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REPORT

OF THE

Indian Tariff Board

ON THE

HEAVY CHEMICAL INDUSTRY



CALCUTTA : GOVERNMENT OF INDIA
CENTRAL PUBLICATION BRANCH
1929

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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

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

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.

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 reason 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. Jensen 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, Vernej.
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. Stuermer, 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. Leahey, 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.

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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.

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., <i>ad valorem</i> , 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., <i>ad valorem</i> , 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., <i>ad valorem</i> , whichever is higher.
Acid, sulphuric	Rs. 1-4-0 per cwt., or 15 per cent., <i>ad valorem</i> , whichever is higher.
Alum, viz., ammonia alum, potash alum or soda alum	As. 15 per cwt.
Aluminium sulphate or hydrated aluminium sulphate, including alumino-ferrie 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	Nitric acid .	50	77
Zinc chloride .	25	nil	25	21	Hydrochloric acid.	80	45
Epsom salts .	242	152	394	165			
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

	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.
II—EXPLOSIVES.												
TOTAL	..	..	..	..	..	..	16,20,465	21,40,055	25,04,234	21,25,868	22,39,176	27,41,850
Share of Bengal .	..	..	..	..	..	..	1,95,855	4,54,042	6,45,872	5,77,338	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	19,018	25,322	1,11,675
" " Madras .	..	..	..	..	..	..	8,46,000	8,30,296	7,72,563	8,69,028	6,40,908	6,32,071
" " Burma .	..	..	..	..	..	..	1,95,780	3,78,372	3,97,035	4,09,243	5,08,668	5,68,669
III—GLASS AND GLASS-WARE.												
TOTAL	..	..	..	..	..	..	1,94,52,795	2,45,74,237	2,60,01,838	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	1,20,45,586	1,23,82,506	1,01,96,112	1,03,05,336
" " Sind .	..	..	..	..	..	..	11,28,270	14,76,031	13,69,317	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	145,058	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	11,09,410	11,86,174	9,09,012	11,32,949	12,82,654
" " Bombay .	106,121	121,067	120,070	68,705	100,544	126,178	76,28,700	2,03,58,053	1,99,88,989	1,06,01,137	1,23,70,104	1,65,41,551

" " Sind . .	6,041	5,756	9,056	3,123	4,741	6,230	4,00,095	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	26,02,965	28,70,122
" " Burma . .	1,600	748	1,152	1,224	958	1,184	1,68,765	2,38,459	3,12,384	3,20,692	2,42,759	2,66,231
V—Soap.												
TOTAL . .	362,860	17,725	361,205	406,655	402,475	422,489	75,08,000	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	24,870	48,016	63,954	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	165,081	179,074	168,904	167,968	24,97,440	50,87,009	52,89,346	56,64,009	56,61,264	60,07,853
" " Sind . .	26,994	22,540	27,861	27,418	35,338	34,876	6,56,790	10,96,391	13,03,134	11,92,098	14,94,850	14,56,622
" " Madras . .	88,497	20,106	22,417	31,400	36,231	37,752	11,01,045	11,35,945	13,03,063	16,48,951	19,56,374	19,87,598
" " Burma . .	91,533	92,429	97,880	105,409	103,737	126,525	16,21,050	29,99,408	32,09,702	35,32,526	34,38,226	39,26,650
VI—ARTIFICIAL AND MINERAL MANURES.												
TOTAL . .	164,680	189,640	252,340	431,760	517,080	714,180	9,52,140	10,22,735	15,28,296	27,50,440	30,65,609	42,00,133
Share of Bengal . .	54,780	72,100	188,460	296,740	306,000	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	1,62,870	2,78,574	4,01,101
" " Sind . .	40	840	1,120	2,280	4,880	1,900	120	3,741	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	24,773	19,978	18,899	20,871	35,675
VII—ARTIFICIAL SILK												
TOTAL . .	..	..	..	..	..	..	..	1,23,64,329	2,27,95,483	2,18,74,911	4,21,73,042	5,48,82,551
Share of Bengal . .	..	..	..	..	..	..	..	..	54,30,695	32,40,778	74,08,250	96,02,944
" " Bombay . .	..	..	..	..	..	..	..	..	1,35,04,945	1,44,38,753	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	17½	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. 19 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 UN-MANURED CROP.		Nett profit per acre due to manuring.	REMARKS.
		Grain.	Straw.		
		mds.	mds.	Rs.	
Jamul 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.)	*5½	..	8	* This increase is over an excellent unmanured crop of 23½ 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 $8\frac{1}{2}$ to $12\frac{1}{2}$ mds. per acre, and gave a nett profit of Rs. 17. On the same farm a leguminous fodder crop (Meth) yielded $91\frac{1}{2}$ 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	
Y. 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. 23-11 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. 28 per acre.
Diammophos 20 per cent. N and 53 per cent. P_2O_5 .	Do. .	110.9	A nett profit of Rs. 13 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.

APPENDIX.

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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. <i>plus</i> 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 18 0
	Do. <i>plus</i> super	2	4,418	3,632	1,786	67	40 7 1
	F. Y. M., sulphate of ammonia and super.	2	8,216	3,771	4,445	117	172 7 8
TOBACCO.							
Bombay	Sulphate of potash, super and nitrate of soda.	6	1,032	698	339	48	30 7 6
WHEAT.							
Bombay	Sulphate of ammonia	6	830	651	179	27	6 15 0
	Do. <i>plus</i> 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 <i>plus</i> super.	3	2,594	1,500	1,094	73	59 9 0
RAGI.							
Madras	F. Y. M., sulphate of ammonia <i>plus</i> 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. <i>plus</i> super	20	2,656	2,330	326	13	12 13 6
Hyderabad	Do. <i>plus</i> 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. <i>plus</i> 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. <i>plus</i> super	3	443	258	185	71	19 5 4
	Do. <i>plus</i> 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.		Value of manured crop.	Extra cost of cultivation and manures.	Nett profit.
		Grain.	Straw.			
		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 0
	5 { 10 cartloads cattle manure.	2,055	2,500	..	..	..
	{ One bag groundnut cake, 1 cwt. bonemeal.	2,235	2,500	8 0 0	Nd	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.	216½ 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	43
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	56 Average.
Super	112 „		
Sulphate of Ammonia	56 „	1	
Super	56 „		
Sulphate of Ammonia	50 „	1	
Super	100 „		
F. Y. M.	85,000 „	1	
Sulphate of Ammonia	112 „		
Super	224 „	1	
F. Y. M.	15,000 „		
Sulphate of Ammonia	56 „	1	
Super	112 „		
F. Y. M.	15,000 „	1	
Sulphate of Ammonia	112 „		
Super	112 „	1	
F. Y. M.	20,000 „		
Sulphate of Ammonia	56 „	1	
Super	112 „		
F. Y. M.	60,000 „	1	
Sulphate of Ammonia	56 „		
Super	112 „	1	
F. Y. M.	25,600 „		
Sulphate of Ammonia	56 „	1	
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.	}	26	
Sulphate of Ammonia	140 "			
Super	112 "			
CHILLIES.				
Bombay—				
Sulphate of Ammonia	120 lbs.	}	98	
Super	240 "			
Madras—				
Indigo refuse	13,333 lbs.	}	} 84 Average of 4 plots.	
Sulphate of Ammonia	240 "			1
Super	224 "			
F. Y. M	36,000 "	1		
Sulphate of Ammonia	160 "			1
Super	160 "			
F. Y. M.	28,000 "	1		
Indigo seeth	8,000 "			1
Sulphate of Ammonia	160 "			
Super	224 "	1		
F. Y. M.	60 cart-loads.			1
Neem cake	750 lbs.			
Sulphate of Ammonia	120 "			
Super	120 "			
Mysore—				
F. Y. M.	2,000 lbs.	}	25	
Sulphate of Ammonia	52 "			
Super	156 "			
CABBAGE.				
Bombay—				
Sulphate of Ammonia	150 lbs.	}	67	
Super	224 "			
F. Y. M.	17,000 "	}	} 117 Average of 2 plots.	
Sulphate of Ammonia	150 "			1
Super	224 "			
F. Y. M.	40,000 "	1		
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	199,500	390,300
TOTAL	1,057,500	1,164,300	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.)

	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	533,676
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.

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