to India are comparatively high, but for larger quantities they are very nearly the same as to Holland which is the largest superphosphate exporting country in Europe. Although foreign countries may have some advantage over India in regard to by-product sulphuric acid, this advantage is more than offset by the freight on superphosphate to India, the cost of re-bagging and other incidental expenses. The cost of transport from European ports to India with the costs incidental to importation slightly exceeds the price of superphosphate f.o.b. European port as the following figures will show:—

	Rs.	A.	P.	Rs.	A.	P.
Superphosphate f.o.r. Dutch port £2-13-3 .				=35	8	0
Freight £1-2-6	=15	0	0			
Landing and carting charges . .	5	8	0			
Importers' commission . . .	7	8	0			
Re-bagging	7	8	0			
Wastage 2 per cent. . . .	1	8	0			
				37	0	0
				72	8	0

These figures were supplied to us by Imperial Chemical Industries Limited and Messrs. Shaw Wallace and Company who market all classes of fertilisers in India. Messrs. Shaw Wallace and Company charge Rs. 7-8-0 as their commission. We have been told that except in rare cases when it is possible to rail it immediately to the consumer it is the invariable practice to re-bag superphosphate on arrival in India. When superphosphate is delivered upcountry, a charge of not less than Rs. 5 per ton is added to cover sub-agency commission, godown charges and propaganda agency, thus bringing up the price to Rs. 77-8-0 per ton *plus* the freight from the port to destination.

Advantage of local manufacture.

84. The import price with which the Indian manufacturer has to compete is Rs. 37 above the price at the port of shipment. In other words, if India is to depend on imported superphosphate, it can never obtain it except at a price which is 100 per cent. in excess of the export price. If, on the other hand, superphosphate is manufactured in India under competitive conditions, it may be possible, after Indian labour has been trained and large units have been erected, to place superphosphate on the market at a price not very much higher than in Europe. We see no insuperable difficulty, if the manufacture of superphosphate is established in India, in reducing the price eventually by at least Rs. 20 a ton. This, in a country where the agriculturists have no large resources, must have a very stimulating effect upon the consumption of superphosphate. Obviously, it would be to the advantage of the country to take every possible step which would ensure to the ryot his superphosphate at as cheap a price as possible.

Economic unit.

85. The capacity of some of the larger works in Europe is as great as 100,000 tons. In European countries where production is undertaken largely for export, the cost at works must be sufficiently low to enable manufacturers after meeting freight and other charges to sell superphosphate at competitive prices in foreign markets. In view of the severe competition which prevails in the superphosphate industry, the Indian manufacturer must also be prepared to reduce his costs to the lowest possible level, but we think that so long as the import price in India exceeds the f.o.b. price by 100 per cent., it is not necessary for him to employ such large units as those in Europe. Any unit which enables the manufacturer eventually to produce the article at a price below that at which it can be imported may be regarded as economic. We consider that if the manufacture of superphosphate is at the beginning undertaken in conjunction with chemicals, a plant of a capacity of 10,000 tons would prove to be economic. During the period of protection, however, we do not think that it would be safe to assume an average production of more than 5,000 tons per annum per unit of manufacture. We therefore propose to take this as our basis of investigation.

Estimate of cost of materials.

86. The imported superphosphate against which the Indian manufacturer will have to compete contains 18/20 per cent. of soluble phosphoric anhydride (P_2O_5). There are several varieties of rock phosphate in the market, but we think that if the Indian manufacturer is to produce such a high class superphosphate he must use the best rock phosphate, which so far as the Eastern Hemisphere is concerned is ordinarily the Moroccan. The price of this rock phosphate is about 4½*d.* per unit of available calcium phosphate and as its purity is generally about 75 per cent., the price per ton f.o.b. Moroccan port may be taken as £1-8-1½ per ton. For small consignments of about 500 tons the freight is £1-5-0 per ton. To the c.i.f. price must be added the usual landing, handling and carting charges of Rs. 6 per ton. Rock phosphate is usually shipped in bulk and for that reason some allowance for wastage should be made. We think that an allowance of 2½ per cent. of the total cost would not be excessive. The total cost of one ton of rock phosphate delivered at the works would thus amount to Rs. 42·4 made up as follows:—

	£	*s.*	*d.*	Rs.
F.o.b. Moroccan port	1	8	1½	
Freight	1	5	0	
	2	13	1½	=35·4
Landing, etc., charges				6·0
				41·4
Wastage 2½ per cent.				1·0
				42·4

The proportions of rock phosphate and of sulphuric acid required in the manufacture of superphosphate depend on the composition of the phosphate. Sulphuric acid must be added in the proportion necessary to decompose the calcium phosphate and to convert it to hydrated hydrogen calcium phosphate, the essential constituent of superphosphate. Sulphuric acid is also consumed in decomposing other constituents such as calcium carbonate. The quantity of sulphuric acid required and the yield of superphosphate therefore vary considerably. We have for the sake of our estimate taken amounts that have been calculated according to the actual analysis of a typical Moroccan phosphate. This will require ·56 tons of rock phosphate and ·35 tons of sulphuric acid (100 per cent. basis). The cost at which sulphuric acid should be taken into account depends upon the stage which the manufacture of that acid has reached in the country. We have assumed that the average production of sulphuric acid during the period of protection will amount to 4,000 tons per annum. We do not contemplate the manufacture of superphosphate for the time being as an independent undertaking but as part of that of chemicals. The manufacturer may not find it easy to market the full quantity

of some of the chemicals and in order to reduce the cost of sulphuric acid, and that of his other products, he may find it convenient to manufacture simultaneously superphosphate in quantities for which a market is available. The average production of 5,000 tons of superphosphate would absorb about 1,750 tons of sulphuric acid and, if the manufacture of 5,000 tons of superphosphate is undertaken in connection with an existing chemical works, the increase in the average production of chamber acid will not be such as to bring the cost of manufacture appreciably below what we have estimated on an output of 4,000 tons of chamber acid on a 100 per cent. basis. We therefore assume that, according to our estimate in the case of the other chemicals, the cost of sulphuric acid including overhead charges and profit should be taken at Rs. 75 per ton. The cost of sulphuric acid per ton of superphosphate would therefore be Rs. 26·25.

Cost above materials.

87. As regards the cost above materials, it is difficult to make an absolutely accurate estimate, but the processes are simple and the machinery used is automatic. We have been supplied with estimates by the Eastern Chemical Company, the Dharamsi Morarji Chemical Company and Messrs. Parry and Company. Messrs. the Dharamsi Morarji Chemical Company have manufactured bone superphosphate to the extent of about 300 tons per annum, while Messrs. Parry and Company have had considerable experience, though on a small scale, of the manufacture both of bone and rock superphosphate. Our estimate of the works cost is as follows:—

	Rs.	Rs.
Raw materials—		
Rock phosphate ·56 tons at Rs. 42·4 per ton .	23·74	
Sulphuric acid ·35 tons at Rs. 75 per ton .	26·25	
		49·99
Labour	2·00	
Power and fuel	4·00	
Repairs and renewals	3·50	
General services and supervision . . .	1·00	
Rent, taxes, insurance, etc.	·50	
		11·00
Selling charges	4·00	
Packing	5·00	
		9·00
Works cost (*ex* godown) .		69·99

Overhead charges and profit.

88. In order to obtain the fair selling price we have to add the overhead charges and manufacturer's profit. For this purpose we must make an estimate of the cost of the plant and equipment. We have been supplied with two estimates, one for a unit of 5,000 tons and another for one of 10,000 tons. For the former plant the equipment and buildings would cost Rs. 1,00,000 but if the capacity were doubled, the cost would not amount to

more than Rs. 1,40,000. We were told in the oral evidence that if the capacity was further increased to 20,000 tons per annum the total cost would not exceed Rs. 1,60,000. It will thus be seen that as the capacity of the plant increases the cost of the equipment is rapidly decreased per unit of production. For our present purpose, however, we shall take a plant of a capacity of 5,000 tons and we shall allow depreciation at the rate of 6¼ per cent. as usual on the whole block value. As regards head office expenses and agents' commission, we shall allow 6¼ per cent. on the works costs, excluding the cost of sulphuric acid, as in the case of the chemicals which we have already considered. As regards working capital, it must be recollected that superphosphate has a seasonal market and, if manufacture is to continue throughout the year, it will be necessary to maintain considerable stocks. In the case of chemicals we have allowed interest on a turnover of six months. In this case more capital will be locked up and it is not unreasonable to base the calculation on a turnover of eight months. As regards manufacturer's profit, in the beginning nothing less than 10 per cent. will suffice, although in European countries owing to competition the return on the manufacture of superphosphate and other fertilisers is much less. In many cases a reduction is made in the selling price by charging little or no profit on sulphuric acid. In India however while the industry is still in its infancy, it is improbable that it would expand as rapidly as is desirable in the country's interest if the profit on the sulphuric acid or on the superphosphate were reduced below a 10 per cent. level. The following items have to be added to obtain the fair selling price:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 1,00,000	6,250
Interest on working capital, 7½ per cent. on Rs. 1,44,000	10,800
Head office expenses and agents' commission	13,750
Manufacturer's profit	10,000
	40,800

	Rs.
Incidence per ton	8·16
Works cost (*ex* godown)	69·99
Fair selling price	78·15

or Rs. 78 in round figures.

89. In the above price we have allowed for selling charges what we consider would be a reasonable amount if the market were properly developed and no propaganda were necessary. But it is certain that much propaganda must be undertaken before the manufacturer acquires a sufficiently large market. Foreign importers have been spending large sums of money for this purpose and, if the Indian manufacturer is to meet competition from this source, he too must be

Charges for propaganda.

prepared to incur considerable expense. If during the period of protection of the chemical industry Rs. 5 per ton were allowed for propaganda, it would not be excessive. The total fair selling price (*ex* godown) would thus amount to Rs. 83 per ton.

C.i.f. landed price.

90. As we have stated in paragraph 86, the c.i.f. landed price of superphosphate including importers' commission and re-bagging charges is Rs. 72-8-0 per ton. There is at present no competition between the foreign importer and the local manufacturer but, when conditions have changed, competition may be expected to arise; not only may the c.i.f. price of superphosphate drop, but the importers may also reduce their commission to the barest minimum. As regards the former we are not able to make any estimate, though there is evidence to suggest that superphosphate is being exported at a price below the f.o.r. works price in Europe. We shall assume for our purposes that the price will not drop substantially below £2-13-3. The commission charged by the importers is at present Rs. 7-8-0 per ton, but under competitive conditions this will almost certainly be reduced and it would not be safe to assume a higher figure than Rs. 2-8-0 a ton. The c.i.f. landed price will then be reduced from Rs. 72-8-0 to Rs. 67-8-0 per ton.

Protection required.

91. Our estimate of the fair selling price required during the period of protection is Rs. 83 per ton. The import price we assume will be Rs. 67-8-0 per ton and therefore the measure of protection is Rs. 15-8-0. Owing to the excess capacity of plant established during the war, very severe competitive conditions exist in the superphosphate industry in Europe. The competition is likely to be even more severe if, as we are informed, chemically combined fertilisers are to be placed on the market in large quantities in the near future. We would therefore allow a margin of Rs. 2-8-0 against future reductions in the price of the imported article. The amount of protection indicated then becomes Rs. 18 per ton.

Estimate on 10,000 ton output.

92. In order to decide whether the manufacture of superphosphate will be able eventually to dispense with protection, we proceed to make an estimate of the future fair selling price on an output of 10,000 tons per annum. In our previous estimate we have allowed 25 shillings per ton for freight on imported rock phosphate because we think that it will be imported in small quantities. When production however goes up to 10,000 tons, it should be possible to charter a whole ship or to obtain very favourable rates for larger consignments. We have been told that if a whole ship were chartered the freight would not be more than 15 shillings per ton. This will reduce the cost of rock phosphate delivered at the works from Rs. 42·4 to Rs. 35·73. For sulphuric acid (100 per cent. basis) we have allowed Rs. 75 per ton in the earlier estimate. We now propose to allow Rs. 55 per ton which is the fair selling price of that acid when the output reaches 8,000 tons. For power and fuel we have allowed in the earlier

estimate Rs. 4 per ton, but with increased output the cost should not exceed Rs. 2·25 per ton. For the same reason a reduction of one rupee in the selling charges would not be unreasonable. For propaganda we have allowed Rs. 5 per ton in the earlier estimate but on an output of 10,000 tons Rs. 3 per ton should suffice. The other reductions call for no special explanation. Our estimate of the future works cost is as follows:—

	Rs.	Rs.
Raw materials:—		
Rock superphosphate (75 per cent.) ·56 tons at Rs. 35·73 per ton	20·01	
Sulphuric acid (100 per cent.) ·35 tons at Rs. 55 per ton	19·25	
		39·26
Labour	1·50	
Power and fuel	2·25	
Repairs and renewals	2·50	
General services and supervision	·75	
Rent, taxes and insurance	·25	
		7·25
		46·51
Selling charges	4·00	
Packing (double bags)	5·00	
		9·00
Works cost (*ex* godown)		55·51
Depreciation at 6¼ per cent. on Rs. 1,40,000	8,750	
Interest on working capital at 7½ per cent. on Rs. 2½ lakhs	18,750	
Head office expenses and agents' commission	23,240	
	50,740	
Profit (10 per cent. on Rs. 1,40,000)	14,000	
	64,740	
Incidence per ton	6·47	
Works cost (*ex* godown)	55·51	
Fair selling price Rs. 61·98 or	62	
Propaganda charges	3	
	65	

Conditions of Fiscal Commission.

93. If the present c.i.f. landed price of superhosphate continues, the industry will be able to dispense with protection when an output of 10,000 tons is attained and if competitive conditions prevail, the ryot will probably obtain his superphosphate at Rs. 65 per ton f.o.r. works instead of Rs. 77-8-0 as at present. In its relation to agriculture the fertiliser industry may fairly be considered a key industry of great national importance. It is at

present unable to meet foreign competition without protection and without the assistance of Government no development of the industry can be expected. At the same time as we have shewn, it should eventually be able to face foreign competition without protection. We therefore consider that the conditions of the Fiscal Commission are satisfied and for this reason and in view of the close connection between the manufacture of fertilisers and of the chemicals which form the subject of this enquiry, we recommend that the manufacture of superphosphate should be declared a protected industry.

94. In the case of an article like superphosphate which is used by agriculturists protection by means of an increased duty is unthinkable. We must therefore recommend a scheme of bounty. At one time we were inclined to the view that the bounty might be fixed upon the quantity of sulphuric acid used in the manufacture of superphosphate. There would be however many administrative difficulties in determining the amount of bounty and we have come to the conclusion that the bounty should be paid on the production of superphosphate. The bounty proposed amounts to Rs. 18 per ton. The fair selling price is based upon the assumption that the superphosphate contains 18 to 20 per cent. of soluble phosphoric anhydride. Superphosphate is sold according to its phosphoric anhydride content and the scale of bounty required on a production of superphosphate up to 5,000 tons would be at the rate of Re. 1 per unit of soluble phosphoric anhydride. Since on an output of 10,000 tons the industry will be able to dispense with protection, a smaller bounty would be required for production in excess of 5,000 tons. It appears to us that a bounty of 8 annas per unit of soluble phosphoric anhydride would suffice for the output in excess of 5,000 but not exceeding 10,000 tons. It will probably be convenient for administrative reasons to fix a single rate of bounty for the whole production. There is some advantage also in proposing a single rate rather than a sliding scale since it offers an inducement to manufacturers to increase their output rapidly. We therefore propose the mean rate of 12 annas per unit of soluble phosphoric anhydride. The bounty should be payable on the first 10,000 tons produced in one factory, and any production in excess of this amount should not be entitled to any bounty. We are advised that the test to be applied for determining the quality is a simple one and the Government of India or any authority which it appoints on this behalf should have no difficulty in determining with reasonable precision the amount of bounty payable. For the reasons which we have already given in the case of chemicals we propose that the period during which the bounty will be payable should also extend to seven years.

Method of protection explained.

95. At present the demand for superphosphate is estimated at 10,000 tons, which would keep only one plant working to full capacity. There are at least three important ports in India excluding Burma where plants for superphosphate may in future be estab-

Burden on Government revenues.

lished. The demand for superphosphate is rapidly increasing and, as we have pointed out, we cannot regard it as improbable that production will reach 30,000 tons per annum during the period of protection. We have proposed that a bounty at the rate of 12 annas per unit of phosphoric anhydride should be granted to manufacturers of superphosphate up to a maximum of 10,000 tons per annum manufactured by any one factory. It is impossible to foresee how the demand for superphosphate may develop and it is difficult to impose any limit on the payment of bounty save that no bounty should be payable on production of more than 10,000 tons by any one factory. Assuming that three factories are in operation, the liability of the Government of India in any one year would probably not exceed Rs. 4 lakhs, but in view of the importance of the industry and the possibility of increase in demand particularly in Burma we think that it would be inexpedient to limit the expenditure to Rs. 4 lakhs, and we propose that the maximum amount of bounty payable in any one year should be fixed at Rs. 7 lakhs. The production of superphosphate in this country apart from its value as an industry would be of great benefit to the ryot since it is probable that conditions of competition would make superphosphate available at a figure far below the present price. Moreover, the existence of a local industry, as we have stated in Chapter II, would stimulate chemical research in relation to agriculture. Sulphuric acid, again, will be produced on a larger scale which would cheapen the cost of production of all the chemicals and industries dependent upon its use and the expansion of the chemical industry as a whole would thereby be expedited and the period of protection shortened.

Conditions of payment of bounty.

96. The payment of the bounty should be subject to the following conditions:—

No bounty shall be payable to or on behalf of any company, firm or other person engaged in the business of manufacturing superphosphate unless such company, firm or person provides facilities to the satisfaction of the Governor General in Council for the technical training of Indians in the manufacturing processes involved in the business and, in the case of a company, unless—

(*a*) it has been formed and registered under the Indian Companies Act, 1913; and

(*b*) it has a share capital the amount of which is expressed in the memorandum of association in rupees; and

(*c*) such proportion of the directors as the Governor General in Council has by general or special order prescribed in this behalf consists of Indians.

In making these proposals we have been guided generally by the provisions of the Steel Industry (Protection) Act of 1924, except in one respect: namely that we consider that to qualify for the payment of bounty a company should comply with the above conditions whether engaged at present in the manufacture of superphos-

phate or not. In the course of our investigation we have satisfied ourselves that no hardship will be caused to any existing company by the observance of these conditions.

Power to make rules.

97. It may also be advisable for the Government of India to take powers to frame rules defining superphosphate and regulating the procedure for the payment of bounty on its production. It is undesirable that the grant of a bounty should result in the establishment of a number of small uneconomic units which, on the withdrawal of protection, would disappear. For this reason provision should be made by Rules to fix the minimum amount of production on which any manufacturer should earn a bounty. Supervision over the course of manufacture will be facilitated if the industry is organized into a few large factories. In our opinion no bounty should be payable unless the production amounts to 2,000 tons in one year. It is also of the utmost importance that there should be no deterioration in the quality of the fertiliser. The rules should provide for a minimum phosphoric anhydride content, which in our opinion should not fall below 12 units. Another matter which must not be overlooked is the possibility of Indian manufacturers joining some world combine as has happened in the case of ammonium sulphate. In such an event it would be impossible to ensure that the bounty served the purpose for which it was intended. Power should be reserved to Government to withhold the payment of bounty in such a case.

Compound fertilisers.

98. Our attention has been drawn to the use of fertilisers in which nitrogen and phosphoric acid are chemically combined and which are sold under various proprietary names. It has been suggested that these may in time replace ammonium sulphate and superphosphate. On the supposition that the new fertilisers largely replace ammonium sulphate and superphosphate, the amount of superphosphate required in India has been placed according to the Director of Agriculture, Madras, at 10,000 tons. These compound fertilisers combine in themselves the properties both of ammonia and of phosphoric acid and it might be urged that if they can be produced and placed on the market more cheaply it is of little use to encourage the manufacture of superphosphate in India. It is probable that the cost of transporting these compound fertilisers from Europe will be less since they are less bulky. But judging from present prices we are not satisfied that compound fertilisers are less expensive to use than a corresponding mechanical mixture of ammonium sulphate and superphosphate. Even if it had been proved that compound fertilisers are at present less expensive, we could not accept the argument as conclusive. As we have already pointed out, the price of ammonium sulphate is much higher in India than elsewhere and we anticipate that in the future there will be a considerable reduction in the price both of this and of superphosphate. Again, on the basis of present world production about 8 million tons of sulphuric acid are used in the manufacture of ammonium sulphate and superphosphate, and it is improbable that this industry will surrender without a struggle. At any rate there is at present no indication

of their displacement by the new fertilisers: for it will be seen from appendix VII that there has been a steady increase in the world production of ammonium sulphate while there is no evidence of any appreciable decline in that of superphosphate. As regards superphosphate there is high authority for the view that in spite of competition from compound fertilisers calcium superphosphate will be required for many years to come as under certain conditions some soils require nothing more than a phosphatic fertiliser capable of ready assimilation. Mr. Hutchinson, the Chief Scientific Adviser in India to the Imperial Chemical Industries (India), Limited, gave evidence before us to the effect that it was improbable that annual applications of compound fertilisers will be required and there will always be room for the use of ammonium sulphate and superphosphate separately. Further we observe* that in South Africa the African Explosives and Industries, Limited, with which the Imperial Chemical Industries is associated, is about to erect a 50,000 ton plant for superphosphates. In Australia† too where the manufacture of superphosphate amounted to 800,000 tons fresh superphosphate plant is being erected while in Canada the output is being extended considerably. Similarly extensions are in progress also in other countries. It appears to us therefore that India cannot afford, in contrast to other countries, to suspend activity until the commercial success of the new process of manufacturing fertilisers is established. It is anomalous that a country in which 90 per cent. of the inhabitants are agriculturists should have to depend on foreign imports for such an important adjunct to agriculture as artificial manure. We see no reason therefore to delay taking action for the establishment of the superphosphate industry in India. Should the superiority of combined fertilisers be proved at a later date, we see no insuperable difficulty in the establishment of the industry in India, under suitable protection if necessary.

* Imperial Chemical Industries, Ltd., Annual Report, 1928.
† Manchester Guardian Commercial, 11th April, 1929.

CHAPTER VIII.

Unit of production.

99. Our proposals for the protection of the chemical industry are based on the output which the industry may reasonably be expected to attain in existing conditions. We propose now to consider what measures are possible to widen the effective market for these chemicals in India and to facilitate that reorganization of the industry without which we believe economic manufacture under modern conditions to be impossible. Since the report of the Fiscal Commission and the adoption by the Government of the policy of discriminating protection, immense changes have been introduced in European countries in the methods, organization and equipment of industries. 'Rationalisation' is one of the many expressions commonly used to describe the process by which these changes have been brought about. There are two fundamental principles upon which this new system of organization is built. In the first place, by voluntary or forced amalgamation the industry is brought under a single management and financial control. The small and inefficient units are closed; manufacture is concentrated in convenient centres and production is carried on with larger and larger units. In the next place, control is acquired not only over the whole market of the country but of groups of countries, and prices are stabilized at levels which will ordinarily preclude competition. The Imperial Chemical Industries, Limited, and the I. G. Farbenindustrie Aktiengesellschaft may be cited as conspicuous illustrations of these new developments in the chemical industry. Concentration of manufacture and distribution on a large scale have now become matters of such paramount importance that few industries which do not aim at both these objects can hope to survive modern competition. If the chemical industry is to be established in India at a cost to the consumer which in the end will be commensurate with the results, it must conform, within reasonable limits, to the conditions imposed by these considerations. It is, therefore, necessary to investigate whether and how far the industry is capable of fulfilling, or may be called upon to fulfil, these conditions.

Rationalisation.

100. One of the implications of concentration is, as we have stated, production by large units. But the unit must not only be large, it must also work to maximum capacity, if both the works costs and the overhead charges are to be reduced, and the best results are to be obtained from the earning capacity of the plant. What capacity will represent an economic unit must vary with the conditions in which manufacture has to be undertaken. An organization such as the Imperial Chemical Industries which aims at international markets must of necessity manufacture on a scale which will not only reduce

Economic unit.

the operating costs, but cover the heavier costs of the higher management and of the more complicated sales organization, and the additional costs of distribution to the more distant markets. When, however, a country aims at catering only for its own requirements and these are reasonably large, the unit may be much smaller, especially if the competing countries have to transport their finished products over long distances and thereby incur heavy transport charges. In other words a unit may be regarded as economic if owing to freight or other advantages it is able to market its products at a price not above the landed price of the competing imports. The average freight advantage including landing, agency and other charges incidental to importation which India possesses in respect of the chemicals now under investigation may be estimated at Rs. 25 per ton. In some of the cheaper commodities this advantage will amount to as much as 30 or 40 per cent. of the import price. It should therefore be possible for a comparatively small unit to operate in India and to compete with success against larger plants outside India. The Indian manufacturer has also other advantages. Even at present the Indian market is sufficient, if it were fully exploited, to allow the Indian manufacturer to work a unit which though small would under local conditions be economic while his potential market is very much larger. Again, in an industry such as the chemical industry in which cheap coal and power are important factors, the abundance of cheap fuel (especially if the industry is located in or near the coalfields) will generally place the Indian manufacturer at some advantage over the foreign. Moreover, where the size of the unit is not too small and the industry lends itself to the use of labour saving appliances and automatic machinery, the relative cheapness of Indian labour, as we have explained in our Report on the match industry, must result in lower costs than in the United Kingdom and to a lesser extent perhaps than in some of the Continental countries. Further, it not infrequently happens that in the case of large amalgamations operating on a national or international scale which have been created out of smaller units the incidence of overhead charges tends to be higher and to that extent the smaller Indian unit may be more advantageously situated.

Reorganization required.

101. It follows then that while the units of production in India may be much smaller than those in the competing countries, the number of factories in operation should not exceed the minimum capable of supplying the available market. It is true that the cost of distribution over the very long distances found in this country is almost as important a factor in determining the average selling price as the cost of production and the erection of a unit in closer proximity to a market may conduce better to the reduction of the price than the enlargement of an existing unit. The line of development most likely to lead to economic results would be the establishment of a single unit to supply the whole market until such time as each important centre has expanded sufficiently to permit of its possessing its own unit of production. Concentration can be and is constantly being effected in other countries by voluntary amalgamation and mergers of groups

under the control of one powerful financial organization. It is not within the legitimate province of this Board, or indeed that of Government, to compel the reorganization of any industry. But it is possible to devise a scheme of protection supplemented by other remedial measures which would on the one hand discourage the erection or existence of small units, and on the other, enable the industry to organize itself on a larger scale.

Special conditions in India.

102. Before considering the measures to be adopted to encourage the concentration of manufacture in large units, it is important to recognise what natural impediments exist. The ideal conditions for the concentration of manufacture in a single unit are those in which the industry is in close proximity both to its essential raw materials and to its market. If the policy of discriminating protection were so interpreted or administered that the existence of these advantages was regarded as a condition precedent to the grant of protection we have upon a careful review of our enquiries during the last six years no hesitation in stating that under modern conditions scarcely any Indian industry could fully establish its claim to protection. Existing transport rates cannot be taken as the final test in determining the market spheres of any given industry. For, apart from such considerations as the national importance of the industry it is obvious that the volume of traffic will vary considerably with the degree of success of the industry and this in turn may depend very largely on the grant of special rates. It is doubtful if the steel industry could have made out as good a case for protection as it did if its principal raw materials and a considerable portion of its market had not been made more accessible by the grant of specially low railway rates. We may add that these rates were first granted in 1909 before production had begun. If large scale industries are to be established in India, steps must be taken to offset their geographical or other natural disadvantages. The chemical industry as a whole requires perhaps a greater variety of raw materials than any other industries. The majority of these raw materials are available in the country. But it is difficult, if not impossible, to suggest a site which is in close proximity to all the raw materials as well as the bulk of the market. Coal is an essential raw material of all industries. For power purposes hydro-electricity, where it is cheap, can be an economic substitute for coal. But where large quantities of steam and heating are required, as is the case with many of the chemicals, considerable quantities of coal would still be required to be used. The largest and best supplies of coal are found in one part of India: Bihar and Bengal. From this point of view of cheap fuel therefore the best situation for a factory would be in this part of India. Unfortunately the majority of the other essential raw materials are not found in or near the coalfields. Magnesite, for instance, which with sulphuric acid is the principal raw material for the manufacture of epsom salts has to be brought from Salem, a distance of about 1,200 miles; bauxite, the principal raw material for alum and aluminium sulphate must be hauled between 500 and 600 miles from the Central

Provinces. But the most striking illustration we can give is that of the alkali or soda industry. The principal raw materials required for the manufacture of soda and soda compounds are coal, limestone, salt, water and (until synthetic ammonia is produced in India) ammonia liquor from coke ovens or gas works. All these raw materials are available in or near the coalfields except salt. If a soda industry is to be established in India, it seems that this is the most suitable locality provided that salt can be brought from other parts of India at a reasonable cost.

103. Concentration and manufacture on a large scale naturally postulate a corresponding market. As we stated in paragraph 21 our estimate of the potential market in the near future is 16,000 tons in terms of sulphuric acid. A unit capable of manufacturing this amount though relatively much smaller than the units in operation abroad, would in the special conditions of India be economic. As we shall show in a subsequent chapter, in the event of such a unit being established a very large reduction of costs may be expected and the industry should be able to hold its own against foreign competition. The market however is divided among the three principal ports and if a factory of this size is to be kept fully employed, it must not only be able to sell in its geographical market but also at the other ports. India's large seaboard makes Indian industries easily accessible to foreign competition and if adequate protection is to be afforded, one of two alternative courses must be adopted. One course is to establish small units at the principal points of competition. This will increase the costs of production, necessitate a high protective tariff and the continuance of protection for a more prolonged period and raise the price of the protected article throughout the whole market. The alternative is the establishment of a large unit and the reduction of freights so as to allow the cheap transport of the products to the markets where competition has to be met.

Results of foreign competition.

104. There can be no question that of the alternatives mentioned in the preceding paragraph, the second is preferable. The principal carriers of goods in the country are the railways. Several of these are owned and worked by Government and of others Government owns nearly 95 per cent. of the capital. Since this is the position, it may be argued that a reduction of freights should present no difficulty. If Government accepted and acted upon this contention in its entirety, railway business would be completely divorced from economic considerations. It would be tantamount to an indiscriminate subsidisation of industries by the taxpayer and would introduce into both our fiscal system and our administration of railways, complications the effects of which it would be impossible to foresee. We are not prepared to put forward such an argument in its entirety. It can only be put forward subject to several limitations. In the first place it must appear probable that the establishment of a large unit would result in a substantial reduction in costs and a consequent reduction in the average selling price of the commodity. Secondly, it

Reduction of freights.

must be shown that the reduction in costs will be sufficient to cover the freight which having regard to economic considerations railways can reasonably be expected to accept. The application of these considerations must naturally vary with the importance of the industry. The principal factor which is generally taken into account in reducing railway freights is the increase in traffic which the railways will obtain thereby and the claim for reduction is particularly strong in the case of an industry in which increased traffic may be expected to follow a reduction in rates. But a decrease in rate quite apart from any increase in traffic would be justified in the case of an industry of national importance. The chemical industry is, as we have shown, of fundamental importance both to industries and agriculture. On this ground railways may justifiably be expected in the national interest to be satisfied with the minimum freight that they can accept without actual loss. Lastly, the industry must not only show that it will eventually be able to dispense with protection but that the scale of protection required will be lower and that the duration of the period of protection will be considerably shortened. In other words, the industry must show that the aggregate burden on the consumer will be substantially smaller than it otherwise would be. We shall now proceed to investigate these three aspects of the question.

CHAPTER IX.

Estimate of economies resulting from large scale production.

105. The problem to be investigated is the possibility of establishing a single unit of manufacture which will supply the whole Indian market and the assistance which can reasonably be afforded by an adjustment of railway rates. Our estimate of the potential market in India for the chemicals which we are considering is 16,000 tons in terms of sulphuric acid. We shall now proceed to frame estimates of the various costs on the basis of an output of 16,000 tons of sulphuric acid, and shall then ascertain what freight the industry can afford to pay on its finished products. In estimating the future fair selling prices we have, for the reasons already given, based our calculations on a unit of 8,000 tons situated in Bombay but producing on an average 4,000 tons of sulphuric acid and a corresponding proportion of other products. Although the industry itself must choose its own location having regard to the proximity of its raw materials and the extent of the available market in its vicinity, in view of the importance of cheap fuel better results are likely to be obtained if a unit of as large a capacity as 16,000 tons is established either in the coalfields or in or near Calcutta. Before such a unit can come into being, the industry will require much re-organization and a considerable amount of time must elapse before full production is reached. In these circumstances we should not be justified in assuming an average production during the next few years of more than 8,000 tons of sulphuric acid and a corresponding proportion of derivatives per annum. This is the full capacity of the Dharamsi Morarji plant as regards sulphuric acid. We have already made an estimate of the costs when that plant reaches maximum production. If such a plant were to work in or near the coalfields the only difference for practical purposes in the costs will arise from the cost of fuel which would be reduced by at least half. In the case of zinc chloride there would also be a further reduction owing to the fact that the freight on zinc ash and skimmings will be considerably less than it would if these materials had to be transported from Jamshedpur to Bombay. We estimate the saving under this head at Rs. 17·5 per ton of zinc chloride. In the following table we give the corresponding costs after making the necessary adjustments and the c.i.f. prices for comparison:—

Intermediate stage : 8,000 tons.

	Fair selling price. Rs.	C.i.f, landed price. Rs.	Difference. Rs.
Rectified oil of vitriol . .	107·18	...	...
Nitric acid	524·38	...	...
Hydrochloric acid . . .	242·53	...	...
Glauber's salts	38·58	37·00	– 1·58

	Fair selling price. Rs.	C.i.f. landed price. Rs.	Difference. Rs.
Sodium sulphide . . .	118·75	115·00	− 3·75
Zinc chloride	234·63	252·20	+17·57
Epsom salts	69·55	56·80	−12·75
Copperas	53·05	70·80	+17·75
Copper sulphate . . .	386·02	382·10	− 3·92
Alumino-ferric	62·03	66·00	+ 3·97
Potash alum	110·63	120·50	+ 9·87

From the above table it will be seen that if our proposals could have been based on an average production of 8,000 tons in Calcutta, the burden of protection involved would have been considerably less. So far as the sales in the Calcutta and nearer markets are concerned, practically no protection would have been required except in the case of epsom salts. Even as regards epsom salts, if the freight on magnesite were reduced to the minimum rate of ·1 pie per maund per mile, the protection required would be only Rs. 7 per ton or $12\frac{1}{2}$ per cent. *ad valorem*. We have however made no allowance for freight charges on the chemicals that we assume will be supplied to the Bombay market. Some provision on this account is necessary, but this will not substantially affect our main contention, as will be seen from the table in paragraph 129. Meanwhile it may be pointed out that if, as in our estimates on an output of 4,000 tons, it is assumed that the chamber acid available from time to time during the period of protection will be utilised for the production of some chemicals at full capacity rather than of all the chemicals simultaneously in small quantities, the incidence of overheads and profit will be lower than we have assumed.

Full production : 16,000 tons.

106. We shall now proceed to make an estimate of the fair selling prices of all the chemicals when the plant attains the maximum production of 16,000 tons of sulphuric acid. The task of making a future estimate is always attended with difficulty which in this case is increased by the fact that there is no plant in the whole of India to-day which has reached an output which we can regard as economic. But we have already made an estimate in consultation with the principal applicants on a four thousand ton footing and without claiming absolute accuracy it is possible to make such adjustments in the cost ascertained on that footing as will enable us to arrive at approximate figures. Without making this report unduly prolix it is not possible to discuss in detail the reasons for expecting the economies for which we make allowance. We propose therefore to indicate the main factors which we have taken into consideration and which are likely in our opinion to contribute to a reduction of the costs. In the case of sulphuric acid the main reduction will come from the increased output which we assume will be quadrupled. Little coal is used in the manufacture of sulphuric acid and therefore cheaper coal will not materially affect the cost

of this acid. As regards the derivatives, while, as in the case of sulphuric acid, there will be a reduction on account of the increase in the output, there will be considerable further reductions as a result of the use of cheaper sulphuric acid and cheaper coal: for in the manufacture of these derivatives the cost of coal is an important item. For a works situated in or near Calcutta the price of coal will be reduced by about half, and for one situated in the coalfields by nearly three quarters, compared with its price in Bombay, and in the estimates that follow we have reduced the charges for power and fuel to half those taken in Chapter IV. Although with the increased output the total expenditure on such charges above the cost of materials as labour, repairs, general services and selling charges will be higher, the incidence should be slightly lower and we have allowed slight reductions in each case. As regards the overhead charges, although the whole plant will require extension, as the additional capital involved would be less in proportion to the increase in capacity, the incidence of the charges for depreciation and profit per ton will be reduced. Similarly head office expenditure will show a smaller incidence per ton. With lower works costs the incidence of the charges for interest on working capital will also be reduced.

Sulphuric acid.

107. Our estimate of the future cost of sulphuric acid on a production of 16,000 tons is as follows:—

	Rs.	Rs.
Raw Materials—		
Sulphur and nitre	35·44	35·44
Labour	·60	
Power and fuel	·75	
Repairs and renewals	1·25	
General services and supervision	1·00	
Rent, taxes, insurance, etc.	·25	
		3·85
Works cost (naked)		39·29

In order to obtain the fair selling price we have to make the following additions:—

	Rs.
Depreciation, 6¼ per cent. on Rs. 8,00,000	50,000
Interest on working capital, 7½ per cent. on Rs. 3,15,000	23,625
Head office expenses and agents' commission	30,000
Profit, 10 per cent. on Rs. 8,00,000	80,000
	1,83,625

	Rs.	
Incidence per ton	11·48	
Works cost (naked)	39·29	
Fair selling price	50·77,	say Rs. 51.

108. We estimate that the annual production of rectified oil of vitriol will rise from 1,500 tons to 4,000 tons. In our previous estimate we have allowed 10 per cent. wastage of chamber sulphuric acid. With increased output we think 5 per cent. wastage should suffice. Our estimate of the fair selling price is as follows:—

Rectified oil of vitriol.

	Rs.	Rs.
Raw materials—		
Chamber sulphuric acid 1·05 tons at Rs. 51 per ton	53·55	53·55
Labour	1·50	
Power and fuel	3·00	
Repairs and renewals	3·00	
General services and supervision, rent, taxes, insurance, etc.	1·50	
		9·00
Selling charges	5·00	
Packing (*ex* containers)	10·00	
		15·00
Works cost (*ex* godown)		77·55
Overhead charges and profit—		
Depreciation, 6¼ per cent. on Rs. 2,00,000	12,500	
Interest on working capital	3,600	
Head office expenses and agents' commission	6,000	
Profit	20,000	
	42,100	
Incidence per ton	10·53	
Works cost (*ex* godown)	77·55	
Fair selling price	88·08	

109. We estimate that the production of nitric acid will rise from 150 tons to 400 tons. Our estimate of the fair selling price is as follows:—

Nitric acid.

	Rs.	Rs.
Raw materials—		
Nitre 1·35 tons at Rs. 180 a ton	243·00	
Sulphuric acid 1·52 tons at Rs. 51 a ton	77·52	
		320·52
Labour	15·00	
Power and fuel	12·00	
Repairs and renewals	15·00	
General services and supervision, rent, taxes, insurance, etc.	30·00	
		72·00
Selling charges	4·00	
Packing (*ex* containers)	13·00	
		17·00
		409·52
Less 1·8 tons nitre cake at Rs. 24 per ton		43·20
Works cost (*ex* godown)		366·32

	Rs.
Overhead charges and profit—	
Depreciation, 6¼ per cent. on Rs. 90,000	5,625
Interest on working capital, 7½ per cent. on Rs. 57,800	4,335
Head office expenses and agents' commission	7,225
Profit	9,000
	26,185
Incidence per ton	65·46
Works cost (*ex* godown)	366·32
Fair selling price	431·78

110. We estimate that the production of hydrochloric acid will rise from 600 to 1,000 tons. Our estimate of the fair selling price is as follows:—

Hydrochloric acid.

	Rs.	Rs.
Raw materials—		
Salt 2·2 tons at Rs. 18 per ton	39·60	
Sulphuric acid 1·5 tons at Rs. 51 per ton	76·50	
		116·10
Labour	15·00	
Power and fuel	15·00	
Repairs and renewals	15·00	
General services and supervision, rent, taxes, insurance, etc.	4·00	
		49·00
Selling charges	4·00	
Packing	30·00	
		34·00
		199·10
Less Salt cake 2·2 tons at Rs. 15 per ton		33·00
Works cost (*ex* godown)		166·10
Overhead charges and profit—		
Depreciation, 6¼ per cent. on Rs. 2,00,000	12,500	
Interest on working capital, 7½ per cent. on Rs. 44,800	3,360	
Head office expenses and agents' commission	5,600	
Profit	20,000	
	41,460	
Incidence per ton	41·46	
Works cost (*ex* godown)	166·10	
Fair selling price	207·56	

111. It is difficult to make even an approximate estimate of the total demand for Glauber's salts in the country, for it is not separately shown in the import figures. It is also manufactured in small quantities at various centres where hydrochloric acid is manufactured. We think, however, that an estimate of the total market at 800 tons per annum will not be far off the actual figure. Our estimate of the fair selling price is as follows:—

Glauber's salts.

	Rs.	Rs.
Raw materials—		
Salt cake ·50 ton at Rs. 15 a ton . .	7·50	
Soda ash ·01 ton at Rs. 140 a ton . .	1·40	
Lime ·02 ton at Rs. 60 a ton . . .	1·20	
Bleaching powder ·004 ton at Rs. 125 .	·50	
		10·60
Labour	1·50	
Power and fuel	2·50	
Repairs and renewals	1·00	
General services and supervision . . .	1·50	
Rent, taxes, insurance, etc.	·18	
		6·68
Selling charges	2·00	
Packing	5·00	
		7·00
Works cost (*ex* godown)		24·28
Overhead charges and profit—		
Depreciation, 6¼ per cent. on Rs. 32,000 .	2,000	
Interest on working capital, 7½ per cent. on Rs. 8,700	650	
Head office expenses and agents' commission	1,088	
Profit	3,200	
	6,938	
Incidence per ton	8·67	
Works cost (*ex* godown)	24·28	
Fair selling price .	32·95	

112. We estimate that the production of sodium sulphide will rise from 1,000 to 2,300 tons per annum. Our estimate of the fair selling price is as follows:—

Sodium sulphide.

	Rs.	Rs.
Raw materials—		
Salt cake 1·3 tons at Rs. 15 per ton . .	19·50	
Coal dust ·7 ton at Rs. 6 a ton . . .	4·20	
		23·70
Labour	8·00	
Power and fuel	25·00	
Repairs and renewals	3·00	
General services and supervision, rent, taxes, insurance, etc.	4·00	
		40·00
Selling charges	3·00	
Packing	15·00	
		18·00
Works cost (*ex* godown)		81·70

	Rs.
Overhead charges and profit—	
Depreciation, 6¼ per cent. on Rs. 2,25,000	14,060
Interest on working capital, 7½ per cent. on Rs. 94,000	7,050
Head office expenses and agents' commission	11,750
Profit	22,500
	55,360
Incidence per ton	24·07
Works cost (*ex* godown)	81·70
Fair selling price	105·77

Zinc chloride.

113. We estimate that the production of zinc chloride will rise from 1,000 to 1,500 tons. We assume that all the zinc required will be obtainable from zinc ash and zinc skimmings and allowing for the difference in freights between Tatanagar and Bombay and Tatanagar and Calcutta we have taken the cost of zinc at Rs. 120 per ton. Our estimate of the fair selling price is as follows:—

	Rs.	Rs.
Raw materials—		
Zinc ·5 tons at Rs. 120 a ton	60·00	
Hydrochloric acid ·57 tons at Rs. 174 per ton (*ex* packing and selling charges)	99·18	
		159·18
Labour	3·00	
Power and fuel	2·50	
Repairs and renewals	1·00	
General services and supervision, rent, taxes, insurance, etc.	2·00	
		8·50
Selling charges	3·00	
Packing	15·00	
		18·00
Works cost (*ex* godown)		185·68
Overhead charges and profit—		
Depreciation, 6¼ per cent. on Rs. 1,25,000		7,812
Interest on working capital, 7½ per cent. on Rs. 65,000		4,875
Head office expenses and agents' commission		8,125
Profit		12,500
		33,312

	Rs.
Incidence per ton	22·21
Works cost (*ex* godown)	185·68
Fair selling price .	207·89

114. In Chapter IV we have taken 2,000 tons as the production of epsom salts. We estimate that the production will increase to 3,200 tons if a single unit is worked and that the fair selling price will be Rs. 54·55. We have allowed for a reduction of freight on magnesite and have taken its cost at Rs. 20 per ton delivered at the works instead of Rs. 40 as before:—

Epsom salts.

	Rs.	Rs.
Raw materials—		
Magnesite ·38 tons at Rs. 20 per ton . .	7·60	
Sulphuric acid ·42 tons at Rs. 51 per ton .	21·42	
		29·02
Labour	1·50	
Power and fuel	3·00	
Repairs and renewals	1·50	
General services and supervision . . .	1·25	
Rent, taxes, insurance, etc.	·35	
		7·60
Selling charges	3·00	
Packing	5·00	
		8·00
Works cost (*ex* godown)		44·62
Overhead charges and profit—		
Depreciation, 6¼ per cent. on Rs. 1,50,000 . .		9,375
Interest on working capital, 7½ per cent. on Rs. 37,000		2,775
Head office expenses and agents' commission . .		4,625
Profit		15,000
		31,775
Incidence per ton		9·93
Works cost (*ex* godown)		44·62
Fair selling price .		54·55

115. The estimate in Chapter IV is based on an output of 500 tons. Our estimate of the total demand for copperas is 650 tons. In these circumstances there would be no material reduction in cost except as regards sulphuric acid and fuel. Our estimate of the fair selling price is as follows:—

Copperas.

	Rs.	Rs.
Raw materials—		
Iron scrap	2·50	
Sulphuric acid ·4 tons at Rs. 51 per ton .	20·40	
		22·90
Labour	1·50	
Power and fuel	5·50	
Repairs and renewals	2·00	
General services and supervision . . .	2·50	
Rent, taxes, insurance, etc.	·30	
		11·80
Selling charges	4·00	
Packing	5·00	
		9·00
Works cost (*ex* godown) .		43·70
Overhead charges and profit—		
Incidence per ton as in previous estimate . .		7·70
Fair selling price .		51·40

116. We estimate an increase in production of copper sulphate from 250 tons to 1,000 tons per annum. Our estimate of the fair selling price is as follows:—

Copper sulphate.

	Rs.	Rs.
Raw materials—		
Copper scrap ·27 tons at Rs. 900 per ton .	243·00	
Rectified oil of vitriol (naked *ex* packing and selling charges) ·87 tons at Rs. 73 per ton	63·51	
		306·51
Labour	5·00	
Power and fuel	5·00	
Repairs and renewals	2·00	
General services and supervision . . .	2·50	
Rent, taxes, insurance, etc.	·75	
		15·25
Selling charges	16·00	
Packing	5·00	
		21·00
Works cost (*ex* godown) .		342·76

	Rs.
Overhead charges and profit—	
Depreciation, 6¼ per cent. on Rs. 42,000	2,625
Interest on working capital, 7½ per cent. on Rs. 1,35,000	10,125
Head office expenses and agents' commission	16,875
Profit	4,200
	33,825
Incidence per ton	33·83
Works cost (*ex* godown)	342·76
Fair selling price	376·59

Alumino-ferric.

117. The estimate in Chapter IV is based on a production of 500 tons only. We anticipate an increase in production of 4,200 tons, raising the total production to 4,700 tons per annum. The plant required for the manufacture of this chemical is a very simple and inexpensive one and there is not therefore much room for reduction in the incidence per ton of overhead charges and profit. Our estimate of the fair selling price is as follows:—

	Rs.	Rs.
Raw materials—		
Bauxite ·36 tons at Rs. 16 per ton	5·76	
Sulphuric acid ·47 tons at Rs. 51 per ton	23·97	
		29·73
Labour	7·00	
Power and fuel	5·00	
Repairs and renewals	2·00	
General services and supervision	·50	
Rent, taxes, insurance, etc.	·10	
		14·60
Selling charges	2·00	
Packing	1·00	
		3·00
Works cost (*ex* godown)		47·33
Overhead charges and profit—		
Depreciation, 6¼ per cent. on Rs. 40,000		2,500
Interest on working capital, 7½ per cent. on Rs. 55,000		3,987
Head office expenses and agents' commission		6,875
Profit		4,000
		17,362
Incidence per ton		3·69
Works cost (*ex* godown)		47·33
Fair selling price		51·02

118. We estimate that the annual production will increase from 2,000 to 3,800 tons. Our estimate of the fair selling price is as follows:—

Potash alum.

	Rs.	Rs.
Raw materials—		
Bauxite ·30 tons at Rs. 16 per ton	4·80	
Sulphuric acid ·38 tons at Rs. 51 per ton	19·38	
Potassium sulphate ·21 tons at Rs. 165 per ton	34·65	
		58·83
Labour	7·50	
Power and fuel	8·00	
Repairs and renewals	3·50	
General services and supervision	1·50	
Rent, taxes, insurance, etc.	·40	
		20·90
Selling charges	3·00	
Packing	5·00	
		8·00
Works cost (*ex* godown)		87·73
Overhead charges and profit—		
Depreciation, 6¼ per cent. on Rs. 1,60,000		10,000
Interest on working capital, 7½ per cent. on Rs. 1,28,000		9,600
Head office expenses and agents' commission		16,000
Profit		16,000
		51,600
Incidence per ton		13·58
Works cost (*ex* godown)		87·73
Fair selling price		101·31

119. In the following table we give the fair selling prices of the various products when the plant reaches its maximum production, and the c.i.f. landed prices for comparison:—

Margin of profit.

Products.	Fair selling price.	C.i.f. landed price.	Difference.
	Rs.	Rs.	Rs.
Rectified oil of vitriol	88·08	...	...
Nitric acid	431·78	...	...
Hydrochloric acid	207·56	...	...
Glauber's salts	32·95	37·00	+ 4·05
Sodium sulphide	105·77	115·00	+ 9·23
Zinc chloride	207·89	252·80	+44·91
Epsom salts	54·55	56·80	+ 2·25
Copperas	51·40	70·80	+19·40
Copper sulphate	376·59	382·10	+ 5·51
Alumino-ferric	51·02	66·00	+14·98
Potash alum	101·31	120·50	+19·19

It will be seen from the above table that when the single unit reaches full output the fair selling prices of all the chemicals will not only have fallen below the import prices but will leave a substantial surplus with which to meet the cost of distribution in other markets.

CHAPTER X.

Railway freights.

General.

120. Before entering into any discussion regarding railway rates for the transport of chemicals, it appears advisable to explain precisely the object which we have in view, so that no misunderstanding may arise as to the scope of our proposals. It is not our purpose to propose direct assistance to the industry by a reduction of railway rates. Our proposals for the assistance of the industry in existing conditions have already been made. Nor do we propose any differentiation between imported and Indian goods in the matter of rates. For we recognize that any such proposal would give rise to important questions of railway rating, which we should not be justified in raising in connection with this enquiry. Our object is merely to bring to the notice of the railway authorities the fact that in the event of a reorganization of the industry a new set of conditions will arise which may on the ordinary principles of railway administration justify a revision of rates for the transport of the raw materials and finished products of the chemical industry. In the course of our discussion it will be necessary to put forward tentatively certain figures illustrating our proposals. We desire to make it plain that no finality is to be attached to such figures, which must be regarded as merely exemplifying the policy which we desire to bring to the notice of Government.

Goods rating.

121. In order to understand the effect of the cost of transport of the raw materials and of the finished products on the development of the industry, it is necessary to explain some of the general principles governing the determination of goods rates. We do not propose to go into the various intricacies of goods rating from the point of view of railway administration or railway economics. Fixation of rates, however, must to some extent be experimental, and alterations are made as fresh facts are brought to the notice of the railway authorities. No apology, therefore, is needed for bringing to notice such anomalies in rating as have been observed by us in the course of our enquiry and the adjustments in railway rates necessary for the organisation of the chemical industry on an economic scale in India. For the purpose of rating, goods are divided into ten classes. Each class has a minimum and maximum rate. Within these limits the railway administrations are generally at liberty to vary the rates. For the first two classes the minimum rate is ·1 of a pie per maund per mile. For the other classes the minimum rate is ·166, that is to say, $\frac{1}{6}$th of a pie per maund per mile. It is thus possible for the railways if they wish to charge one-sixth of a pie for all goods irrespective of how they are classified and in the case of the first two classes this can be further reduced to one-tenth of a pie. The usual practice for railways is to charge either at the maximum rates or rates which approximate to the maximum. Numerous excep-

tions, however, are made. These occur (*a*) as a result of special arrangements by manufacturers or producers with railways; (*b*) when it is to the interest of the railways to create or attract traffic by competition against other railways or transport by sea; (*c*) when the Railway Board has for some special reason, as for instance, in the case of coal and fertilisers, recommended a special rate. It will be seen from the manner in which the rates can be applied that within limits the development of industries can, by the manipulation of the rates, be made largely a question of freights. Railways can, if they desire, give substantial protection to industries by quoting special rates or deprive them of protection by quoting higher rates within, of course, the prescribed limits. The difference between the maximum and minimum rates is so high that there is a very large margin which can be employed in either direction by the railway administration. However suitable the system may be from the point of view of railway economics, it has certain obvious disadvantages from the manufacturers' point of view. There is considerable uncertainty regarding the freight that any particular industry may be able to obtain and the fate of an industry may depend to no small degree upon the success of negotiations with individual railway administrations. When an industry has a market extending over the whole of India, negotiations with individual administrations, even if practicable, can seldom lead to uniformity or create that security in the mind of the manufacturer which is essential to induce him to invest his capital in large undertakings. The accepted principle in assessing railway rates is to fix that freight which the traffic can bear and as a general guide, subject to many exceptions, the value of an article is taken as the determining factor. Other things being equal, a heavier rate is imposed on the more valuable articles, the assumption being that the consumer of the more expensive goods is better able to defray a higher rate. Even on this principle it is difficult to understand the railways' classification of chemicals. It is possible to explain that while sulphuric acid is placed in Class IV, hydrochloric and nitric acids are placed in Class IX because the latter two acids are more expensive. Similarly zinc chloride and copper sulphate may have been placed in Class IV because they are somewhat expensive chemicals. But we have not been able to follow why copperas, alumino-ferric and alum are classified at Railway Risk under Class I of the Railway Rates while Glauber's salts, epsom salts and sodium sulphide are entered under Class III. These chemicals are of much the same value and there appears no great difference among them in regard to bulk or risk in handling. It is not easy to understand on what principles this differentiation is made and the railway officers whom we have examined have not been able to offer any explanation.

Special rates for coal.

122. Coal is at present the one commodity which for long distances pays the lowest rate starting with ·17 pies per maund per mile for a distance up to 200 miles. After a distance of 450 miles the rate drops below

the minimum of ·1 of a pie and at 900 miles and after it is ·07 of a pie. This is in accordance with the principle that a raw material of almost universal use for industrial purposes should bear the lowest possible rate. Fertilisers for which there is already a growing demand pay a minimum freight of ·1 of a pie per maund per mile irrespective of distance. Up to a distance of 450 miles no doubt fertilisers are at an advantage compared to coal, but fertilisers will form evenutally perhaps the largest proportion of heavy chemical products. If fertilisers were manufactured in or near the coal fields, their transport to Bombay would cost Rs. 16-14-0 per ton against Rs. 11-6-0 for coal. The importance to the country of cheap fertilisers cannot be over-emphasised, and it is hard to understand the principle on which differentiation is justified between coal, the raw material of industries, and fertilisers which are essential to the development of agriculture.

Telescopic rates.

123. Another feature of railway tariffs is the employment of what is known as the telescopic system, that is the fixation of rates on a scale decreasing in proportion to the distance of transport. We recognise that in the existing state of transport in the country there are serious difficulties in the way of applying a uniform telescopic rate over the railway system as a whole. Company-managed railways still exist side by side with State Railways and rates must perforce be regarded from the point of view of each railway. Different conditions of traffic or different costs of transport over the various lengths of line must be given full weight in determining the rates to be charged. At the same time it does appear that some simplification of rates is still possible. We are referring to no new feature of railway administration when we point out that the tendency of the railways to encourage traffic from and to the ports which has been brought under criticism on several occasions is still to be seen though perhaps not to the same extent as before. We are informed, for instance, that the freight on some of the chemicals from Ambernath to the interior was higher than from Bombay to the same places though the distance in the latter case was about 45 miles longer. We pointed this out to the Agent of the Great Indian Peninsula Railway and he assured us that if his attention had been drawn to this, he would have equalised the freights from the two places. But equalisation of the freights does not, in our opinion, meet the objection in principle that the indigenous industry is deprived of its geographical advantage and the foreign industry is given to that extent a preference over the indigenous industry. We do not deny that such inequalities of rates may admit of justification if considered purely from the point of view of railway economics, but in certain directions it is essential that considerations of railway finance should be subordinated to the interests of the country as a whole.

Rate of freight which industry can afford.

124. If a single large scale unit to supply the whole Indian market for chemicals is brought into existence in or near the coalfields, very different conditions both of traffic and of market will prevail from those that have so far been brought to the notice of the railway authorities and we shall now proceed to investigate what such a unit could afford to pay for the transport of its surplus products to other markets. We think that the question can be most satisfactorily examined if we take for illustrative purposes the Bombay market as the one in which these products are to be sold. It is the largest individual market for these heavy chemicals in India and is perhaps in point of distance also the farthest from Calcutta with the exception of Sind. In paragraph 119 we have given a table to show the margin of profit per ton for each product. In the case of the salts we should be justified in treating the whole of the difference between the fair selling price and the c.i.f. price in Bombay as representing the margin of surplus profit. In the case of the acids, however, such an assumption would be misleading. The prices of acids on the Bombay side are on higher levels than those for the salts because there is no competition either between the local producers themselves or between the local producer and the foreign manufacturer. The erection of a competing factory in Bengal will, until a complete reorganisation of the industry takes place and the smaller units cease to function, create severe competition and the price of acids must drop considerably below their present levels before they obtain a footing in this market. We should not be justified therefore in estimating the margin of profit on rectified oil of vitriol at more than Rs. 50 or that on nitric acid at more than Rs. 60 in view of the recent importation into Bombay of that acid at an abnormally low figure. The profit on hydrochloric acid might reach Rs. 300. In the following table we give the total profit which the sale of these chemicals will yield.

Chemical.	Tons	Profit per ton.	Total.
		Rs.	Rs.
Acids-			
Rectified oil of vitriol	1,500	50	75,000
Nitric acid	150	60	9,000
Hydrochloric acid	75	300	22,500
	1,725		1,06,500
Salts–			
Glauber's salts	300	4·05	1,215
Sodium sulphide	1,000	9·23	9,230
Zinc chloride	1,000	44·91	44,910
Epsom salts	2,000	2·25	4,500
Copperas	500	19·40	9,700
Copper sulphate	250	5·51	1,377
Alumino-ferric	500	14·98	7,490
Potash alum	2,000	19·19	38,380
	7,550		1,16,802
		TOTAL	2,23,302

The profit which the manufacturer will earn over and above his fair selling price thus amounts to Rs. 2,23,302. If the freights on raw materials are also reduced the margin will be somewhat higher. But we have not been able to take this factor into account owing to the difficulty of estimating the quantities of various raw materials and the distances. The total quantity of salts to be hauled is 7,550 tons and of acids 1,725 tons. Unless the freight on these quantities in addition to terminal, handling and carting charges at the Bombay end is covered by the total additional profit, *viz.*, Rs. 2,23,302, made on the Bombay market it will not pay the manufacturer to market these products in Bombay. In order that this may be possible the total charge that each ton of salts can bear should not exceed Rs. 20 per ton and for acids Rs. 30 per ton. This assumes that in the case of acids, on account of the large and continuous traffic which will be created, transport will be generally in bulk by means of tank wagons and that no extra freight on jars or carboys will be incurred. The aggregate charges would then absorb Rs. 2,02,750 of the available surplus:—

	Tons.	Charge per ton.	
		Rs.	Rs.
Salts	7,550	20 =	1,51,000
Acids	1,725	30 =	51,750
			2,02,750

By the shortest route the distance between Calcutta and Bombay may be taken approximately at 1,200 miles. If freight is calculated at ·1 of a pie per maund per mile on salts in wagon loads and ·15 of a pie per maund per mile on acids in wagon loads also, the former would amount to about Rs. 17 and the latter to Rs. 25-8-0 per ton. The terminal, handling and cartage charges to which we have referred may be estimated at about Rs. 3 per ton in the case of salts and about Rs. 4 per ton in the case of acids. Upon these figures it is fairly clear that for the Bombay market the freights which the salts and the acids can respectively bear are ·1 of a pie and ·15 of a pie per maund per mile. For nearer markets the products will be able to bear somewhat higher rates. We have treated the subject very generally and in considering the rates which the industry can afford have taken the profit in the Bombay market over and above the fair selling price for this group of chemicals as a whole. Our proposition may not hold good in some cases if each chemical is considered singly. It may not pay, for example, to send zinc chloride or epsom salts to the Bombay market even on the reduced rates. But it will be seen from the figures that the margin on the whole group of chemicals supplied to Bombay after meeting railway freight on the proposed scale will enable the manufacturer to adjust his prices for zinc chloride and epsom salts in conformity with import prices in the Bombay market. We have not overlooked the fact that there will also be considerable addi-

tional profits over and above those allowed for in the fair selling price on the sale of acids and salts in Calcutta. Our argument as regards rates, however, has been based on the assumption that the whole of the Bombay market will be captured by the Calcutta manufacturer and that competitive conditions will remain much as they are at present. Both these assumptions are likely to be falsified at any rate during the period in which the industry is establishing itself and we consider therefore that the possibility of additional profits in Calcutta should be regarded as offsetting the possibility of severe competition in Bombay.

Reduction of earnings.

125. The question that we have now to consider is whether the railway administration should be called upon to make a reduction in freights. The East Indian and the Great Indian Peninsula Railways have supplied us with information regarding the rates which would be charged for these chemicals between Calcutta and Bombay. Though this route is longer than that by the Bengal Nagpur Railway we prefer to use these rates because the former railways have fixed special rates for most of the chemicals. The Bengal Nagpur Railway on the other hand usually charges the ordinary rates as there is little or no traffic in chemicals at present on that railway. For the purpose of illustrating the position we give below a table showing the difference per ton mile and the difference in earnings at the rates now in force and at the rates proposed. The rates given refer to complete wagon loads. Making allowance for telescopic distances the rates work out as follows:—

Chemicals.	Production for Bombay market.	Present Rate.		Proposed Rate.		Difference.		Difference in earnings in freight to Bombay.
		Per md. per mile.	Per ton per mile.	Per md. per mile.	Per ton per mile.	Per md. per mile.	Per ton per mile.	
Salts.	Tons.	Pies.	Rs. a. p.	Pies.	Rs. a. p.	Pies.	Rs. a. p.	Rs.
Glauber's salts	300	·19	0 0 5·13			·09	0 0 2·43	4,556
Sodium sulphide	1,000	·31	0 0 8·37			·21	0 0 5·67	35,437
Zinc chloride	1,000	·41	0 0 11·07			·31	0 0 8·37	52,312
Epsom salts	2,000	·41	0 0 11·07			·31	0 0 8·37	1,04,625
Copperas	500	·29	0 0 7·83	·10	0 0 2·7	·19	0 0 5·13	16,031
Copper sulphate	250	·41	0 0 11·07			·31	0 0 8·37	13,078
Alumino-ferric	500	·29	0 0 7·83			·19	0 0 5·13	16,031
Potash alum	2,000	·19	0 0 5·13			·09	0 0 2·43	30,375
Acids.								
Rectified oil of vitriol	1,500	·50	0 1 1·5			·35	0 0 9·45	88,594
Nitric acid	150	·79	0 1 9·33	·15	0 0 4·05	·64	0 1 5·28	16,200
Hydrochloric acid	75	·79	0 1 9·33			*64	0 1 5·28	8,100
Total	..	..	..	..	..	..	..	3,85,339

Haulage costs.

126. Since most of the chemicals now manufactured in India are used in the large industrial centres situated at the seaports it is probable that the immediate loss to the railways resulting from the adoption of these reduced rates would be insignificant. As regards the future it will be seen from the above table that if the whole production that we have estimated for the Bombay market were carried by the railways the difference between the earnings at existing rates and those we have suggested would be Rs. 3,85,339. This difference, however, cannot be regarded as a loss to the railways for the increased traffic could only be obtained as a result of reduced rates. The railway revenues therefore would be affected only if the rates were insufficient to cover the cost of transport. We realise that it is quite impossible to say with reference to any particular item of traffic what its cost is to the railway and indeed the railway officials who have appeared before us frankly admitted that it could not be established that the minimum rate of ·1 pie per maund per mile would involve the railway administration in an actual loss. The minimum rate is in force for several commodities such as bauxite and fertilisers for distances over 400 miles. The special rate granted by the Bengal Nagpur Railway to the Tata Iron and Steel Company for the haulage of their finished products is the minimum class rate. In 1923 a special rate was quoted by the Great Indian Peninsula Railway in conjunction with the Bengal Nagpur Railway of pie ·22 per maund per mile for sulphuric acid in tank wagons between Ambernath and Tatanagar. It appears therefore that the suggestions which we have put forward are not inconsistent with the general railway policy. In the case of the three principal railways, *viz.*, the East Indian, the Bengal Nagpur and the Great Indian Peninsula, which will carry the whole of the traffic between Calcutta and Bombay, some support is lent to this view by an examination of the following figures relating to the average cost of haulage per ton mile given in statement 15, Vol. II of the Report of the Railway Board on Indian Railways for 1927-28:—

	Cost of haulage per ton mile.	= Maund mile.	Cost of haulage per ton mile *plus* 5½ per cent. interest on capital.	= Maund mile.
	Pies.	Pies.	Pies.	Pies.
Bengal Nagpur Railway . .	2·66	·098	4·50	·166
East Indian Railway . .	2·50	·092	3·94	·145
Great Indian Peninsula Railway	3·78	·14	6·26	·231

Though we do not suggest that the average haulage cost is necessarily the actual cost of haulage of any particular commodity, the figures do afford some indication of the ability of the railways to transport chemicals at the rates which we have suggested. On the figures as they stand both the Bengal Nagpur Railway and

the East Indian Railway will at the rates that we have suggested for salts fully cover the haulage cost. In respect of the acids the East Indian Railway will cover not only the cost of haulage but also the interest charges. The position of the Bengal Nagpur Railway is almost equally favourable except that in the case of the acids it will just fail to recover the whole of the interest. As regards the Great Indian Peninsula Railway the figures are less favourable. On acids it will receive the average haulage costs in full; but on salts its receipts will fall short of the average haulage cost by ·04 pie. It must be remembered that not all rates are expected to cover haulage charges and capital charges. On the principle of assessing rates on what the traffic will bear, the more highly assessed traffic is expected to bear a portion of the charges for the more lightly assessed traffic. It appears to us, therefore, that in the case of a key industry the railways might reasonably be expected to accept rates approximating more or less to the rates which we have suggested.

Railways—a public utility service.

127. A railway is a public utility service and its object must be to provide transport at the cheapest possible rate so that both industries and agriculture may develop and so add to the prosperity of the country. We have no desire to enter into any controversy as to whether the policy of the country with reference to railways ought to be on different lines, but we think it must be pointed out that so long as railways are used not merely as public utility services but as a source of profit or rather of taxation the reduction of freights so necessary to the development of industries must be retarded. For the past several years the railways have made not only very large contributions to the general revenues after meeting heavy depreciation, replacement charges, loan charges and working expenditure but have also carried to reserves nearly Rs. 20 crores. The net profit after meeting all legitimate charges last year was Rs. 11 crores. It would appear therefore that the railways can well afford a reduction in the rate of transport for chemicals and the raw materials required in their manufacture. It is true that during the period in which the industry is in process of re-organization, such reduction may result in a small fall in railway revenue. But any loss to general revenues resulting therefrom will probably be made good by the revenue received from the protective duties which we have proposed. We believe that when, facilitated by the reduction of rates, the establishment of a large unit is accomplished, the increased traffic resulting therefrom will prove remunerative to the railways, while the general revenues of the country will also benefit from the increased prosperity resulting from manufacture on a large scale.

Increased traffic.

128. Even if it could be established that in the case of some of the chemicals on the basis of present traffic returns the railway administration is likely to lose permanently by the adoption of reduced rates, the objec-

tion on that score in our opinion will not be decisive. The problem must be looked at as a whole from two points of view. First whether the reduction of freights results in the creation of additional traffic and thereby increases the total earnings of the railways: secondly whether it would on the whole be in the national interest, if the reduction of freights helps the building up of a large chemical industry in the country. The railways have at present practically no traffic in these products between the ports of Calcutta and Bombay or between any one port and another. By the establishment of a large unit this traffic will be created. As regards the interior the position will probably remain the same as now except that instead of the traffic being distributed from three or four different ports, it will be taken from one centre. The establishment of the chemical industry, however, even confined as it is at present to a dozen chemicals, in the country would give to the railway administration an additional amount of traffic in raw materials also. Taking the chemicals (excluding fertilisers) we estimate that the additional traffic that the railways would receive in raw materials is approximately as follows:—

	Tons.
Bauxite	3,000
Magnesite	1,200
Coal	30,000
Iron scrap	600
Zinc scrap	750
Salt	1,500
Copper	300

We have so far dealt with the few chemicals that are now under discussion, but if a large and well developed chemical industry were established in the country, the amount of additional traffic that the railways would obtain would be very much higher. In chapter II we have shown the possibilities of the industry, if the other industries dependent on the growth of the heavy chemical industry are taken into account. It is not necessary for our purpose to elaborate the argument, but if, for instance, the reduction of freights makes it possible to establish an alkali industry in the country, the finished products alone may amount to more than 70,000 tons per year, a considerable percentage of which will require to be hauled from the centre of production to different ports. In the production of this quantity large amounts of raw materials would be required. The principal raw material is salt which, if the industry is located near the coalfields, will have to be taken over a distance of several hundred miles. Limestone will have to be collected from a radius of, say, 150 miles. Unless the industry

is located actually in the coalfield itself, coal may have to be carried over a distance of 100 to 150 miles. In addition to these materials large quantities of stores, machinery, building materials, etc., will have to be transported. Again, the potential market for fertilisers in India is enormous. Their manufacture on a large scale in the not distant future is quite probable and as a result a substantial increase may be expected in railway revenues. Upon a long view, while the reduction of freight would benefit the industry, the railway administration itself would benefit by the creation of a considerable amount of new traffic. The benefit to the railway, moreover, does not end with the direct growth in the goods traffic connected with manufacture. The concentration of a large and flourishing industry in one place implies also the creation of a considerable labour population residing in close proximity to the works. Much additional traffic, both goods and passenger, may be expected from the growth of such a population.

Shortening of period of protection.

129. The argument that the speedy establishment of a large chemical industry, if it can be brought about by a reasonable reduction of freights, will promote the national interest is too obvious to call for much discussion. The industrial and agricultural development of every country is, in the present day conditions, largely a matter of the study, manufacture and application of chemicals, and the more backward the country the greater the need for their development. The industrial advancement of India is hampered to a very large degree by small scale manufacture and the employment of small and uneconomic units of production. This is peculiarly the case with the chemical industry and any measures not involving an undue sacrifice of public resources, which will help the establishment of large scale industries, cannot but be regarded as steps in the right direction for the attainment of an object in itself of great national importance. The case for a reduction of freights from the national point of view does not, moreover, rest solely on general grounds. The economic argument in its favour is equally strong. We have held that the industry has made out a case for the grant of protection, and we have recommended a measure of protection which we believe should place it on a sound footing. But the measure of protection has had to be pitched at a higher level than would have been necessary had it been possible for the industry to adjust itself to modern conditions within the period of protection, and to manufacture on a scale which would have made the employment of a large unit of production possible. Our estimates of the fair selling prices on which protection would have been based if a single unit of manufacture producing on a large scale had been in existence in Bengal are given in paragraph 105. If we assume that approximately half the output would be sold in the Bombay market, the average additional charge per ton of the salts which we are now considering on account of railway freight would be Rs. 10 on the tentative rates

proposed by us. The resulting position is shown in the following table:—

	Fair selling price on 4,000 tons Bombay.	Fair selling price on 8,000 tons Calcutta *plus* freight	Difference
	Rs.	Rs.	Rs.
Glauber's salts	43·83	48·58	− 4·75
Sodium sulphide	142·75	128·75	+14·00
Zinc chloride	338·76	244·63	+94·04
Epsom salts	81·70	79·55	+ 2·15
Copperas	66·55	63·05	+ 3·50
Copper sulphate	400·70	396·02	+ 4·68
Alumino-ferric	76·93	72·03	+ 4·90
Potash alum	125·75	120·63	+ 5·12

The existing railway freights have been accepted by us as a temporary justification for the continuance of smaller units than we have considered economic. The natural consequence, as the above table shows, is that the burden on the consumer is likely to be heavier. Further, though we have held that the industry will eventually be able to stand world competition without protection, it has not been possible for us to estimate with precision the length of the period during which protection should continue. We have proposed that the period of protection should be fixed provisionally at seven years, but in the absence of a large unit serving the bulk of the market, protection should obviously continue until each important market or centre of distribution has developed a demand which would justify the establishment of a unit of production sufficiently large to reduce the fair selling price below the import price.

Economic justification.

130. Though our recommendations have in no way been affected by the possibility of a reduction in freights, and we have based our proposals on their existing level we believe that the possibility of organizing the chemical industry on a satisfactory basis depends to a great extent on the fixation of lower railway freights. We have attempted to visualise the possibilities of the industry from the traffic point of view and bring them to the notice of the railway authorities and Government. Judging from the representations of some of the railway administrations, it appears as though they were under the impression that in proposing the reduction of railway freights we were advocating the payment of an indirect bounty to the indigenous industry, or differentiation involving undue preference as between locally manufactured and imported articles. There is no justification for such a misapprehension. We are recommending the reduction of freights precisely upon grounds similar to those on which a railway administration might adopt it, *viz.*, that the freights should have some relation to what the traffic can bear, and

that lowering of freights if it results in the long run in the expansion of traffic, is to the advantage of railways from the economic point of view. Having this object before us, but bearing in mind also that the chemical industry is a key industry of very great national importance, we desire to put forward the following propositions for the consideration of Government:—

(1) That the freights payable on the various raw materials and finished products of the chemical industry should be reduced to the lowest possible rates.

(2) That in order to introduce uniformity and create certainty as to the incidence of the freight so far as possible uniform rates for chemicals be adopted on all railways.

(3) That if telescopic rates are adopted they should be applied as a through rate as in the case of coal; and, in view of the importance attached to the encouragement of the use of fertilisers and the probability of an increase in the traffic in this commodity, it should be considered whether the freight on fertilisers cannot also be reduced on lines similar to the reductions made in the case of coal.

We desire also to say that since the amount of protection granted to the industry can be changed by any variation in freights, no increase in freights should take place during the period of protection without reference to the Government of India.

131. That the reduction of freights is a practical method of assisting key industries has recently been shown by the adoption in Great Britain of the derating scheme under which railways receive a rebate of about £4,000,000 per annum. This amount is to be spent by the railways on the reduction of freights. Agriculture is to receive £800,000 enabling a rebate of 10 per cent. to be made on the selected raw materials of that industry. Of the remaining £3,200,000 the greater part will go to the reduction of the freight rates on coal, the rest to the reduction of the freights on limestone, iron and other raw materials of the iron and steel industry.

Reduction of freights in Great Britain.

132. If the principles suggested in paragraph 130 are adopted by the Government it is not unlikely that the smaller units brought into existence either at the ports or in the interior behind the protection enjoyed by them in the local markets owing to the past policy of the railways may cease to function. But that is precisely the object in view if a chemical industry organized in accordance with modern methods is to be established in India. In any event if protection is granted to the chemical industry, smaller units must eventually disappear if the policy of protection succeeds because the industry itself must realize sooner or later that it is only by the erection of large units that it can hope to meet foreign competition.

Disappearance of smaller units.

133. We desire to make it clear that we have assumed that a large unit of production will be established in Bengal merely for illustrative purposes. It would be incorrect to conclude that in establishing the chemical industry in Bombay a mistake has been made which should be discounted in framing any proposals for protection. Except as regards fuel Bombay has a decided advantage over Bengal. The market for these chemicals is greater while sulphuric acid requires little or no fuel and to the extent to which that acid enters into the manufacture of other chemicals Bombay is at no disadvantage. We express no definite opinion as to where the industry should be located. This is a question for the industry to decide having regard to the accessibility of raw materials and the requirements of the market. Our intention is to illustrate the advantages of unified production and control as an important factor which, with reduction of freights, may eventually make the establishment of this industry on a large scale in the country a practical proposition.

Location of industry.

CHAPTER XI.

Removal of Duties.

134. One of the questions specifically referred to us for investigation is that of the removal of duties on chemicals used in industries. Paragraph 3 of our terms of reference runs as follows:—

Sacrifice of revenue involved.

"The removal of the import duties on materials of industry was recommended by the Fiscal Commission and is in accordance with the principle of the Resolution adopted by the Legislative Assembly on the 16th February, 1923. Chemicals are utilised as raw materials in certain Indian industries and the Government of India have decided that, along with the question of extending protection to the manufacture of particular chemicals, the Tariff Board will examine the question of the removal of the import duties on those chemicals which are used as materials in Indian industries."

Whilst we are in entire agreement with the principle enunciated in the Government of India Resolution, the question of the removal of the import duties on those chemicals which are used as materials in Indian industries is not free from difficulty. Before deciding whether industries will benefit by the removal of these duties, it is necessary to consider the sacrifice of revenue involved and whether it would be commensurate with the advantage which the industries would derive. It may be presumed that most of these chemicals are used by industries and that the duties therefore are a burden upon them. But the evidence in our possession does not enable us to ascertain the precise burden on each industry using these chemicals. We have, therefore, to consider whether the duties should be removed *en bloc* or whether the removal of the duty should be confined only to those industries which have been able to establish that their costs have been substantially increased by the existence of these duties. If we were to adopt the former course, the sacrifice of revenue involved would on the average of the last three years amount to about Rs. 35 lakhs, for the imports of chemicals classified as such amount to nearly Rs. $2\frac{1}{2}$ crores a year. In our opinion, however, this will not represent the whole amount which the Government would lose for some of the chemicals may have been classified under other heads such as paints and colours, dyes, etc. Without a more elaborate enquiry than it has been possible to undertake, we are unable to estimate what additional revenue would be sacrificed. The attention of manufacturers was drawn both in the Board's press communique and during the public sittings of the Board to this aspect of our enquiry, but we have received very few representations demanding the removal

of these duties and none that has been able to substantiate its claim.

Individual representations considered.

135. The following representations have been received:—

(1) *Messrs. Adamjee Hajee Dawood and Company.*—This company asks for the removal of duties on chemicals used in the manufacture of matches. In our report on the match industry we took these duties into account and our recommendations which have been accepted by Government afford the industry adequate protection without their removal.

(2) *Messrs. Jenson and Nicholson (India) Limited, Calcutta.*—The applicants are manufacturers of paints and use a number of chemical colours. Most of these chemical colours do not come strictly within the category of chemicals and in any case many of them are manufactured in India. The removal of these duties might therefore damage an existing Indian industry. Further, there is already a duty of 15 per cent. on the finished products as also on the colours in question and therefore until it is shown that the duties on imported pigments cause a tariff inequality which places the domestic manufacturer at a disadvantage compared with the foreign manufacturer, there is no case for their removal.

(3) *Shalimar Colour, Paint and Varnish Company, Limited.*—This firm also manufactures paint and opposes any increase in the duty on sulphuric acid, ferrous sulphate, Glauber's salts or hydrochloric acid. Of these chemicals we are recommending an increase of duty on Glauber's salts only and that increase is insignificant. The annual consumption of sulphuric acid by this firm amounts to only 6 tons a year which would represent a total burden of not more than Rs. 120 per year. Of ferrous sulphate they use 7 tons a year, the duty upon which is only 2½ per cent. and would amount to Rs. 14 a year. As regards Glauber's salts, the total requirement of this firm is 5 tons which would mean a burden of Rs. 35 per annum. They also use 2 tons of hydrochloric acid which would involve a burden of Rs. 115. It will thus be seen that from these figures the total duty per annum is less than Rs. 300 a year, and it is obvious that the burden involved is negligible.

(4) *Chrome Leather Company, Madras.*—This firm uses some of the chemicals now under investigation. We asked for information regarding the precise nature of the burden thrown upon the industry and have been supplied with the following information:—

Chemical.	Average annual consumption.	Percentage of cost price of finished leathers.
	Tons.	Per cent.
Magnesium sulphate	12	·02
Aluminium sulphate	4	·02
Sodium sulphide	50	·02
Copper sulphate	1	·905

From the above figures it will be seen how small is the increase in cost as a result of these duties.

(5) *Bengal Paper Mill Company, Limited.*—This firm submitted a representation requesting that the duty on aluminium sulphate should not be raised but subsequently withdrew it on the ground that, in view of the new system of water supply adopted by them, heavy quantities of aluminium sulphate are no longer required and the firm therefore has no cause for complaint.

(6) *North West Soap Company.*—This firm manufactures glycerine and has represented that the duty on hydrochloric acid should be reduced or at least should not be raised. We do not propose any increase in the import duty on this acid. We have received no figures regarding the amount of hydrochloric acid used in the preparation of glycerine but so far as our information goes the burden imposed by the duty is small.

136. These are the principal representations we have received in connection with the removal of the duties. We have ourselves examined the question in the light of such evidence as we have been able to obtain. Most of the chemicals under consideration are used by the textile industry. We examined a representative of the Mill Owners' Association at Bombay and he agreed that if protection were granted to these chemicals, the additional burden on the textile industry would be inconsiderable. This will be seen from the following table prepared from figures supplied by the Sassoon group of mills relating to two typical kinds of cloth.

Removal of duties not justified

	Amount per piece.	Value in pies.	Percentage of cost.	Proposed duty in pies.
I.				
	oz.			
Zinc chloride . .	¾	1·0125	·0928	·3465
Epsom salts . .	12	3·6514	·3381	1·6071
Sodium sulphide .	6	3·6964	·3422	·9241
Glauber's salts .	6	1·1893	·1101	·2411
				3·1188

=·2888 per cent. of the sale price.

II.				
	oz.			
Zinc chloride . .	¾	1·0125	·0811	·3465
Epsom salts . .	8	2·4343	·1951	1·0714
Sodium sulphide .	4	2·4643	·1975	·6161
Glauber's salts .	7	1·3875	·1112	·2813
				2·3153

=·1855 per cent. of the sale price.

Although the textile industry is now in a very depressed condition, the above figures suggest that the burden thrown upon it by the duties cannot be regarded as justifying their removal. We

are satisfied therefore that there is no case at present for the removal of the duty on chemicals. The sacrifice of revenue would be out of all proportion to the benefit to industries. No substantial relief is likely to result from a partial removal of duties on raw materials. If industries are to derive any material benefit, what is required is a rearrangement of the Customs tariff in such a way that apart from protective duties the tariff schedule should consist of as few duties as possible. These duties should be confined as a rule to commodities in large demand from which substantial revenue may be expected and articles such as raw materials of industries should be totally exempted. Until a fiscal policy on these lines is evolved, such relief as industries require must be given either by way of compensatory protection or by the removal of tariff inequality.

CHAPTER XII.

Summary of findings and proposals.

Summary of conclusions.

137. We summarise our conclusions as follows:—

The basis of the whole group of chemicals considered in this report is sulphuric acid. On account of the heavy freight on acids, the manufacture of sulphuric, hydrochloric and nitric acids has generally been carried on profitably in India. The absence of this natural protection, however, in the case of salts derived from sulphuric acid has prevented their manufacture except on a small scale.

2. The total market in India (excluding Burma) for the chemicals with which we are concerned is approximately 12,000 tons in terms of chamber acid on a 100 per cent. basis. In the next few years we estimate that the market may reach 16,000 tons, without taking into account the manufacture of artificial fertilisers. On these figures we find that the market in India is sufficiently large for the production of chemicals on an economic scale.

3. The machinery used in modern chemical works is generally simple in operation and can be easily handled by Indian labour. Further, fuel being an important item in the cost of many chemicals the abundance of cheap fuel especially near the coalfields places India in a position of considerable advantage.

4. Although India possesses several of the raw materials required for the chemical industry such as salt, bauxite, magnesite, potassium nitrate, and copper, iron and zinc scrap, it is lacking at present in the most important material namely sulphur. We do not however consider that this is a bar to the grant of protection to the chemical industry. India in this respect is at no disadvantage as compared with the two principal competing countries, Great Britain and Germany. It is by no means certain that the existence of an indigenous supply of sulphur would cheapen the cost of the material in India since unless the deposits were very extensive and conditions of free competition prevailed internal prices would necessarily conform to the world parity price. Moreover there are alternative sources of supply such as zinc concentrates, copper sulphide and gypsum which are present in sufficient quantities and at least in times of war might prove of great value.

5. The case for protection of the chemical industry rests primarily on its supreme national importance. It is a key industry whose products are used in most other industries, it is indispensable for purposes of national defence and it provides an essential foundation for chemical research in industries and agriculture.

6. The largest chemical works in India at present are situated in Bombay. Taking the Dharamsi Morarji Company's Works at Ambernath as typical of chemical works in India, we find that under present conditions of production the fair selling price of

chamber acid on a 100 per cent. basis including overhead charges and profit is Rs. 105 a ton. The corresponding costs of the chemicals based on sulphuric acid would leave the company at current market prices with a net loss of at least Rs. 40,000 on the works costs alone and Rs. 95,000 on the works costs and overhead charges together. In these circumstances the industry would in the natural course cease to exist if no protection were granted.

7. The present costs of the industry however are based on too small a scale of production and cannot be accepted as a suitable basis for determining the measure of protection. We consider that if the industry were so organised that one of the two chemical works in Bombay would supply the whole of the market in Western India, the resulting costs would afford a more appropriate basis for determining the measure of protection.

8. On this basis we consider that during the period of protection the industry should attain an average annual production of 4,000 tons of chamber acid on a 100 per cent. basis. If this output is attained, we estimate that the fair selling price of chamber acid at 100 per cent. will be Rs. 75 a ton. Taking the corresponding fair selling prices of the various chemicals and comparing them with the latest import prices, we find that except in the case of epsom salts and zinc chloride, no substantial addition to the revenue duty will be required while in some cases duties considerably less than the revenue duty will suffice. On the three acids and on copperas no protection will be necessary.

9. If the industry attains an output of 8,000 tons of chamber acid on a 100 per cent. basis, for which in the next few years a sufficient market would be found in Western India, we estimate that the fair selling price of chamber acid at 100 per cent. will be Rs. 55 a ton, which compares very favourably with the price of sulphuric acid of the same strength in any other part of the world. On the corresponding fair selling prices for the various chemicals, we find that the three acids and five out of the eight salts we are considering will require no protection at all. Of the remaining salts, one will require a duty well below the revenue duty and in the case of two only would a duty in excess of the revenue duty be required. Further economies and increased output may reduce costs still more.

10. On these facts we find that the conditions laid down by the Fiscal Commission are substantially fulfilled by the chemical industry.

11. Our recommendations regarding the form and measure of protection are set out in chapter VI and Appendix I. We propose that the protection required should be given generally in the form of specific duties. In the case of epsom salts and zinc chloride the specific duties proposed are equivalent to *ad valorem* duties of 44 per cent. and 34 per cent. respectively. We are satisfied that no appreciable burden will be thrown on industries thereby. On the other chemicals, the duties represent substantially the

present level of revenue duties. In certain cases where on the fair selling prices a reduction in the revenue duties might be theoretically justifiable, we have proposed their retention at the present rate as there has been no serious demand for their reduction and the effect on the industries concerned is negligible.

12. We desire to emphasise the interconnection of the duties we have proposed on the various classes of chemical products. The alteration of any individual duty may have unforeseen consequences on the output and cost of production of other chemicals, thus vitiating the whole scheme of protection.

13. On account of overproduction in European countries and the existence of large combines in the chemical industry, we cannot make any forecast regarding the future course of import prices. We therefore recommend that power should be conferred on the Governor General in Council to levy such additional duties as may be necessary to offset a decline in import prices.

14. It is impossible to estimate precisely the period within which the chemical industry will be able to dispense with protection. We therefore recommend as in the case of the steel industry that no limit should be fixed to the period of protection, but that provision should be made for a fresh enquiry at the expiration of seven years.

15. We find that there is no case for the removal of the import duties on those chemicals which are used as materials in Indian industries. No substantial relief of the burden on industries is likely to result and the question of the removal of these duties must wait until a general revision of the fiscal policy with a view to the removal of duties on all raw materials is effected.

16. In view of the close connection between the chemical industry and the manufacture of two classes of artificial fertilisers namely ammonium sulphate and superphosphate in the manufacture of which sulphuric acid plays an important part and in view of their obvious importance for Indian agriculture, we have considered the advisability of fostering the manufacture of these fertilisers in India.

17. No assistance is called for under present circumstances in respect of ammonium sulphate. But, having regard to the fact that ammonium sulphate is already produced in India on a considerable scale, we consider it important that the price at which it is sold in India should be substantially reduced with a view to the encouragement of agriculture and extension of the market for fertilisers. The present price in India is considerably above the level in England, though the purchasing power of the Indian ryot is much below that of the English farmer.

18. We find that the manufacture of superphosphate is a suitable industry for the grant of protection. We believe that in spite of competition from compound fertilisers there will be a sufficiently large market in India for superphosphate and that the

establishment of a local industry will help materially to reduce its price to the great benefit of the Indian agriculturist.

19. We recommend that the protection required for the manufacture of superphosphate should take the form of a bounty. The bounty should be payable on the first 10,000 tons of superphosphate produced in a year by any individual factory whose annual output is not less than 2,000 tons. We have proposed a minimum output to qualify for the bounty because we consider that it is undesirable to encourage the establishment of small uneconomic units of manufacture which would be unable to survive the withdrawal of protection. The rate of bounty should be fixed at 12 annas per unit of soluble phosphoric anhydride. The payment of bounty should be subject generally to the conditions laid down in the Steel Industry (Protection) Act, 1924 and the maximum liability of Government should be fixed at 7 lakhs of rupees annually for a period of seven years.

20. We have based our proposals for the protection of the chemical industry on the assumption that production will be carried on by several units of manufacture working independently in the principal centres of distribution. In view of the increasing tendency to large scale organisation in other countries, we consider that a much more economical method of development would be to organise a single unit of manufacture supplying the whole of the Indian market until each important centre of distribution has ultimately developed a large enough market of its own. A reorganisation of the industry on these lines necessarily implies a substantial reduction of transport charges both on raw materials and on finished products by the principal carriers of goods in the country namely the railways.

21. On a careful examination of the question, we find that a policy of reduction of railway freights with a view to the formation of a large scale chemical industry in India will be not merely to the national interest but to the interest of the railways themselves. The reduction in the costs of the industry will provide a sufficient margin to cover railway freight from the centre of production to the more distant markets, while the resulting growth in traffic will increase the aggregate revenues of the railways. The burden of protection also would be less and its period considerably shortened.

P. P. GINWALA—*President.*
A. E. MATHIAS, } *Members.*
J. MATTHAI, }

R. L. WALKER—*Secretary.*

24th May, 1929.

APPENDIX I.

If our proposals for protection are accepted the following alterations in Schedule II of the Indian Tariff Act, 1894, will be necessary:—

In part III, No. 50, Copperas, green will have to be deleted.

In part VII, the following additions will be required:—

Names of Articles.	Rate of Duty.
CHEMICALS, DRUGS AND MEDICINES.	
Acid, hydrochloric	Rs. 2-9-0 per cwt., or 15 per cent., *ad velorem*, whichever is higher.
Acid, nitric—	
Having a density at 15° C. of not more than 1·42 grammes per cubic centimetre .	Rs. 3-10-0 per cwt., or 15 per cent., *ad valorem*, whichever is higher.
Having a density at 15° C. of more than 1·42 grammes per cubic centimetre .	Rs. 5-3-0 per cwt., or 15 per cent., *ad valorem*, whichever is higher.
Acid, sulphuric	Rs. 1-4-0 per cwt., or 15 per cent., *ad valorem*, whichever is higher.
Alum, *viz.*, ammonia alum, potash alum or soda alum	As. 15 per cwt.
Aluminium sulphate or hydrated aluminium sulphate, including alumino-ferric and alum cake—	
Containing not more than 0·010 per cent. of iron	As. 13 per cwt.
Containing more than 0·010 per cent. of iron	As. 9 per cwt.
Copperas	As. 2 per cwt.
Copper sulphate or hydrated copper sulphate .	Rs. 3 per cwt.
Magnesium sulphate or hydrated magnesium sulphate—	
Containing not more than 50·0 per cent. of magnesium sulphate . . .	Rs. 1-4-0 per cwt.
Containing more than 50·0 per cent. of magnesium sulphate	Rs. 2-8-0 per cwt.
Sodium sulphate or hydrated sodium sulphate—	
Containing not more than 50·0 per cent. of sodium sulphate	As. 6 per cwt.
Containing more than 50·0 per cent. of sodium sulphate	As. 13 per cwt.
Sodium sulphide or hydrated sodium sulphide	Rs. 1-7-0 per cwt.
Zinc chloride or zinc chloride solution . .	Rs. 4-5-0 per cwt.

APPENDIX II.

TABLE A.

Market in the Bombay Presidency.

	Salts.						Acids (sold as such).	
	Imports Bombay.	Imports Sind.	Local production.	Total.	Equivalent of sulphuric acid.	——	Estimated market.	Equivalent of sulphuric acid.
	Tons.	Tons.	Tons.	Tons.	Tons.		Tons.	Tons.
Glauber's salts . .	Not listed	*nil*	300	300	*nil*	Rectified oil of vitriol.	1,500	1,650
Sodium sulphide . .	1,830	5	*nil*	1,835	*nil*	Nitric acid	150	231
Zinc chloride . .	1,214	18	*nil*	1,232	1,056	Hydrochloric acid	100	150
Epsom salts . .	2,358	255	130	2,743	1,152			
Copperas . . .	4	88	475	567	227			
Copper sulphate . .	113	70	35	218	96			
Aluminium sulphate .	619	48	65	732	344			
Alum	920	1,361	350	2,631	1,000			
TOTAL .	7,058	1,845	1,355	10,258	3,875		..	2,031
GRAND TOTAL OF SULPHURIC ACID.	..	..	..	..	5,906			

TABLE B.

Market in Bengal.

	SALTS.				ACIDS (SOLD AS SUCH).		
	Imports.	Local production.	Total.	Equivalent of sulphuric acid.	—	Market.	Equivalent of sulphuric acid.
	Tons.	Tons.	Tons.	Tons.		Tons.	Tons.
Glauber's salts .	Not listed	*nil*	*nil*	*nil*	Rectified oil of vitriol.	1,500	1,650
Sodium sulphide .	193	*nil*	193	*nil*	Nitric acid	200	308
Zinc chloride .	154	*nil*	154	132	Hydrochloric acid.	100	150
Epsom salts .	269	300	569	239			
Copperas . .	3	400	403	161			
Copper sulphate .	205	*nil*	205	89			
Aluminium sulphate.	2,241	1,400	3,641	1,711			
Alum . . .	113	250	363	138			
Total .	3,178	2,350	5,528	2,470			2,108
Grand total of sulphuric acid.	..	..	..	4,578			

TABLE C.

Market in the Madras Presidency.

——	SALTS.				ACIDS (SOLD AS SUCH).		
	Imports.	Local production.	Total.	Equivalent of sulphuric acid.	——	Market.	Equivalent of sulphuric acid.
	Tons.	Tons.	Tons.	Tons.		Tons.	Tons.
Glauber's salts .	Not listed	*nil*	*nil*	*nil*	Rectified oil of vitriol.	800	880
Sodium sulphide .	295	*nil*	295	*nil*			
Zinc chloride .	25	*nil*	25	21	Nitric acid	50	77
Epsom salts .	242	152	394	165	Hydrochloric acid.	30	45
Copperas . .	49	83	132	53			
Copper sulphate .	234	*nil*	234	103			
Aluminium sulphate.	300	*nil*	300	141			
Alum . . .	205	*nil*	205	78			
Total .	1,350	235	1,585	561			1,002
Grand total of sulphuric acid.	..	..	..	1,563			

TABLE D.

Market in India (excluding Burma).

SUMMARY OF TABLES A, B AND C.

Tons.

	Total salts.	Equivalent of sulphuric acid.	Acids (sold as such).	Equivalent of sulphuric acid.	Total equivalent of sulphuric acid.
Bombay	10,258	3,875	1,750	2,031	5,906
Bengal	5,528	2,470	1,800	2,108	4,578
Madras	1,585	561	880	1,002	1,563
	17,371	6,906	4,430	5,141	12,047

APPENDIX III.

Table showing the imports of chemicals and associated products into British India during 1913-14 and each of the five years from 1923-24 to 1927-28.

	Quantity.						Value.					
	1913-14.	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.	1913-14.	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
I—Chemicals (proper).												
A—Sodium Compounds.												
Total .	662,962	1,073,716	1,181,974	1,146,565	1,399,266	1,490,507	33,09,360	95,65,664	1,00,07,141	88,39,075	1,05,75,192	1,12,35,381
Share of Bengal . .	452,790	543,517	583,954	567,437	695,392	697,499	20,62,470	41,77,820	46,25,765	38,45,025	46,85,372	45,39,850
,, ,, Bombay .	104,201	229,052	218,214	188,859	277,919	276,971	5,46,915	20,00,675	15,47,697	14,37,880	21,45,132	22,32,681
,, ,, Sind .	50,469	161,407	198,283	206,489	229,973	264,622	3,00,090	15,08,237	16,55,736	14,16,058	16,18,928	18,23,805
,, ,, Madras . .	35,445	80,314	112,597	112,488	131,025	141,186	2,78,490	13,23,880	15,73,747	14,98,144	14,95,895	16,76,156
,, ,, Burma . .	20,057	59,426	68,926	71,292	64,957	110,229	1,21,395	5,55,052	6,04,196	6,41,968	6,29,865	9,62,889
B—Other Chemicals.												
Total .	..	..	..	..	..	..	62,39,820	95,92,886	97,07,770	1,00,52,271	1,22,60,745	1,32,65,828
Share of Bengal . .	..	..	..	..	..	..	19,13,445	29,04,204	29,65,382	32,27,501	36,49,068	38,19,862
,, ,, Bombay .	..	..	..	..	..	..	25,42,305	44,34,817	43,41,014	41,53,704	57,89,461	59,92,694
,, ,, Sind . .	..	..	..	..	..	..	4,52,745	8,99,432	8,38,766	7,78,893	8,31,361	10,51,051
,, ,, Madras .	..	..	..	..	..	..	7,56,615	7,25,638	7,42,274	10,82,339	11,59,518	14,82,719
,, ,, Burma . .	..	..	..	..	..	..	5,74,710	6,28,795	8,20,334	8,09,834	8,31,337	9,19,502

	Quantity.						Value.					
	1913-14.	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.	1913-14.	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.
II—Explosives.	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Total .	..	..	..	..	..	..	16,20,465	21,49,955	25,04,234	21,25,368	22,39,176	27,41,850
Share of Bengal . .	..	..	..	..	..	..	1,95,855	4,54,042	6,45,872	5,77,333	4,63,730	8,32,080
,, ,, Bombay .	..	..	..	..	..	..	3,47,280	4,37,350	6,64,111	2,49,851	6,00,438	5,97,355
,, ,, Sind . .	..	..	..	..	..	..	35,550	49,895	24,653	19,913	25,322	1,11,675
,, ,, Madras . .	..	..	..	..	..	..	8,46,000	8,30,296	7,72,563	8,69,028	6,40,998	6,32,071
,, ,, Burma . .	..	..	..	..	..	..	1,95,780	3,78,372	3,97,035	4,09,243	5,08,688	5,68,669
III—Glass and glass ware.												
Total .	..	..	..	..	..	..	1,94,52,795	2,45,74,237	2,60,01,338	2,59,45,644	2,52,88,239	2,48,40,850
Share of Bengal . .	..	..	..	..	..	..	60,46,905	80,04,498	77,42,655	83,85,939	86,68,080	80,83,678
,, ,, Bombay .	..	..	..	..	..	..	89,95,605	1,16,56,722	1,29,45,586	1,23,82,506	1,01,96,112	1,03,05,336
,, ,, Sind . .	..	..	..	..	..	..	11,28,270	14,76,031	13,89,317	14,88,439	17,16,909	15,22,274
,, ,, Madras . .	..	..	..	..	..	..	20,62,740	22,24,737	25,58,464	23,68,735	32,06,707	33,33,698
,, ,, Burma . .	..	..	..	..	..	..	12,19,275	12,12,249	13,65,316	13,20,025	15,00,431	15,95,864
IV—Dyes.												
Total .	145,053	148,890	167,069	92,077	133,992	164,864	1,06,00,965	2,51,03,616	2,56,25,979	1,43,23,175	1,70,30,122	2,16,28,560
Share of Bengal . .	13,155	5,905	6,836	5,502	7,550	9,471	11,71,785	11,69,416	11,86,174	9,09,012	11,32,949	12,82,654
,, ,, Bombay .	106,121	121,067	126,970	68,705	100,544	126,173	76,28,760	2,03,58,053	1,99,88,989	1,06,01,137	1,23,70,194	1,65,41,551

,, ,, Sind . .	6,041	5,756	9,056	3,123	4,741	6,230	4,09,095	9,92,474	11,34,127	5,29,742	6,21,255	6,68,002
,, ,, Madras . .	18,136	15,419	23,055	13,523	20,199	21,806	12,22,560	23,52,214	30,04,355	19,62,592	26,62,965	28,70,122
,, ,, Burma . .	1,600	743	1,152	1,224	958	1,184	1,68,765	2,31,459	3,12,334	3,20,692	2,42,759	2,66,231
V—Soap.												
Total .	362,860	17,725	361,205	96,655	402,475	422,489	75,06,000	1,19,27,266	1,32,47,591	1,46,11,219	1,52,41,278	1,61,37,248
Share of Bengal . .	66,138	24,879	48,016	63,354	58,270	55,368	16,29,675	16,14,513	21,42,341	25,73,035	26,90,564	27,59,025
,, ,, Bombay .	139,648	157,771	165,031	179,074	168,904	167,968	24,97,440	50,87,009	52,89,346	56,64,009	56,61,264	60,07,353
,, ,, Sind . .	26,994	22,540	27,861	27,418	35,333	34,876	6,56,790	10,96,391	13,03,134	11,92,698	14,94,850	14,56,622
,, ,, Madras . .	38,497	20,106	22,417	31,400	36,231	37,752	11,01,045	11,35,945	13,03,068	16,48,951	19,56,374	19,87,598
,, ,, Burma . .	91,583	92,429	97,880	105,409	103,737	126,525	16,21,050	29,98,408	32,09,702	35,32,526	34,38,226	39,26,650
VI—Artificial and Mineral Manures.												
Total .	164,680	139,640	252,340	431,760	517,080	714,180	9,52,140	10,22,735	15,28,236	27,50,449	30,65,609	42,00,138
Share of Bengal . .	54,780	72,100	188,460	296,740	306,600	392,640	2,89,515	4,71,948	11,09,086	18,41,341	17,40,897	21,69,723
,, ,, Bombay .	980	17,120	6,860	21,040	31,800	47,300	9,270	1,94,621	61,708	1,92,870	2,78,574	4,01,101
,, ,, Sind . .	40	840	1,120	2,280	4,380	1,900	120	8,741	14,344	21,727	42,362	17,401
,, ,, Madras . .	105,380	47,140	54,120	109,740	172,020	268,540	6,19,260	3,14,652	3,23,120	6,75,612	9,82,905	15,76,238
,, ,, Burma . .	3,500	2,440	1,780	1,960	2,280	3,800	33,975	23,773	19,978	18,899	20,871	35,675
VII—Artificial Silk												
Total .	..	..	..	..	..	..	..	1,23,64,329	2,27,95,433	2,18,74,911	4,21,73,042	5,48,82,551
Share of Bengal . .	..	..	..	..	..	..	..	.	54,30,635	32,40,778	74,03,250	96,02,944
,, ,, Bombay .	..	..	..	..	..	..	..	.	1,35,04,945	1,44,36,753	2,92,88,889	3,48,67,355
,, ,, Sind . .	..	..	..	..	..	..	..	.	16,17,040	13,09,879	24,92,697	31,05,256
,, ,, Madras . .	..	..	..	..	..	..	..	.	8,60,094	11,25,259	6,04,389	19,40,734
,, ,, Burma . .	..	..	..	..	..	..	..	.	13,82,719	17,62,242	23,83,817	53,66,262

APPENDIX IV.

Summary prepared by Dr. Clouston, Agricultural Adviser to the Government of India, of the results of experiments with phosphatic manures in India.

The following is a summary of replies received from the Directors of Agriculture, Bengal, Bihar and Orissa, Bombay, Assam and Burma, to an enquiry regarding the results obtained from the use of superphosphate in their provinces.

2. *Bengal.*—Experiments to test the effect of superphosphate and ammonium sulphate on wheat and paddy have recently been started on the Rajshahi Agricultural Station. The results which are tabulated below are not conclusive. As all the red soils in Bengal are acid and most of the remaining soils contain practically no carbonate of calcium, superphosphate is not generally recommended.

WHEAT.

Treatment.	Number of plots.	AVERAGE YIELD PER ACRE.			
		1926-27.		1927-28.	
		Grain.	Bhusa.	Grain.	Bhusa.
		mds.	mds.	mds.	mds.
Double superphosphate . .	4	13½	33½	10½	19½
Double super Sulphate of ammonia.	2	11½	34½	10½	20
No manure	6	13½	34½	10	18½

PADDY.

Treatment.	AVERAGE YIELD PER ACRE, 1927-28.	
	Paddy.	Straw.
	mds.	mds.
Residual effect of the following manures which were applied to the previous crop of wheat—		
Superphosphate	14½	34½
Superphosphate *plus* ammonium sulphate	17⅛	38½
No manure	17½	39½

3. *Bihar and Orissa.*—An extensive series of experiments to ascertain the value of phosphatic manures is in progress in this province. The results have not yet been fully worked up and in many cases the trials are not yet complete. A brief summary of the more important information at present available is given below, from which it will appear that on the whole better results have been obtained with compound manures of the ammophos type

than with superphosphate. Ammophos has an important advantage in that it is distinctly less hygroscopic than many mixed fertilizers.

(*i*) *Sugarcane.*—On the Sepaya Farm, in addition to a fair general manuring, an application of superphosphate and ammonium sulphate to supply 50 lbs. of P_2O_5 and 40 lbs. of nitrogen per acre gave an increased yield of 165 maunds of cane, valued at Rs. 35. An increase in super to provide 100 lbs. of P_2O_5 per acre gave an increase of 253 maunds of cane per acre, valued at Rs. 84, so that the additional application of phosphate gave a return of Rs. 29 against an expenditure of about Rs. 12. There are no figures to show the effect of ammonium sulphate alone, but an application of 100 lbs. of P_2O_5 per acre at a cost of Rs. 24 gave, in the present year, a return of about Rs. 60 or a nett profit of Rs. 36 due to phosphate.

On the Nawadah Farm in South Bihar where practically no crop can be grown to advantage without phosphatic manure it has been found that with an expenditure of Rs. 50 on manure, including 3 maunds of ammophos per acre costing about Rs. 24, a crop of 550 maunds of sugarcane can be raised with irrigation.

(*ii*) *Paddy.*—In an article published on page 104 of the Agricultural Journal of India, Vol. XVIII, pt. 2, March, 1923, the economic results of phosphatic manuring for rice in South Bihar have been described. It has been shown that 1 cwt. superphosphate per acre applied along with a green manure gave in one case a return of Rs. 32 for an expenditure of about Rs. 8. Difficulties, however, arose over the green manuring as it was not successful in all years. Ammophos was therefore substituted for this combination, and very definite results have been obtained with it for a number of years. It contains 17 per cent. of nitrogen and 20 per cent. of P_2O_5. The earlier experiments showed that an application of 1 md. per acre of ammophos to rice at a cost of Rs. 9 gave on an average an increased yield worth Rs. 18 per acre, or a nett profit of Rs. 9. A similar figure was obtained in 1926 on farm plots and cultivator's plots. The results obtained in 1927 are tabulated below.

Place of experiment.	Treatment.	Increased yield per acre over unmanured crop.		Nett profit per acre due to manuring.	Remarks.
		Grain.	Straw.		
		mds.	mds.	Rs.	
Jamui Farm (Monghyr district).	Ammophos 1 md. per acre.	7	21	15	
Khurda (Puri District).	Diamonphos, 30 srs. per acre. (This is practically pure ammonium phosphate.)	*5¼	..	8	* This increase is over an excellent unmanured crop of 23¼ mds. per acre.
Nawadah Farm (Gaya District).	Ammophos, 1 md. per acre.	6½	..	10-8-0	A bad year for rice crop on the farm.
Cuttack . . .	Ammophos . .	..	..	4-8-0	This increase was over an application of oil-cake at the same cost.

(iii) Leguminous crops.—On the Gaya farm, interesting results have been obtained with the use of superphosphate on leguminous crops. An application of 30 lbs. of P_2O_5 as super at a cost of Rs. 7 per acre increased yield of soybeans from 8½ to 12½ mds. per acre, and gave a nett profit of Rs. 17. On the same farm a leguminous fodder crop (Meth) yielded 91¼ mds. per acre without super and 141 mds. per acre with super—an increase worth Rs. 25 for an expenditure of Rs. 7.

(iv) The results on the whole demonstrate the importance of a combination of nitrogen and phosphoric acid for soils in Bihar and Orissa and experiments are in progress to determine the most profitable ratio of these constituents under different conditions.

4. *Bombay.* Superphosphate is not at present a fertilizer of importance in Bombay and the Department of Agriculture is not pushing it.

5. *Assam.*—No systematic trials with phosphatic manures have been conducted in this province. A few experiments have been started at two of the farms this year.

6. *Burma.*—The results obtained in this province from the use of phosphatic manures applied singly or in combination with other manures on paddy are given in the following table. They demonstrate the superiority of compound manures of the ammophos type.

Manure applied per acre.	Total period of experiments.	Average increase per acre over the controls.	Remarks.
		Per cent.	
Bonemeal at 20 lbs. P_2O_5	5 years	26·5	
Superphosphate at 20 lbs. P_2O_5	Do.	35·3	
N. M. at 30 lbs. N *plus* super at 20 lbs. P_2O_5	Do.	43·5	
F. Y. M. at 30 lbs. N *plus* super at 30 lbs. P_2O_5 *plus* sulphate of potash at 30 lbs. K_2O.	Do.	53	
Amm. Sulph. at 30 lbs. N *plus* super at 20 lbs. P_2O_5 *plus* sulphate of potash at 20 lbs. K_2O.	Do.	33	No profit was obtained in the beginning due to high prices of manures.
Ammophos 15 per cent. N and 20 per cent. P_2O_5 at 200 lbs. per acre.	2 years	115·4	A nett profit of Rs. 28-11 per acre.
Ammophos 11 per cent. N and 48 per cent. P_2O_5 at 200 lbs. per acre.	Do.	90·8	A nett profit of Rs. 22 per acre.
Lennaphos 20 per cent. N and 18 per cent. P_2O_5.	1 year	103·8	A nett profit of Rs. 26 per acre.
Diammophos 20 per cent. N and 53 per cent. P_2O_5.	Do.	110·9	A nett profit of Rs. 18 per acre.
Amm. Sulph. per cent. 30 lbs. N *plus* Super at 45 lbs. P_2O_5.	Do.	98·1	A nett profit of Rs. 11 per acre.

Results of treats with manures carried out by the Fertilizer Propaganda Company.

Provinces.	Treatment.	No. of plots.	Average yield per acre.		Increase.	Percentage of increase.	Nett profit per acre.
			Treated.	Control.			
			lbs.	lbs.	lbs.	Per cent.	Rs. A. P.
	CHILLIES.						
Bombay .	Sulphate of ammonia .	1	2,687	2,023	664	33	32 11 0
	Do. *plus* super .	1	4,192	2,112	2,080	98	46 13 5
Madras .	Indigo refuse, sulphate of ammonia and super.	1	1,791	625	1,166	186	255 8 0
	F. Y. M., sulphate of ammonia and super.	1	1,250	886	363	40	58 12 8
	F. Y. M., indigo refuse, sulphate of ammonia and super.	1	1,192	880	312	35	58 14 4
Mysore .	F. Y. M., sulphate of ammonia and super.	1	5,600	4,480	1,120	25	36 8 0
	CABBAGE.						
Bombay .	Sulphate of ammonia .	1	7,530	5,315	2,215	41	108 13 0
	Do. *plus* super .	2	4,418	2,632	1,786	67	40 7 1
	F. Y. M., sulphate of ammonia and super.	2	8,216	3,771	4,445	117	172 7 3
	TOBACCO.						
Bombay .	Sulphate of potash, super and nitrate of soda.	6	1,032	693	339	48	30 7 6
	WHEAT.						
Bombay .	Sulphate of ammonia .	6	830	651	179	27	6 15 0
	Do. plus super .	8	920	589	331	56	15 12 6
	F. Y. M., sulphate of ammonia and super.	7	769	542	227	41	6 1 0
	GROUNDNUT.						
Madras .	Sulphate of ammonia *plus* super.	3	2,594	1,500	1,094	73	59 9 0
	RAGI.						
Madras .	F. Y. M., sulphate of ammonia *plus* super.	2	1,110	756	354	46	10 11 6
	ONIONS.						
Bombay	Sulphate of ammonia	2	13,866	8,868	4,998	56	140 13 6
	Poudrette and sulphate of ammonia.	1	9,728	6,800	2,928	43	55 0 0
	F Y. M., sulphate of ammonia and super.	1	10,971	8,640	2,331	26	11 8 11

Results of two years' work carried out by the Fertilizer Propaganda Company of India to demonstrate the value of artificial fertilizers for various crops in India.

Provinces.	Treatment.	No. of plots.	AVERAGE YIELD PER ACRE.		Increase.	Percentage of increase.	Nett profit per acre.
			Treated.	Control.			
			lbs.	lbs.	lbs.	Per cent.	Rs. A. P.
	PADDY.						
Madras	Sulphate of ammonia .	18	3,091	2,503	588	23	26 13 11
	Do. *plus* super .	20	2,656	2,330	326	13	12 13 6
Hyderabad	Do. *plus* super .	23	2,957	2,202	755	34	18 11 9
Mysore	Do. Do. .	4	3,081	1,988	1,093	54	36 11 0
Bombay	Sulphate of ammonia .	7	3,374	2,508	866	34	30 0 0
	Do. *plus* super .	1	3,881	2,161	1,720	79	25 2 9
	F. Y. M. and sulphate of ammonia.	3	2,760	1,920	840	43	29 12 0
Burma	Ammophos . . .	..	2,542	1,250	1,292	103·4	32 6 3
	POTATO.						
Bombay	F. Y. M., sulph. of ammonia and sulphate of potash.	6	15,699	9,875	5,824	59	124 1 4
	F. Y. M., nitrate of soda, super and sulphate of potash.	6	13,866	9,875	3,991	40	74 0 10
Mysore	F. Y. M., sulphate of ammonia and super.	2	11,340	7,560	3,780	50	107 8 0
	COTTON.						
Bombay	Sulphate of ammonia .	67	351	246	105	42	8 6 4
	Do. *plus* super .	3	443	258	185	71	19 5 4
	Do. *plus* cake .	12	517	323	194	60	19 15 9

APPENDIX V.

Figures showing the benefits obtained from the application of manures in the Madras Presidency.

(Reproduced from the evidence given by Mr. R. D. Anstead, Director of Agriculture, Madras, before the Royal Commission on Agriculture in India, *vide* page 147, Volume III, Evidence taken in the Madras Presidency.)

II.—Guntur District.

Paddy—Phosphatic manures by themselves and in conjunction with organic manures.

The following results have been obtained on ryots own land :—

Year.		Manure.	Yield per acre. Grain.	Yield per acre. Straw.	Value of manured crop.	Extra cost of cultivation and manures.	Nett profit.
			lbs.	lbs.	Rs. A. P.	Rs. A. P.	Rs. A. P.
1926	1	No manure . . .	504	2,050	..	..	..
		3 cwts. super . .	2,352	2,500	75 0 0	19 15 0	55 1 0
	2	No manure . . .	1,092	1,500	..	..	..
		2 cwts. bonemeal .	3,832	4,920	39 14 0	13 0 0	26 14 0
	3	Green leaf . . .	1,680	2,500	..	..	..
		Green leaf, 1 cwt. super	2,184	2,500	19 8 0	6 11 0	12 13 0
	4	10 cartloads cattle manure.	2,000	3,000	..	..	..
		10 cartloads cattle manure, 1½ cwts. bonemeal.	2,553	3,000	21 6 9	7 2 0	14 4 9
	5	10 cartloads cattle manure.	2,055	2,500	..	..	..
		One bag groundnut cake, 1 cwt. bonemeal.	2,235	2,500	8 0 0	*Nil*	8 0 0

III.—Bellary District.

Sugarcane—Ammonium sulphate and superphosphate.

Year.	Strain.	Yield of grain per acre.	Extra cost.	Value of increased crop.	Nett profit.
			Rs. A. P.	Rs. A. P.	Rs. A. P.
1925	Local	173½ maunds of jaggery	..	..	..
	Ammonium sulphate and superphosphate.	216¾ maunds of jaggery	..	..	119 2 8
1926	Local	200 maunds of jaggery .	..	..	..
	Ammonium sulphate and superphosphate.	280 maunds of jaggery .	32 0 0	192 0 0	160 0 0

APPENDIX VI.

Statement giving a summary of the results obtained from the application of artificial manures in a number of experiments carried out under the direction of Imperial Chemical Industries (India), Limited.

	Per acre.	No. of plots.	Increase.
			Per cent.
PADDY.			
Madras—			
Sulphate of Ammonia	80 lbs.	20	13
Super	1 cwt.		
Hyderabad—			
Sulphate of Ammonia	80 lbs.	23	34
Super	1 cwt.		
Mysore—			
Sulphate of Ammonia	56 lbs.	4	54
Super	168 ,,		
Bombay—			
Sulphate of Ammonia	300 lbs.	1	79
Super	600 ,,		
POTATO.			
Bombay—			
Sulphate of potash	150 lbs.	6	59
Super	112 ,,		
Sulphate of Ammonia	120 ,,		
Sulphate of potash	150 ,,	6	49
Super	112 ,,		
Nitrate of soda	170 ,,		
Mysore—			
F. Y. M.	100 baskets.	2	50
Sulphate of Ammonia	150 lbs.		
Super	360 ,,		
Sulphate of potash	55 ,,		
COTTON.			
Bombay—			
Sulphate of Ammonia	70 lbs.	1	71 Average.
Super	112 ,,		
Sulphate of Ammonia	112 ,,	1	
Super	56 ,,		
Sulphate of Ammonia	80	1	
Super	100 ,,		
TOBACCO.			
Bombay—			
Sulphate of potash	150 lbs.	6	48
Super	112 ,,		
Nitrate of soda	285 ,,		

	Per acre.	No. of plots.	Increase.
			Per cent.
WHEAT.			
Bombay—			
Sulphate of Ammonia	56 lbs.	6	
Super	112 ,,		
Sulphate of Ammonia	56 ,,	1	56 Average.
Super	56 ,,		
Sulphate of Ammonia	50 ,,	1	
Super	100 ,,		
F. Y. M.	35,000 ,,	1	
Sulphate of Ammonia	112 ,,		
Super	224 ,,		
F. Y. M.	15,000 ,,	1	
Sulphate of Ammonia	56 ,,		
Super	112 ,,		
F. Y. M.	15,000 ,,	1	
Sulphate of Ammonia	112 ,,		
Super	112 ,,		
F. Y. M	20,000 ,,	1	41 Average of 7 plots.
Sulphate of Ammonia	56 ,,		
Super	112 ,,		
F. Y. M.	60,000 ,,	1	
Sulphate of Ammonia	56 ,,		
Super	112 ,,		
F. Y. M.	25,600 ,,	1	
Sulphate of Ammonia	56 ,,		
Super	112 ,,		
F. Y. M.	5,600 ,,	1	
Sulphate of Ammonia	60 ,,		
Super	112 ,,		
RAGI.			
Madras—			
F. Y. M.	3 cart-loads.	2	46
Sulphate of Ammonia	80 lbs.		
Super	112 ,,		
GROUNDNUT.			
Madras—			
Sulphate of Ammonia	40 lbs.	3	73
Super	112 ,,		
TURMERIC.			
Madras—			
Sulphate of Ammonia	160 lbs.	1	Here though there is no increase, the profit over control is due to the high cost of F. Y. M.
Super	224 ,,		

	Per acre.	No. of plots.	Increase.
			Per cent.
ONIONS.			
Bombay—			
F. Y. M	22,400 lbs.		
Sulphate of Ammonia	140 „		26
Super	112 „		
CHILLIES.			
Bombay—			
Sulphate of Ammonia	120 lbs.	1	98
Super	240 „		
Madras—			
Indigo refuse	13,333 lbs.		
Sulphate of Ammonia	240 „	1	
Super	224 „		
F. Y. M	36,000 „		
Sulphate of Ammonia	160 „	1	
Super	160 „		
F. Y. M.	26,000 „		84 Average of 4 plots.
Indigo seeth	8,000 „	1	
Sulphate of Ammonia	160 „		
Super	224 „		
F. Y. M.	60 cart-loads.		
Neem cake	750 lbs.	1	
Sulphate of Ammonia	120 „		
Super	120 „		
Mysore—			
F. Y. M.	2,000 lbs.		
Sulphate of Ammonia	52 „	1	25
Super	156		
CABBAGE.			
Bombay—			
Sulphate of Ammonia	150 lbs.	2	
Super	224 „		
F. Y. M.	17,000 „		
Sulphate of Ammonia	150 „		
Super	224 „	1	
F. Y. M.	40,000 „		
Sulphate of Ammonia	150 „		
Super	224 „		

APPENDIX VII.

A.—*Statement showing the world production and agricultural consumption of nitrogen compounds in metric tons of nitrogen for the five years 1923-24 to 1927-28.*

(Extracted from the Eighth Annual Report of the British Sulphate of Ammonia Federation, Limited.)

	1923-24.	1924-25.	1925-26.	1926-27.	1927-28.
By-product ammonium sulphate.	264,600	278,300	296,700	303,200	336,300
Synthetic ammonium sulphate .	231,100	255,000	289,200	300,000	366,100
TOTAL .	495,700	533,300	585,900	603,200	702,400
Cyanamide . . .	104,000	115,000	150,000	180,000	197,000
Calcium nitrate . . .	18,000	25,000	30,000	81,000	101,000
Other forms of synthetic nitrogen.	51,100	66,100	120,700	133,400	211,400
Other forms of by-product nitrogen.	50,200	47,400	47,700	40,300	55,200
Chilean Nitre . . .	338,500	367,500	399,400	199,600	390,300
TOTAL .	1,057,500	1,154,300	1,333,700	1,237,500	1,657,300
Agricultural consumption about	934,000	1,020,000	1,117,000	1,200,000	1,450,000

B.—*Statement showing the production of superphosphate in Europe and America in 1913 and 1925.*

(Extracted from the Times Trade and Engineering Supplement, November 26th, 1927.)

(In metric tons.)

	1913.	1925.
Germany	1,818,700	660,400
Poland	196,172	192,346
Czecho-Slovakia	...	201,857*
Belgium	450,000	381,000
Denmark	90,000	218,500
Spain	225,000	722,653
Russia	158,300	62,439
Italy	972,317	1,464,056
France	1,920,000	2,379,760
Great Britain	830,000	538,676
Holland	346,000	572,000
Sweden	184,259	239,732
United States	3,248,000	3,489,397
	10,438,748	10,920,959

* Excluded from total as no comparative figures are available.

N.B.—In addition to the countries given in the table there are several other large producers. In 1925 Australia produced 831,770 tons, Japan 673,800 tons and North Africa, where there are five factories operating, not less than 200,000 tons. South Africa also has two large plants The total production in 1925 was thus, excluding the South African factories, 12,828,386 metric tons.

MGIPC—L—169STB—24-8-29—1,250.