



the Chemical Industries  
Committee of the Provincial  
Committee, Bombay

BOMBAY

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# CONTENTS

CHAPTER	I—INTRODUCTION ... ..	1
CHAPTER	II—HEAVY CHEMICALS ... ..	9
	Sulphuric Acid and Allied Products ... ..	12
	Alkali and Chlorine Products ... ..	14
	Other Heavy Chemicals ... ..	17
	Industrial Gases ... ..	22
CHAPTER	III—FINE CHEMICALS ... ..	24
	Inorganic Chemicals ... ..	25
	Organic Chemicals ... ..	29
	Drugs and Pharmaceuticals ... ..	31
	Photographic Chemicals ... ..	35
	Textile Chemicals ... ..	38
CHAPTER	IV—WOOD-DISTILLATION, COAL CARBONISATION AND PETROLEUM REFINING INDUSTRIES ... ..	42
	Destructive Distillation of Wood ... ..	42
	Coal Gas and Coal Tar Products ... ..	47
	Dyestuff Industry ... ..	49
	Petroleum Refining Industry ... ..	57
CHAPTER	V—GLASS, POTTERY, CERAMICS AND REFRACTORIES—	
	Glass Industry ... ..	60
	Pottery, Ceramics and Refractories Industries ... ..	64
CHAPTER	VI—CEMENT AND CEMENT PRODUCTS ... ..	69
CHAPTER	VII—INEDIBLE OILS, SOAPS, PAINTS AND VARNISHES—	
	Inedible Oils ... ..	73
	Soap Industry ... ..	78
	Paints and Varnishes ... ..	81
CHAPTER	VIII—ELECTRO-CHEMICAL INDUSTRIES—	
	General ... ..	85
	Aluminium Industry ... ..	86
	Other Chemicals depending upon Electro-Chemical applications... ..	90
CHAPTER	IX—PLASTICS INDUSTRY ... ..	92

	PAGE
<b>CHAPTER X—GENERAL RECOMMENDATIONS AND SUMMARY OF THE REPORT—</b>	
General Recommendations ... ..	98
Summary of Report—	
I. Sulphuric Acid and its Derivatives ... ..	100
II. Alkali and Chlorine Products ... ..	102
III. Other Heavy Chemicals ... ..	102
IV. Industrial Gases ... ..	103
V. Inorganic Fine Chemicals ... ..	103
VI. Organic Fine Chemicals ... ..	103
VII. Drugs and Pharmaceuticals ... ..	104
VIII. Photographic Chemicals ... ..	105
IX. Textile Chemicals ... ..	105
X. Coal Gas and Coal Tar Products ... ..	105
XI. Destructive Distillation of Wood ... ..	105
XII. Dyestuffs Industry ... ..	106
XIII. Petroleum Refining Industry ... ..	106
XIV. Glass Industry ... ..	106
XV. Potteries, Ceramics and Refractories Industry ... ..	107
XVI. Cement and Cement Products ... ..	107
XVII. Inedible Oils ... ..	107
XVIII. Soap Industry ... ..	108
XIX. Paints and Varnishes ... ..	108
XX. Aluminium Industry ... ..	108
XXI. Minor Electro-Chemicals... ..	109
XXII. Plastics Industry ... ..	109
<b>APPENDICES—A—Summarised Supplementary Questionnaire prepared by the Sub-Committee ... ..</b>	<b>110</b>
<b>B—Information Card for individual Product ... ..</b>	<b>111</b>
<b>C—List of Factories which answered the Questionnaire ... ..</b>	<b>113</b>
<b>D—Statement showing the quantity and value of Imports of Chemicals into the Province of Bombay from foreign countries ... ..</b>	<b>117</b>
<b>E—Statement showing the existing and estimated production of Vegetable Ghee in the Province of Bombay including adjacent States ... ..</b>	<b>120</b>

# REPORT OF THE CHEMICAL INDUSTRIES SUB-COMMITTEE OF THE PROVINCIAL INDUSTRIES COMMITTEE, BOMBAY.

## CHAPTER I.

### INTRODUCTION.

1. *Appointment and Terms of Reference of the Sub-Committee.*—The Government of Bombay, by the General Department, Government Resolution No. 5393/33, appointed the Bombay Provincial Industries Committee. The basis of appointment of this Committee was the same as that of the Policy Committee for Industries appointed by the Government of India. The Provincial Industries Committee of Bombay at their first meeting held on the 19th July 1945 resolved to set up a Chemical Industries Sub-Committee and other Sub-Committees under the following terms of reference :—

- ✓ (i) To recommend existing industries in the Province which should be further expanded and new industries which should be started during the post-war period.
- ✓ (ii) To recommend such industries as can best be organised as (1) large scale industries (2) small scale or cottage industries.
- ✓ (iii) To suggest the most suitable sites for the location of various industries after taking into consideration the availability of labour, electric power, raw materials, markets and the desirability of preventing congestion in thickly populated areas.
- ✓ (iv) To advise whether the industries recommended should be promoted by Government or private agencies; and in the latter case whether Government should participate and if so the nature of the help which should be required.

The Sub-Committee was set up to carry out the survey of chemical industries in the Province as per the above terms of reference, and based on such a survey it was expected of the Sub-Committee to make recommendations regarding the promotion of new industries.

As the Provincial Industries Committee was expected to co-operate with the Government of India Panels supplying as much factual information as possible and thus facilitate the work of the panels in making the final recommendations to the Government of India, the main function of the Chemical Industries Sub-Committee has been to collect such information and in some cases to make their recommendations to the Provincial Industries Committee.

2. *Members.*—The composition of the Chemical Industries Sub-Committee as fixed at the first meeting of the Provincial Industries Committee was as follows :—

Mr. M. A. Master	... Chairman.
Mr. K. H. Vakil	... Co-opted as member by the Provincial Industries Committee.
Lt.-Col. S. S. Sokhey	... Co-opted as member by the Provincial Industries Committee.
Dr. K. Venkataraman	... Co-opted as member by the Provincial Industries Committee.
Dr. N. R. Damle	... Industrial Chemist representing the Department of Industries.

Later on Mr. C. S. Patel, Managing Director of Swastik Oil Mills, Mr. C. P. Shah, Potteries and Ceramics expert and Dr. Mataprasad were co-opted by the Chairman of the Chemical Industries Sub-Committee. As Mr. Master had to go out of India, the late Mr. K. H. Vakil was requested to officiate as Chairman of the Chemical Industries Sub-Committee. Of the original members of the Committee, Lt.-Col. Sokhey suggested in his letter D.O. No. 30/4 of 1945, dated 6th September 1945, that the appointment of Dr. K. Ganapathi in his place may be more advantageous to the Committee and as such Dr. K. Ganapathi was appointed in place of Col. S. S. Sokhey.

Mr. K. H. Vakil died on the 28th January and thereafter the Chairmanship of the Sub-Committee was accepted by Dr. Venkataraman from 16th of February to 7th May 1946 when he had to leave for America. Mr. C. S. Patel acted as Chairman in the absence of Dr. K. Venkataraman.

Dr. L. A. Bhatt was co-opted as member by the Chairman, Chemical Industries Sub-Committee, on the 13th of March 1946.

Dr. R. K. Trivedi was appointed as full time Secretary of the Sub-Committee on the 24th of November 1945 by Government Resolution No. 5393/33 and was in charge of the office of the Chemical Industries Sub-Committee.

The following table gives the summary of the composition of the Chemical Industries Sub-Committee :—

*List of Members, Chemical Industries Sub-Committee.*

Name of the Member.	Date of appointment.	Remarks.
1. Mr. K. H. Vakil ...	30th August 1945 ...	Co-opted member by the Provincial Industries Committee, officiated as Chairman from 13th November 1945 to 28th January 1946.
2. Dr. K. Venkataraman ...	30th August 1945 ...	Co-opted member by the Provincial Industries Committee, Chairman from 16th February 1946. Left for U. S. A. and U. K. on 7th May 1946.
3. Dr. Mataprasad ...	2nd November 1945 ...	Co-opted by the Chairman, Sub-Committee.
4. Dr. K. Ganapathi ...	2nd November 1945 ...	Co-opted by the Provincial Industries Committee, vice Lt.-Col. Sokhey. Left for U. K. on 5th June 1946.
5. Mr. C. S. Patel ...	2nd November 1945 ...	Co-opted by the Chemical Industries Sub-Committee. Was appointed Chairman vice Dr. Venkataraman from 7th May 1946.
6. Mr. C. P. Shah ...	2nd November 1945 ...	Co-opted by the Chairman, Sub-Committee.
7. Dr. N. R. Damle ...	.....	Representing Department of Industries. Ceased to be member from 21st June 1946.
8. Dr. M. R. Mandlekar ...	21st June 1946 ...	Represented the Department of Industries from 21st June 1946.
9. Dr. L. A. Bhatt ...	13th March 1946 ...	Co-opted by the Chairman, Chemical Industries Sub-Committee.
10. Dr. R. K. Trivedi (Secretary).	24th November 1945...	Appointed. Government Resolution No. 5393/33.

3. *Commencement of Work.*—A special meeting of the Sub-Committee was held on 13th November to meet Mr. Morton Cressey of the American Cynamide Corporation and Chemical Construction Co., U.S.A. Mr. Cressey had been invited by the Government of India to advise the Department of Planning and Development with regard to the development of the chemical industries in India ; and the object of the meeting was to discuss with Mr. Cressey the post-war development of chemical industries in the Province of Bombay.

Mr. Cressey was of opinion that Bombay having many industries such as textiles, pharmaceuticals, oil, soaps, paints, rubber, etc., was an ideal location for chemical plants. In his opinion, sites near about Kalyan would prove very suitable for chemical factories and chemical industries might concentrate near about this place. In Mr. Cressey's opinion the following types of plants were best suited for the Province :—

- (1) Fertilizer (he was aware of the plant built at Sindri in Bihar and considered Mithapur as a suitable place for the fertilizer industry).
- (2) Food preservatives.
- (3) Disinfectants such as D.D.T.
- (4) Heavy Chemicals as for example caustic soda, soda ash, textile chemicals.
- (5) Dye-Staff.
- (6) Starches.
- (7) Medicinal products.

The above meeting naturally formed a starting point for the survey of chemical industries of the Province. The Committee's work actually commenced on the 24th November 1945 and in the first meeting held under the Chairmanship of the late Mr. K. H. Vakil it was decided to divide the programme of work of the Sub-Committee into the following three stages :—

*Stage 1.*—Collection of information by sending out a proper and adequate questionnaire. Survey of the resources and the present condition of the various items of industries coming under the purview of the Sub-Committee.

*Stage 2.*—A first hand information to be obtained by undertaking tours of inspection, sending out investigator, and getting in touch with the manufacturers, wishing to avail of the opportunities offered by the activities of this Sub-Committee.

*Stage 3.*—A comprehensive report to be made on the basis of this survey and information obtained during the first two stages of the Committee's work. The Report shall incorporate the final recommendations of the Sub-Committee to the Government of Bombay regarding expansion, location and various other factors concerned with the chemical industries in the Province.

4. *Collection of Information.*—(1) From factories in British Territory in the Province.

As decided in the first meeting, the collection of information was started by sending out questionnaire forms to the various factories coming under the purview of the Chemical Industries Sub-Committee registered under the Factories Act (Sections 2 j and 5) as also to various factories actually located by the investigator attached to this Sub-Committee. The list of factories classified according to the grouping of industries falling within the scope of Sub-Committee was prepared.

Two types of questionnaire forms were generally used. One was the general questionnaire formed by the Provincial Industries Committee and later on the investigator was sent out with supplementary forms addressed to each factory as per the model (Appendix A). He made personal contacts with the management of the factory to explain to them the aims of the present survey and help them filling up the forms.

The main objective as kept in view in collecting the information was to get as accurately as possible figures regarding the following :—

- (i) Figures of production of chemical and allied products in the Province.
- (ii) Figures of consumption of chemical commodities in the Province.
- (iii) Estimated consumption of chemical products in the Province.
- (iv) Likely possible expansion in the present production.

The ultimate idea in seeking this information was to recommend a definite line of chemical industries in the Province in the years to come.

With the above view in mind, communications were issued to several Provincial Associations interested in the chemical industries, various Provincial authorities and some of the Central Government Departments concerned. The following is the list of officers addressed to, and the general idea of the information sought from them :—

Designation of the Officer.	Information sought.
Secretary, Bombay Millowners' Association.	(i) Consumption of textile chemicals. (ii) Requirements of bleaching materials.
Secretary, Ahmedabad Millowners' Association.	Do.
Secretary, Indian Chemical Manufacturers' Association.	(i) Analysis of consumption for Heavy Chemicals. (ii) Production and consumption of chemicals.
Chairman, Bombay Presidency Chemical Manufacturers' Association.	Do.
Messrs. Kantawalla Nanavati & Co. ...	Imports and consumption of chemicals.
I. C. I., India Ltd. ...	Do.
General Manager, Bhadravati Iron and Steel Works.	Results of analysis of Hardwood Distillation.
The Director of Industries, Mysore ...	Do.
The Director of Chemicals, Chemical Directorate, New Delhi.	Production and consumption chemicals in the Province.
The Director of Statistics, Government of India.	Imports of chemicals in British India.
Collector of Customs, Bombay ...	Imports of chemicals at Bombay.
Officer on Special Duty : Department of Food.	Information regarding Vanaspati industry and oil refineries.

Designation of the Officer.	Information sought.
The Registrar, Geological Survey of India.	Mineral wealth of the Province.
Textile Commissioner, Bombay	(i) Consumption of textile chemicals. (ii) Requirements of bleaching materials.
Director of Forest Research Institute, Dehra Dun.	Results of analysis of hardwood distillation.
Honorary Geologist to the Department of Industries, Bombay.	Mineral wealth of the Province.
The Conservator of Forests, Bombay Province.	Availability of hardwood.
Various Officers of the Department of Industries.	.....

*Collection of Information.*—(2) From factories situated in Indian States adjacent to the Province of Bombay.

In any survey regarding the production, consumption and future expansion of chemical industries in the Province of Bombay, the existence of the chemical factories in the neighbouring States could not be ignored for obvious reasons. Products of State factories are not necessarily consumed in the State markets; in fact, a very large portion of the chemical production in the States would find its way to the markets of the Province of Bombay. As such, any scheme of future expansion of chemical industry, should be based on the considerations of joint production of the Province and the Indian States. With a view, therefore, to obtain data regarding the production of chemicals in Indian States, supplementary forms were sent to the various factories in the States.

After having collected the information the next step was to record in a comprehensive manner.

5. *Recording of Information.*—The technical information and other statistical data regarding production and consumption, collected by the Sub-Committee have been recorded with a view to form a correct judgment regarding the existing position and future possibilities of expansion of chemical industries in the Province of Bombay. Each important substance was allotted a complete information card on which all the important data about it was duly recorded (Appendix B). Wherever possible, the more involved factors regarding the industry such as cost of production, industries utilising the product, etc. were also included in the record.

6. *Discussion of Records by Committee Meetings.*—With a view to arrive at a final decision regarding each group of chemicals, as to the factors touching the production and consumption of products included in that group, technical notes were prepared by the office of the Sub-Committee and these were discussed in the full Committee meetings. The deliberations and conclusions arrived at at the meetings were conveyed from time to time to the Provincial Industries Committee. Over and above the discussions in the Committees, it was arranged to invite leading



industrialists of the Province for an informal exchange of views with the Committee regarding factors of production, markets, likely expansion of industries, present difficulties encountered by the industries and the possible help that could be rendered by the Provincial authorities. Representatives of the following industries were invited :—

- (1) Caustic Soda and Chlorine.
- (2) Sulphuric Acid.
- (3) Bricks, etc.
- (4) Paints, Varnishes.

Discussion with these representatives together with the deliberations in the Committee meeting helped to form a fairly clear picture regarding the requirements of the Province in the matter of chemical industries.

7. *Classification of Chemical Industries under survey.*—For the purposes of the present survey the various chemicals coming under the scope of this Sub-Committee were considered and classified as follows at the second meeting held on 14th December 1945 under the Chairmanship of late Mr. K. H. Vakil :—

#### I. HEAVY CHEMICALS.

- (a) Sulphuric Acid and Allied Products.
- (b) Alkali and Chlorine Products.
- (c) Other Heavy Chemicals.
- (d) Industrial Gases.

#### II. FINE CHEMICALS.

- (a) Inorganic Chemicals.
- (b) Organic Chemicals.
- (c) Fermentation Products.
- (d) Drugs and Pharmaceuticals.
- (e) Photographic Chemicals.
- (f) Textile Chemicals.

#### III. COAL CARBONISATION AND COAL PRODUCTS.

- (a) Coal Gas and Coal Tar Products.
- (b) Destructive Distillation of Wood.
- (c) Dye-stuff Industry.

#### IV. GLASS—CERAMICS—REFRACTORIES.

- (a) Glass.
- (b) Potteries and Ceramics.

#### V. CEMENT AND LIME.

Cement and Cement Products.

VI. SOAPS, OILS (INEDIBLE), PAINTS, COLOURS AND VARNISHES.  
INDUSTRIAL SOLVENTS.

- (a) Oils (Inedible).
- (b) Soap Industry.
- (c) Paints and Varnishes.

VII. ELECTRO-CHEMICALS.

- (a) Aluminium.
- (b) Minor Electro-Chemicals.

VIII. MISCELLANEOUS.

Plastics.

8. *Limitations of the Report.*—During the war, industry was a subject transferred to the Government of India as it was thought proper for the efficient prosecution of the war to control the industries from a central administration. Now that the war is at an end, industry has once more become a Provincial subject and as such the burden of efficiently implementing the recommendations approved by the Government of India would fall on the shoulders of the Provincial administration. At a time like this, when the post-war schemes have to be cautiously considered and effectually put into execution for the benefit of the Province and the country as a whole, the report of a Committee like the Provincial Industries Committee assumes special significance, especially because it is to refer to the post-war period.

To fulfil the responsibilities of making sound recommendations for the development of existing chemical industries and suggestions for putting up new industries, the Sub-Committee ought to have full knowledge of the schemes already thought of by the Central Government. This is more so in view of the fact that the Central Government Departments during the war years, when controlled economy was more or less the rule of the day, were in a position to collate fairly accurate data about the existing position and the possibilities of development of the chemical industries in India with particular reference to the Province of Bombay. It was also easy for them to gauge the requirements of particular industries in respect of heavy and fine chemicals. Such being the case, any Committee undertaking economic and industrial survey of the industries of the Province would naturally look forward to get the data and the proposed schemes of the Central Government and would be seriously handicapped if they were not furnished with the same. This dependence of securing statistical material mainly from the Central Government would be a limiting factor to any survey Committee; and we are afraid it has proved to be a limitation of this Committee also.

The Chemical Industries Sub-Committee have tried their best to compute the requirements of important chemicals and allied products in the Province of Bombay and in the light of these computations, they have set certain targets of production with regard to each industry they have surveyed. They have also taken care to bring up-to-date information available from previous records.

9. *Absence of reliable Statistical Data.*—It is needless to emphasise that the work of any planning department is seriously handicapped by the absence of primary data to go by. This Sub-Committee have also experienced the same difficulty in

getting reliable factual information. Every attempt has been, however, made to collate the necessary data from authoritative quarters and to apply various checks on the authenticity of the same whenever it was practicable to do so. It is obvious that recommendations based on doubtful data would be very misleading and as such the Committee has taken care to fix up the targets of production only in cases where they have found reliable to do so.

10. *Limited Co-operation by Industries.*—The absence of statistical data from official quarters should have been made up, had the individuals and associations connected with chemical industry offered their whole-hearted co-operation to the Sub-Committee. We regret to note that this co-operation was not forthcoming from the industrialists, except for some leading manufacturers in each group of chemical industries who willingly supplied all the information they had with them. Many industrialists felt from their past experience that such surveys could not be of much use to the industry as the Government do not readily implement the recommendations made by such Committees, while there were others who were reluctant to co-operate as they had apprehensions that the information supplied by them might be used for official purposes, other than those meant for the survey. As already stated, personal contacts through the investigator were also undertaken by the Sub-Committee but these efforts did not meet with much success. Consequently, only 90 out of a total of 375 questionnaires issued to factories were returned duly filled in. The Sub-Committee have, however, every satisfaction that they have done their best in trying to secure the co-operation of the industry in collecting the factual information, and in case of recommendations the Sub-Committee have taken care to verify the authenticity of the data on hand.

11. *Acknowledgments.*—The Chemical Industries Sub-Committee wish to record their grateful appreciation of the very valuable help rendered by Dr. J. G. Kane, M.Sc., Ph.D., A.I.I.Sc., Reader in Oil Technology, Bombay University Department of Technology, for his suggestions and help regarding the section on inedible oils. Mr. B. G. Pendharkar, Chief Chemist, Swastik Oil Mills, has also contributed his experience in the preparation of the Chapter on "Inedible Oils, Soap Industry and Paints and Varnishes". The Committee express their gratitude to Mr. R. D. Chandorkar of the Vijay Glass Works, Bombay, who supplied useful and authentic information in writing the section on glass industry.

## CHAPTER II.

## HEAVY CHEMICALS.

12. *General.*—The important part played by heavy chemicals in the economy of this country in general and in the economy of the Province in particular has been amply demonstrated during the years of World Wars I and II. As such, it would be superfluous to make out a case for the establishment of heavy chemicals industry in the Province, which is necessary in the interests of the general industrialisation of the Province during the coming five years.

The word heavy chemical used in this Chapter refers to chemicals such as sulphuric acid, caustic soda, soda ash, superphosphates and such other materials that are produced in large quantities at a low cost, and serve as raw materials for various other consuming industries. The importance of heavy chemicals would be at once realised from their extensive use in industries such as textiles, soaps, oils, rayons, paper, leather, dyestuffs, glass explosives etc. As these industries develop in the Province, heavy chemicals would be consumed in greater quantities. This industry, thus, forms the corner stone of a sound industrial structure in the Province.

For the purpose of this report, heavy chemicals have been classified in the following sections :—

- (1) Sulphuric acid and its derivatives.
- (2) Alkali and Chlorine products.
- (3) Other industrial chemicals.
- (4) Industrial gases.

The individual sections have been treated separately in the following pages.

## SECTION I.

## Sulphuric Acid and Allied Products.

13. *General Considerations.*—The names of the chemicals included under this heading are given in column 2 of Table 1.

14. *Figures of Present Production in the Province.*—The figures of their actual annual production in 1944 and estimated annual production in 1946 are given in columns 3 and 4 of Table 1.

*Production of Sulphuric Acid.*—At present 40 tons a day are being produced in Bombay and Gujarat at the following factories. Four of these employ chamber process, while one of them in Bombay employs a 10 ton-a-day contact process :—

- (1) Eastern Chemical Works Ltd., Bombay.
- (2) Dharamsi Morarji Chemical Works Ltd., Ambernath.
- (3) Sonawala Industries Ltd., Kalyan.
- (4) Ramco Chemical Works Ltd., Ahmedabad.
- (5) Star Chemical Works Ltd., Baroda.

15. *Factors Relative to Production.*—Sulphuric acid is manufactured from sulphur imported from foreign countries in the absence of native sulphur in India. The Government of India are, however, considering the proposal of utilisation of gypsum for the production of sulphuric acid. Larger quantities of this acid will have to be produced in the Province when industries which consume the acid in large quantities come into existence.

16. *Market Conditions and Factors relative of Off-take of Indigenous products.*—It is visualised that factories producing superphosphates, ammonium sulphate and dyestuffs will develop to a considerable extent in the Province during the coming five years. As these industries consume a large amount of sulphuric acid, the installation of new plants in addition to the existing units may be found necessary.

17. *Figures of Present Consumption.*—The figures of the present consumption as also the figures of estimated consumption during the next five years are given in columns 6 and 7. It will be seen from the table that in the case of some of these chemicals, there is a large difference between the amounts consumed and produced. This is partly met by imports from foreign countries, the figures for which are shown in column 5 of Table 1.

18. *Scope and Possibilities of Expansion in the Production.*—Taking into consideration the estimated production in the Province in 1946-47 and the estimated consumption during the next five years, there appears to be a large deficiency of the production of some chemicals. The figures for this deficiency for all the chemicals are given in the last column of Table 1.

19. *Location of future units of Production—Proposed production of sulphuric acid.*—It is proposed that 35 tons of sulphuric acid per day should be further produced in the Province as follows :—

Bombay	...	...	...	...	25 tons a day.
Ahmedabad	...	...	...	...	10 tons a day.

It will be seen that if all the present and proposed units work to capacity, there is still a deficiency of 30,000 tons (i.e. 100 tons/day) from the target suggested

(cf: column 8 of Table 1). This, however relates to the requirements of the proposed dyestuffs and rayon industries. It is hence suggested that this amount of the acid could be produced at places where the dyestuffs and rayon industries will be established.

20. *Recommendations for the Production of Sulphuric Acid.*—It is recommended that preference should be given to the existing manufacturers to install new units in addition to the plants already in operation, or replace the existing plants, after thoroughly examining their plans and the location of their factories with respect to the other industries. Preference must be given to the installation of plants employing “contact process”.

It is also recommended that there should be a greater concentration of the industry in Bombay and its suburbs (up to Ambernath) because the industries consuming the acid and the products derived from it are and will be located in and around Bombay to a large extent. In the allocation of new sulphuric acid plants it is assumed that the fertilizers industry will be put up near about Bombay. Similar concentration of industries is also taking place near Ahmedabad and a large portion of the allocation of this industry for the Province outside Bombay and its suburbs may, therefore, be made for Ahmedabad and places near about. Both these cities have further advantages in being railway centres and have available power and industrial labour.

21. *Recommendations for the Production of other allied Products.*—

*Nitric Acid.*—The target suggested for the production of this acid has taken into consideration the development of ammunition and plastics industry in the Province.

*Hydrochloric Acid.*—The deficiency of this acid shown in the last column could partly be met with by the acid produced in the manufacture of D. D. T. which is envisaged for production in this Province for the utilisation of the excess of chlorine produced from electrolytic caustic soda plant.

*Ferric Alum.*—It could be conveniently produced in Gujarat. Large deposits of bauxite containing ferric iron are available.

*Epsom Salt.*—It need not be produced from magnesite as very large quantities of it can be obtained from bitters available at Mithapur and Kharagoda.

*Copper Sulphate.*—No deposits of copper ores are found in the Province. If copper sulphide ores are imported at cheap rates from foreign countries, then the sulphur could be converted into sulphuric acid and the copper oxide into the copper sulphate.

*Sodium Sulphate.*—It should be obtained in the required purity from the bi-chromates industry which is fairly well established in this Province. No other steps should be taken for its manufacture as ultimately they might prove uneconomical.

*Superphosphates.*—An attempt should be made to manufacture it from the bone meal. This raw material will be available to the extent of about 25,000 tons a year in the Province. There already exist mill for the treatment of bone which do not flourish on account of very keen competition by factories established elsewhere in the country by foreigners. If, however, superphosphates are manufactured in the Province, both the agricultural activity and the bone meal industry will benefit. It is, therefore, recommended that 25,000 tons of superphosphates be produced in this Province. It is recommended that the Government may arrange to give adequate facilities to the superphosphates industry in the Province.

**SECTION II.****Alkali and Chlorine Products.**

22. *General Considerations.*—The names of the chemicals included under this heading are given in column 2 of Table 2.

23. *Figures of Present Production in the Province.*—The figures of estimated annual production in 1946 and remarks are given in columns 3 and 4 of Table 2.

24. *Factors relative to Production.*—The main requirements of these chemicals are sufficiently pure salt and electric energy at cheap rates. It is envisaged that both these requirements will be plentifully available in coastal towns of the Province.

25. *Market Conditions and Factors relative to Off-take of Indigenous products.*—There is a good market for these chemicals in Bombay and Ahmedabad. It is contemplated that the requirements for these chemicals will go up with the establishment of dyestuffs and rayon industries and the expansion of soap and vegetable oil industries.

26. *Figures of Present Consumption.*—The figures of the consumption of these chemicals in 1944 as also the figures of estimated consumption during the next five years are given in columns 5 and 6 of Table II. It will be seen from the table that in case of some of these chemicals there is a large difference between the amounts consumed and produced.

27. *Scope and Possibilities of Expansion in the Production.*—Taking into consideration the estimated production in the Province in 1946-47 and the estimated consumption during the next five years, there appears to be a large deficiency of production of some chemicals. The figures for this deficiency for all the chemicals are given in the last column of Table 2.

TABLE 2.

## Alkali and Chlorine Products.

No.	Chemical.	Estimated Production (in tons).		Consumption in various industries.			Target for future production (in tons).	Deficiency.
		In 1946-47 (in tons).	Remarks.	In 1944.	Estimated during next five years (in tons).			
1	2	3	4	5	6	7	8	
1	Soda Ash	30,000 18,000 <hr/> 48,000	.....	30,000	Paper ... 4,000 Glass ... 3,000 Textiles ... 6,000 Bichromates ... 3,000 Sodium Silicate ... 2,000 Dyestuffs ... 2,000 Washing etc. ... 20,000 Miscellaneous Chemical Industries ... 2,000 <hr/> Total ... 41,000	41,000	Nil.	
2	Sodium Bicarbonate	1,800	.....	.....	Medical preparations and cooking. ... 1,000 Fire Extinguishers ... 1,000 <hr/> Total ... 2,000	2,000	200	
3	Caustic Soda	2,000 4,500 <hr/> 6,500	Electrolysis Caustici- sation.	14,000	Textiles ... 6,000 Soap and Glycerine ... 6,000 Paper and Pulp ... 1,000 Vegetable Oil ... 1,000 Rayon ... 12,000 Dyestuffs ... 4,000 Miscellaneous ... 1,000 <hr/> Total ... 31,000	31,000 (20,000 by Electrolytic process).  (11,000 by by Caustici- sation).	24,500	



TABLE 2—*contd.*

No.	Chemical.	Estimated Production (in tons).		Consumption in various industries.			Target for future production (in tons).	Deficiency.
		In 1946-47 (in tons).	Remarks.	In 1944.	Estimated during next five years (in tons).			
1	2	3	4	5	6	7	8	
4	Chlorine (liquid compressed) ...	700	.....	50	Textiles ... .. 2,000 Municipal and Sanitation Chlorinated products like D. D. T. ... .. 1,200 Paper ... .. 1,000 Bleaching materials (like Sodium Chlorite high test Chlorate etc.) ... .. 1,000 Production of raw materials for Plastic moulding powders. ... .. 1,000 Dyestuffs ... .. 800 D. D. T. ... .. 8,500 Miscellaneous Chemical Industries. ... .. 1,000 Total ... 17,500	17,500	16,800	
5	Bleaching Powder ...	1,500	.....	1,800	Textiles and Sanitation	6,000	6,000	4,500
6	Calcium and Sodium Hypochlorites.	3,000	Manufactured by textile mills in Bombay Province for their own consumption.	3,000	Textiles ... ..	5,000	5,000	(to be provided by 30 per cent. individual mills.)
7	Sodium Chlorate ...	.....	.....	.....	Agricultural weed-killer	1,500	1,500	1,500
8	Potassium Chlorate ...	1,800	Manufactured in Bombay.	1,800	Ammunition and Matches.	2,000	2,000	200
9	Caustic Potash ...	.....	.....	2,000	Soap ... ..	1,500	1,500	1,500
10	Potassium Carbonate ...	250	.....	.....	Textiles ... ..	4,500	6,500	6,250
							(2,000 for Caustic Potash).	

28. *Location of future units of Production—Proposed production of caustic soda.*—The location of the caustic soda-chlorine industry may profitably be distributed as follows :—

At or near about Ahmedabad	...	...	10 tons a day.
At or near about Bombay	...	...	25 tons a day.

29. *Recommendations.*—(1) The production of these chemicals in the Province is very important as they are largely required in various industrial processes. The Province must be made self-sufficient as regards these chemicals.

(2) Most of the new industries should be installed near Bombay because various consuming industries of these chemicals are located near about Bombay. There are other advantages in installing these plants near about Bombay, such as, caustic soda can be utilised in the solution form and chlorine in the form of liquid hypochlorite solution. Further, electrical power, technical labour and other amenities for industrial organisation will be easily available in Bombay.

(3) In order to make the production of these chemicals a success, the following facilities are required and should be provided :—

(a) Electrical power at cheap rate not exceeding 3 pies per kw.

(b) Tariff protection, wherever necessary, to enable the products of this industry to compete with imported foreign products.

(c) Minimised inland freight charges, transportation charges and coastal shipping freight to enable the manufacturers to transport the raw materials or finished products at profitable rates.

(d) Facilities to import the most modern equipment and capital goods and raw materials from abroad.

(e) Common salt at a duty free rate as it forms the main raw material from which these chemicals are manufactured.

30. *Other recommendations for the useful production and utilisation of some of these chemicals.*—

*Caustic Soda.*—The quantity produced by electrolytic process should be determined by the amount of chlorine demanded by the chlorine utilising factories. The rest of it should be produced by causticisation.

*Chlorine.*—Factories for the manufacture of chlorinated products should be encouraged. They can best be located at places where electrolytic caustic soda-plants are working.

*Potassium Chlorate.*—There is only one factory in the Province which produces this chemical on a large scale. It is necessary that another plant should be put up in conjunction with one of the caustic soda-chlorine plant.

*Caustic Potash.*—The demand for this chemical is not great ; the required amount should be produced at one of the factories producing electrolytic caustic soda.

### SECTION III.

#### Other Heavy Chemicals.

31. *General Considerations.*—The names of the chemicals included under this heading are given in column 2 of Table 3.

32. *Figures of Present Production in the Province.*—The figures of the actual annual production in 1946 and estimated annual production in 1946 are given in columns 3 and 4 of Table 3.

TABLE  
Other heavy

No.	Chemical	Production (in tons)		Imports into Bombay Harbour during 1944.
		in 1944	Estimated in 1946.	
1	2	3	4	5
1	Sodium Bichromate .. ..	1,042	1,500	1,100
2	Potassium Bichromate .. ..	128	60	Small quantities
3	Sodium Silicate .. ..	7,224	7,700	Negligible.
4	Sodium Sulphide .. ..	119	1,900 (installed capacity).	800
5	Potassium Chloride .. ..	500	700	800
6	Magnesium Chloride .. ..	5,200	8,000	Nil.
7	Calcium Chloride .. ..	1,000	2,000	Negligible.
8	Ammonia (Liquor) .. ..	....	35	....
9	Ammonia Anhydrous .. ..	....	....	....
10	Sodium Hydrosulphite .. ..	....	....	1,277
11	Sodium Sulphite .. ..	90	150 (installed capacity).	100
12	Sodium Bisulphite .. ..	50	150	....
13	Sodium Thiosulphate .. ..	238	400	219

3.

## chemicals.

				Estimated Consumption during the next five years.	Target for future production.	Deficiency.
				6	7	8
Textiles	..	..	..	400	2,000	500
Leather	..	..	..	400		
Pigments and Chromic Acid	..	..	..	200		
Dyestuffs	..	..	..	1,000		
Total				2,000		
Matches and Chemicals	..	..	..	60	60	...
				8,000	8,000	300
Textiles	..	..	..	700	4,000	2,100
Leather	..	..	..	300		
Soda Ash	..	..	..	800		
Dyestuffs	..	..	..	2,500		
Total				4,000		
Fertiliser	..	..	..	1,800	3,000	2,300
Chlorate manufacture	..	..	..	1,200		
Total				3,000		
				8,000	8,000	Extra capacity is available with the exist- ing manufac- turers.
				(For all India)		1,000
				3,000	3,000	65
In terms of $\text{NH}_4\text{Cl}$ and $(\text{NH}_4)_2\text{CO}_3$	..	..	..	300	100	
Nitric Acid	..	..	..	2,000	4,350	
Urea (Fertiliser and Plastics)	..	..	..	1,000		
Soda Ash	..	..	..	1,000		
Refrigeration	..	..	..	50		
Total				4,350		
Textiles and Sugar	..	..	..	1,500	1,500	1,500
Photography and Food preservation	..	..	..	150	150	...
Textiles	..	..	..	600	600	450
Photography	..	..	..	500	600	200
Leather	..	..	..	100		
Total				600		

33. *Factors Relative to Production*—(i) *Sodium and Potassium Bichromate*.—Introduction of this industry in India has taken place during the war. Bichromates are required mainly for textile, leather, safety matches and pigments industries. Their use in textile industry for khaki dyeing may be reduced in the coming years but their other uses and their requirements in the manufacture of dyestuffs will provide an easy market for the indigenous products.

The industry has submitted a memorandum to the Tariff Board for protection under the present circumstances. The industry suffers from certain basic disadvantages such as high price of raw materials used in the manufacture, namely sulphuric acid and soda ash, and high transport charges. When these raw materials are available locally at cheaper rates, the industry would be able to compete with the imported chemicals.

Chromates and chromic acid are at present being manufactured in small quantities by manufacturers of bichromates.

(ii) *Sodium Silicate*.—The industry has developed considerably during recent years. A number of small concerns have come up which manufacture products which are not up to the required standard. This industry requires better organisation in order to produce better quality product which can stand comparison with the imported stuff. The availability of cheaper indigenous soda ash will go a long way in stabilising this industry in post-war years.

(iii) *Sodium Sulphide*.—It is used in leather, paper, textiles, and soda ash industries. The demand for this material in the industry is very large and the total present capacity will have to be supplemented with further installations to supply the total demands. The sulphide should be manufactured from sodium sulphate which is a by-product of the bichromate industry.

(iv) *Potassium Chloride*.—This industry forms a part of the important marine chemicals industry. With the large manufacture of common salt by solar evaporation large amounts of bittern are available for this industry. However, only a small portion of the available bittern is yet being processed for the recovery of potassium chloride. Two grades of potassium chlorides are generally available. The crude product is used as fertiliser and the pure product in chemical industries including the manufacture of potassium chlorate. The latter grade is not yet manufactured in the Province but would be required to meet the demands of potassium chlorate industry, when established in the Province.

(v) *Magnesium Chloride*.—This forms another product of the marine chemicals industry. The present production supplies the requirements of local consuming industries and in addition the product is exported.

(vi) *Calcium Chloride*.—This is produced as a by-product in the soda ash and magnesium oxide industries. Its use in refrigeration and road-building is at present limited and all the requirements can be supplied by the present production.

(vii) *Ammonia*.—It is not yet produced in the Province. It is used as such for refrigeration and in the manufacture of salts such as ammonium sulphate, ammonium carbonate and ammonium chloride and the dyestuffs, nitric acid and urea. Due to the proposed establishment of the factory for the manufacture of ammonium sulphate in large quantities by the Government of India in Bihar, the product of a small factory may not find a market. However, it could be utilised in the manufacture of soda ash, urea, dyestuffs and nitric acid.

(viii-x) *Sodium Hydrosulphite, Sodium bi-sulphite, Sodium sulphite and Sodium Thiosulphate.*—Sodium hydrosulphite is not manufactured in the Province; the other chemicals are now produced in sufficient quantities in the Province. The raw materials required for their production are caustic soda, soda ash and sulphur dioxide. These are available locally; hence it would be convenient to manufacture these chemicals in Bombay. The zinc required for the manufacture of hydrosulphite will have to be imported from abroad.

34. *Market Conditions and Factors relative to off-take of Indigenous Products.*—Except for magnesium chloride, calcium chloride and sodium silicate the manufacture of other chemicals in the country has developed only during recent years due to restricted imports. The total requirements were met with until recently and even now a part of the requirements are supplied by imports. The uses of these chemicals in post-war period are sufficiently important to justify the continuation and expansion of the locally installed industries.

35. *Figures of Present Consumption.*—The figures of estimated consumption during the next five years are given in columns 6 and 7 of Table 3. It will be seen from the Table that the requirements of some of these chemicals are met with by imports from foreign countries. The figures in this connection are given in column 5 of Table 3. The actual figures of consumption are not given because they are not correctly available.

36. *Scope and Possibilities of Expansion in the Production.*—Taking into consideration the estimated production in the Province in 1946-47 and the estimated consumption during the next five years, there appears to be a large deficiency of the production of these chemicals. The figures for this deficiency are given in the last column of Table 3.

37. *Location of Future Units of Production.*—The extension of the production of the chemicals under this section is proposed as follows:—

1. Bichromates, sodium sulphide and sodium silicate in Bombay.
2. Potassium chloride at Kharagoda and Mithapur.
3. Sodium Hydrosulphite, Sodium sulphite, sodium bin-sulphite and Sodium Thiosulphate in Bombay and its suburbs.

38. *Recommendations.*—It is recommended that the following measures should be taken to develop the existing industries and to install the new ones:—

(a) Prohibition or control of imports of bichromates, chromates, chrome-products and sodium silicate after controlling the standard of quality of local products and their prices, through a board consisting of representatives of the industry and the Government.

(b) Encouragement of the manufacture of Sodium sulphide from Sodium sulphate obtained at the bichromates industry.

(c) Control of the prices of imported Sodium sulphide, Sodium sulphite, Sodium bi-sulphite, Sodium Thiosulphate and potassium chloride by Tariff duties, until the production capacity for these chemicals comes up to the requirements.

(d) Rendering all necessary assistance to the parties proposing to undertake the manufacture of ammonia and Sodium hydrosulphite.

(e) Facilities for manufacturers to import the latest type of machinery to improve the efficiency of production.

(f) Minimising of the railway freight, specially in case of important raw materials, to lower the cost of production of the certain chemicals.

## SECTION IV.

### Industrial Gases.

39. *General Consideration.*—The names of the gases included under this heading are given in column 2 of Table 4. These are industrial gases which are consumed at the place where they are made or are transported in compressed form for utilisation in various industrial processes.

40. *Figures of Present Production in the Province.*—The figures of their actual annual production are given in column 4 of the Table 4. It can be very generally stated that at present there is a very limited production of these gases in the Province.

TABLE 4.

### Industrial Gases.

No.	Gas.	Centre of Production.	Production figures.	Consuming Industries.	Quantity consumed.
1	2	3	4	5	6
1	Non-condensable Gases.	Wood Distillation Factory (non-existent at present).	.....	.....	....
2	Hydrogen	Oil hydrogenating factories.	All the quantity produced is immediately utilised in the hydrogenation of oils.	Vegetable ghee	.. More than 200,000,000 c.ft.
3	Oxygen	(1) The Indian and Acetylene Co., Ltd., Bombay.	17,500,000 c.ft.	Army Railways Shipping etc. Special drum welding General Engineering Medical	.. 2,283,050 c.ft. .. 1,600,500 ;; .. 6,645,700 ;; .. 2,300,500 ;; .. 4,000,000 ;; .. 360,000 ;;
		(2) At present all the vegetable ghee factories producing hydrogen by the hydrolysis of water also produce oxygen for the recovery of which no arrangements have been made yet.		Total	.. 17,250,350 ;;
4	Acetylene	(1) The Indian and Acetylene Co., Ltd., Bombay.	6,500,000 c.ft.	Army Railways Ship repairs Special drum welding General Engineering Marine	.. 1,267,000 c.ft. .. 400,000 ;; .. 1,805,000 ;; .. 1,610,000 ;; .. 1,300,000 ;; .. 60,000 ;;
				Total	.. 6,442,000 c.ft.

41. *Factors relative to Production.*—The availability of cheap electrical power and easy absorption of the industrial gases in the new pattern of industry should render the production of these gases a profitable industry in the Province.

42. *Market Conditions and Factors relative to Off-take of Indigenous Products.*—Even with the present market conditions, factors relative to the off-take of industrial gases in the Province are very favourable.

43. *Figures of Present Consumption.*—The figures of the present consumption as well as the names of the consuming industries are given in columns 5 and 6 of the Table 4.

44. *Scope and Possibilities of expansion in the Production.*—It will be possible to produce large quantities of all these gases in this Province in view of the fact that the following industries are due to expand in the coming five years :—

1. Wood distillation Industry.
2. Hydrogenation of Oils Industry.
3. Calcium Carbide (in Bihar).

45. *Location of Future units of Production.*—No recommendations can be made at this stage for targets of production, as well as for the location of the production centres.

Almost unlimited quantities of oxygen gas will be available by the installation of compression plants on the site of factories to come into existence in the coming five years in the Province.



## CHAPTER III.

## FINE CHEMICALS.

46. *General.*—The fine chemicals industry in the Province will generally depend upon the development of the heavy chemical industry. The basic chemicals produced by the heavy chemical industry will be either processed or converted or purified into what are known as fine chemicals to be consumed by various industries. The fine chemical industry, therefore, should fall within the classification of what is commonly known as the “Chemical Converting Industry”. This group would include medicinal and pharmaceutical preparations, pure chemicals, analytical reagents, insecticides, fungicides, herbicides, germicides, antiseptics, disinfectants, etc. The industry will be based on small units of production installed in factories at suitable places. The scope of fine chemicals is very wide and includes varied chemical products such as, ingredients for perfumes and flavours, textile and tannings, electroplating, fruit preservation and most of other industries.

This “Chemical Converting” group is heterogenous with many sub-divisions, composed of big and small units, distinguished by the fact that they are preparing chemical compounds for the direct use of the ultimate consumer.

In view of the above it must be pointed out that it will be difficult to indicate definite limits of production of fine chemicals of various descriptions as required in the Province. As to the present production of fine chemicals in the Province, it can be stated definitely that up to the beginning of the recent war, there was no fine chemicals industry in the Province worth the name. During the war years, conditions suitable to the growth of this industry were created in this Province by the stoppage of imports of fine chemicals from abroad. It was during this period that small nuclei producing fine chemicals were established in the Province, e.g., stearic acid for waterproofing, cosmetics and ointments was made in Bombay. Production of Hydrofluoric acid for frosting and etching of glass has been started. Oxalic acid required by textile and laundries is being manufactured in the Province and so on. They can be described as having flourished to a certain extent. In the years to come there will be conditions definitely suitable for the growth of the fine chemicals industry in the Province.

The following factors in the Province are considered favourable to the growth of the fine chemicals industry :—

(i) Establishment of heavy chemicals industry which would supply important starting materials for the fine chemicals—especially the inorganic fine chemicals. The heavy chemicals industry will also supply chemicals useful in the processing of organic fine chemicals. For example, production of acetic acid in the Province would lead to production of lead acetates required in yellow and orange shade pigments in the paint industry as well as in waterproofing of textiles.

(ii) The installation of dyestuff industry in the Province will produce some fine chemicals as important by-products. Instance could be given of Benzene and Aniline required as primary intermediates in the dyestuff industry. These very materials would help establishing production of D. D. T.—an insecticide and Hydroquinonea Photography developer.

(iii) The tendency towards the establishment of synthetic processes for various fine chemicals is estimated to favour the cheap production of high-grade fine chemicals. This tendency could be illustrated in the case of phenol derivatives, for instance, acetyl salicylic acid was produced in 1921 at \$. 0.73 per lb.

In 1939, the cost of production was brought down to \$ 0.47 per lb. Similarly Sulphanilamide was produced at \$ 4.95 per lb. in 1937, whereas the cost of production in 1939 was reduced to \$ 1.28 a lb. Again, the production of Vitamin C cost \$ 43.15 a lb. in 1939 while there is a constant tendency towards reducing this cost of production.

(iv) The consciousness of using the fine chemicals produced indigenously is now growing in the Province and it appears that the pharmaceutical and other consuming industries would be ready to use fine chemicals produced in the Province provided they could compete in quality if not immediately in price, with the imported stuff.

From the above, it would appear that the fine chemicals industry in the Province has reasonably bright prospects of thriving. The following Sections have been considered in the present report:—

*Section 1.*—Inorganic Fine Chemicals.

*Section 2.*—Organic Fine Chemicals.

*Section 3.*—Drugs and Pharmaceuticals.

*Section 4.*—Photographic Chemicals.

*Section 5.*—Textile Chemicals.

## SECTION I.

### Inorganic Chemicals.

47. *General Considerations.*—The inorganic fine chemicals form an important section of the “Chemical Converting” industry. A large variety of these chemicals can be easily manufactured after processing of some of the important basic chemicals. The equipment necessary for manufacturing inorganic fine chemicals is comparatively simple and could be easily installed in any factory producing pharmaceutical and allied materials. For example, most of the important inorganic sodium, potassium, copper and nickel compounds such as the sulphates, chlorides, nitrates and cyanides could be obtained in pure state with comparative ease. Such chemicals are included in the following illustrative list:—

- |  |   |
|--|---|
| 1. Potassium cyanide.  | 9. Manganese nitrate.                               |
| 2. Sodium cyanide.   | 10. Drying agents such as Manganese Linoleate, etc. |
| 3. Potassium ferrocyanide.                                   | 11. Silica gel.                                     |
| 4. Iron citrate.   | 12. Chemicals in pigment industry.                  |
| 5. Ammonium citrate.   | 13. Chemicals for glass and ceramics.               |
| 6. Hydrochloric acid.  | 14. Aluminium chloride.                             |
| 7. Stearates of aluminium, calcium, barium, magnesium, zinc. | 15. Antimony trichloride.                           |
| 8. Ferric chloride.  | 16. Potassium bromide.                              |

The equipment involved in the production of such fine chemicals would include simple reacting vessels, settlers, crystallizers, purifiers, hydro-extractors and vacuum driers. All these could be designed and fabricated in the Province to meet the general needs of the industry producing inorganic fine chemicals.

48. *Imports of Fine Chemicals.*—As generally pointed out regarding the chemical industry, it can be stated in this case also that up to 1939, the requirements of the Province in the matter of inorganic fine chemicals were met by importing these from overseas. The table No. 5 would speak for itself.

The Committee are definitely of the opinion that such chemicals as have been shown in the table could have been prepared in this Province by the purification of the raw product or by the conversion of some of the basic heavy chemicals. To illustrate this point it can be stated that copper sulphate, of the requisite purity required for electroplating purposes could have been prepared by the purification of the crude product. But this was never attempted here before the recent World War and the consumers imported the material from overseas. It has to be noted that this situation was the outcome of prejudice on the part of the consumers generally in favour of imported stuff and against the indigenous product. Fortunately for the indigenous fine chemicals industry, seven years of cessation of foreign imports have served to create a favourable impression for the chemicals manufactured here, as also a sense of growing confidence in the manufacturers as to their ability to cope with the demands of the consumers.

The conditions mentioned above would favour the establishments of inorganic fine chemicals industry in this Province.

TABLE 5.

*Imports of inorganic fine chemicals into Bombay Harbour.*

Name of Chemical	Quantity (in Cwts.)				Value (in Rupees)			
	1941-42	1942-43	1943-44	1944-45	1941-42	1942-43	1943-44	1944-45
Alum .. ..	2,013	315	2,450	3,385	40,370	3,880	45,700	46,015
Aluminous Sulphate ..	1,039	3,476	8,510	35,640	11,760	32,404	60,690	257,944
Carbonate and Bicarbonate of Ammonia.	2,180	1,863	2,079	10,058	73,008	62,603	1,12,946	3,97,510
Muriate of Ammonia ..	4,838	3,835	6,350	13,544	1,19,982	1,21,761	1,75,924	3,43,712
Arsenic and its oxides ..	822	..	18	240	22,904	35	3,055	6,592
Copperas (Ferrous Sulphate)	30	28	31	29	2,505	2,090	2,444	2,234
Copper Sulphate .. ..	1,290	31,193	10,353	11,612	37,221	15,00,490	5,32,330	4,80,841
Lead Acetate .. ..	2,910	942	124	2,243	1,14,270	40,787	5,336	92,018
Litharge .. ..	105	60	55	..	5,170	2,000	2,002	7
Other Lead compounds ..	190	98	13	223	13,302	5,581	1,621	12,087
Magnesium Chloride ..	1	..	2	2	131	..	162	184
Magnesium Sulphate ..	370	208	203	247	13,264	11,577	13,518	10,508
Other Magnesium compounds	4,488	1,693	2,748	4,514	1,06,488	45,996	83,101	1,77,442
Potassium Bichromate ..	8	79	..	..	30,087	3,650	..	..
Potassium Chlorate ..	10,535	2,448	81	200	11,52,880	3,08,765	11,070	18,811
.. anide .. ..	189	126	336	327	28,555	19,052	37,219	33,750
Other Potassium compounds	5,009	2,777	4,319	3,767	6,90,133	4,44,072	11,30,718	8,97,539
Borax .. ..	9,412	23,198	19,936	23,254	2,33,938	5,73,159	5,51,535	7,28,944

TABLE 5—*contd.*

Name of Chemical	Quantity (In Cwts.)				Value (In Rupees)			
	1941-42	1942-43	1943-44	1944-45	1941-42	1942-43	1943-44	1944-45
Sodium Cyanide ..	137	89	472	560	7,054	5,413	20,901	32,058
Sodium Sulphate ..	3,700	3,275	160	5	38,174	24,560	3,908	60
Sodium Sulphide ..	45,966	10,272	23,737	10,006	7,97,590	3,36,702	6,07,263	4,04,811
Sodium Bichromate ..	29,020	21,090	40,788	22,734	10,53,060	8,72,745	19,50,226	11,07,191
Zinc Chloride ..	34,963	7,711	16,684	11,200	7,41,970	1,77,933	4,59,216	3,56,670
Other sorts of chemicals ..	..	..	..	..	72,63,616	46,19,656	48,28,806	60,70,975

49. *Consumption.*—The inorganic fine chemicals would be generally consumed by the following industries:—

- (i) Textile industry.
- (ii) Photographic and film production.
- (iii) Foundries and workshops (case hardening compounds, tempering chemicals and fluxes, etc.).
- (iv) Leather industry.
- (v) Electroplating industry.
- (vi) Laboratory chemicals and analytical reagents.

The inorganic fine chemicals used in textile and photographic industries have been dealt with in separate Sections. The most important inorganic chemicals used in the leather industry, electroplating industry and as laboratory chemicals and analytical reagents have been indicated herein.

50. *Chemicals in Leather Industry.*—In this Province, the leather industry is firmly established and there are big tanneries of the magnitude of the Western India Tanneries, Ltd., Dharavi. A study of the processes carried out in these tanneries shows clearly that there is a tendency to use the chemical tanning processes on a daily increasing scale. Chemicals such as sodium sulphate, sulfamic acid, sulphuric acid, hydrochloric acid are increasingly used for processes such as "Pickling".

The most important tendency now developing is the recognition of the role of "Chrome" tanning in the preparation of chrome leather. Thus, sodium bichromate and basic chromium sulphate and hypo are finding increasing use in the tanneries of Bombay.

In the bleaching of leather, crystal magnesium sulphate will find increasing use day by day. Similarly, chemical astringents like alums are also used in large quantities. Sodium thiosulphate, sodium sulphate, sodium sulphhydrate, arsenic sulphide, sodium cyanide and potassium cyanide would be used as de-hairing agents in conjunction with lime when the most recent researches in this field are adopted by the tanneries of the Province. In this connection, it would be useful to cite the research work of the Tanners' Council Research Laboratory at the University of Cincinnati (U. S. A.). It has been suggested that any material acting

as a reducing agent in an alkaline solution would expedite the unhairing reaction. Study of the unhairing activity of substances named above showed that they are ideal unhairing agents. As such, they are likely to be adopted by the tanners in this Province. In view of this, the manufacturing of the following inorganic chemicals should be encouraged in the interest of the tanning industry:—

- (i) Sodium sulphate.
- (ii) Magnesium sulphate (crystals).
- (iii) Alum.
- (iv) Sodium bichromate.
- (v) Basic chromealum liquors.
- (vi) Sodium cyanide.
- (vii) Sodium sulphide.
- (viii) Sodium sulphite.
- (ix) Sodium thiosulphate.
- (x) Sodium sulfhydrate.

*The target of production.*—This could not be indicated herein but it will always be possible to regulate the production of these chemicals to cope with the demands of leather industry in view of the fact that the basic materials and starting materials will be always available in the Province.

51. *Electroplating Industry.*—The electroplating industry in the Province has attained enormous commercial importance in view of the fact that centres for electroplating of automobile parts, cycle parts, E. P. N. S. materials, household cutlery and other industrial requirements have been established fairly well in the Province generally and in the city of Bombay in particular.

Electroplating consists of coating the surface of one metal—generally a cheap metal—with a thin skin of another metal either for decorative or rust preservative purposes. Thus, the base metal is coated with gold for decorative purpose whereas iron is coated with nickel or chromium for protective reasons. Practically, all this metal coating—electroplating—is now done by suspending the object to be plated as a cathode in a suitable bath formed by the solution of the salts of higher metals and the desired metal is deposited as a coating electrolytically.

The chemicals entering into the electroplating industry are generally used in the preparation of baths so constituted that the metal is not deposited by simple chemical replacements. For this purpose a complex bath is prepared. The chemicals used for such baths are as follows:—

1. Copper sulphate.
2. Silver nitrate—to be converted into a double cyanide of Silver and Potassium.
3. Gold chloride—double cyanide of gold and potassium.
4. Zinc sulphate.
5. Nickel-ammonium sulphate.
6. Chromium sulphate and chromic acid.
7. Cadmium nitrate—double salt cadmium—sodium cyanide.

The production of these chemicals in required purity must be encouraged to be undertaken by factories planning the manufacture of fine chemicals. The targets

of production of these fine chemicals cannot be fixed at this stage. The requisite materials will be available in quantities necessary to facilitate the production of these chemicals.

52. *Foundry and Workshop Chemicals.*—Fluxes such as for soldering and welding consist mostly in judicious admixture of carbonates and bicarbonates of soda, borax, boric acid and flourides. Productions of these could be easily undertaken.

Again case-hardening compounds and tempering compounds for steel and iron, Phosphoric acid and phosphates for making steel corrosion proof, are imported in large quantities. These are mostly proprietary brands but could easily be manufactured once cyanides and ferrocyanides start getting produced in the Province.

53. *Baking Powders.*—These are usually mixtures of soda-bicarbonate or ammonium carbonate with acidic materials like sodium triphosphate, alum and tartaric acid together with 50 per cent. starch. Production of these is a very simple affair.

54. *Laboratory Chemicals and Analytical Re-agents.*—The pure inorganic chemicals needed for the increasing requirements of the Province in view of the establishment of Colleges and Research Institutes teaching Science will have to be met by the preparation of these at the factories producing fine chemicals. Similarly, analytical re-agents of approved degree of purity could also be undertaken to meet the limited demands of Research Institutes of the Province. The list of such minor chemicals is too long to be given herein. As such, it is proposed that an institution like the Department of Technology, University of Bombay, may be requested to undertake the preparation of these re-agents on the basis of controlled processes. The installation of a special section by the Department of Technology besides providing training to the students of the fine chemicals section will cope with the needs of the whole Province. Such an attempt to manufacture organic fine chemicals has been successfully made at the Indian Institute of Science, Bangalore.

## SECTION II.

### Organic Chemicals.

55. *Grouping of Organic Chemicals.*—The organic chemicals which are of prime importance in the industrial structure of the Province, have been considered here. They have been grouped as follows. The list of Chemicals indicated under each group is, by no means, exhaustive. It is only illustrative.

(1) *Chemicals of general importance.*—Acetaldehyde, Acetamide, Acetic Acid, Acetic Anhydride, Acetylchloride, Acetate of Lime, Carbamide (Urea), Chloral Hydrate, Citric Acid, Formaldehyde, Oxalic Acid, Rochelle Salt, Tartaric Acid, Ethyl Chloride and Methyl Chloride.

Benzene, Phenol, Aniline, Toluene, Saccharine, Nitrophenols and Nitranilines, Acetated Phenols and Acetated Nitranilines, Amino Phenols, and Aniline Salts.

(2) *Organic Products of Fermentation.*—Ethyl Alcohol, Amyl Alcohol, Butanol and Acetone.

(3) *Industrial Solvents.*—Ethyl Acetate, Amyl Acetate, Amyl Butyrate, Butyl Acetate, Carbon-disulphide, Chloroform, Carbon Tetrachloride, Methyl Alcohol, Glycol and Diethyl Ether.

56. *Production.*—Up to now, most of these important organic chemicals have not been produced in India. Even in the Province, no attempt has been made to produce these organic chemicals. The only organic chemicals produced and absorbed in the market of the Province have been given here-below in the tabular form :—

Name of Chemical.	Factory Manufacturing.	Daily Production.	Industries utilising.
1. Ethyl Alcohol	(i) Government Distillery, Nasik.	1,000 Gals.	(a) Solvents.
	(ii) Alembic Chemical Works	500 „	(b) For the preparation of Denatured Alcohol.
	(iii) Marstrand & Price, Walchand Nagar.	2,500 „	
2. Chloroform	Alembic Chemical Works	....	(a) Solvents. (b) Medical. (c) Laboratories.
3. Diethyl Ether	Do.	....	(a) Solvents. (b) Laboratories. (c) Anesthetic.

57. *Scope for Organic Chemicals.*—The Province, as it is, presents a good market for the organic chemicals mentioned above. In view of the standardization of the various processes employed in the manufacture of organic chemicals, and in view of the facts that the applications of such processes will be easily achieved in this Province, it is reasonable to hope that the manufacture of these organic chemicals would both prove useful and profitable to this Province. The organic processes are generally known as the organic unit processes, such as nitration, sulphonation, chlorination, etc. The raw materials required for all these processes will be easily available in the Province. With the establishment of the heavy chemical industry, important products like fuming nitric acid, 30 per cent. oleum, liquid chlorine, chlorosulphonic acid, etc., will be available cheaply for the development of the fine organic chemicals industry in the Province.

Another important factor to be considered in the development of organic chemicals is the encouragement to chemical engineering (designing, fabrication and erection of plants), adequately suitable for this branch of chemical industry. It will be reasonable to assume that with the advent of heavy chemical industry in the Province, the problem of the raw materials will be easily solved.

The most outstanding characteristic associated with the manufacture of organic chemicals is the fact that a variety of products may be obtained from a very few starting materials. For example, ethyl alcohol or acetylene or benzene could each be the starting point for a number of fine organic chemicals, useful in important industries such as the dyestuffs industry, the textile industry or the pharmaceutical industry.

58. *Recommendations.*—I. As to the targets of production of organic chemicals, generally it would be difficult to indicate figures at this stage. This must be attributed to the fact that organic chemicals considered are numerous and the

factors relative to their consumption are complex. Only in the case of industrial solvents, a very approximate indication could be made as follows :—

Name of Chemical				Target of annual production during the coming 5 years.
(i) Acetic Acid	...	...	...	500 tons.
(ii) Ethyl Alcohol	...	...	...	1,000,000 gallons.
(iii) Methyl Alcohol	...	...	...	200,000 gallons.
(iv) Ether	...	...	...	300 gallons.
(v) Carbon Tetrachloride	...	...	...	1,000 tons.

The other solvents will be the esters derived from the acetic acid and various alcohols to be obtained as the products of fermentation, to be used in paints, varnishes and similar manufactures.

II. The likely centres of production of organic chemicals will be governed by the availability of raw materials, research and technical help and nearness of market of consumption. As such, the factories may be suitably located at or near :

(a) Bombay.

(b) Baroda.

(c) Ahmedabad.

(d) Alcohol manufacture to be near the centres of molasses production in the Province—Places such as Rawalgaon.

III. The industry may be encouraged to be started by private capital, but the necessary protection and transport facilities may be afforded so as to enable economic production.

### SECTION III.

#### Drugs and Pharmaceuticals.

59. *General Considerations.*—The importance of Drugs and Pharmaceuticals industries in a disease-ridden country like India cannot be over-emphasised. Medical facilities for the public are being continuously improved in all civilised countries, and as such, the essential drugs should be manufactured in India, in as large quantities and as cheaply as possible to be within the easy reach of even the poorest of the community.

60. *Trend of Present Production.*—The development taking place in the Province (as also in the country) is mainly on the pharmacy side of the industry. The production of galenicals, purifying of products, packing, ampouling, tableting of materials obtained from abroad are activities that are welcome but cannot be classed as industrial manufacture. In the production of many of the items, the



processes adopted are only large-scale laboratory operations and not commercial processes. The following factories are established on a fairly sound basis :—

1. Chemical, Industrial and Pharmaceuticals Laboratories, Ltd., Bombay.
2. Oriental Pharmaceutical and Industrial Laboratories, Ltd., Bombay.
3. Syntetic (India) Ltd., Bombay.
4. Teddington Chemical Factory, Bombay.
5. Chemo-pharma Laboratories, Ltd., Bombay.
6. Alembic Chemical Works, Baroda.
7. Sarabai Chemicals Ltd., Baroda.
8. Zandu Pharmaceutical Works Ltd., Bombay.
9. Unza Pharmaceutical Works, Unza.
10. Dhutpapeshwar Ltd., Panvel.

61. *Factors Relative to Production.*—The main reason for this state of affairs is the absence of well-developed feeder chemical industries. We are further handicapped in respect of special types of equipment for the fabrication of which we have yet no facilities.

It should not be concluded from the foregoing that we must produce all the basic materials in the country before the manufacture of drugs is undertaken; the two activities must go side by side in a well planned programme. The manufacture of drugs utilising the available raw materials can be started immediately; others may be imported till our resources are developed.

Hundreds of items come in the category of drugs and pharmaceuticals; but we might confine our attention to two classes of products—those which are very essential for guarding the health of the public i.e. preventive, and the rest for which the raw materials are easily available in the Province. The first class comprises sulphur drugs, synthetic vitamins etc., while vaccines, antitoxins, antisera drugs of vegetable origin etc., fall in the second class.

No stronger argument is needed in favour of manufacture of the first category of drugs than the simple fact that sulphur drugs and antimalarials together, can prevent or treat more than three-fourths of all the illnesses afflicting the country.

It might also be noted here that the Committee have recommended the dye-stuff industry to be located in this Province; as such, the manufacture of these drugs should admirably fit in the picture because a number of raw materials are common to both the industries.

Regarding drugs, obtainable from vegetable sources, such as quinine, ephedrine, strychnine, emetine, santonin, morphine etc., Bombay Province may not be able to undertake the manufacture of many of them. However, a survey of the Province should profitably be made to explore possibilities in this direction.

62. *Market Conditions and Factors Relative to Off-take of Indigenous Products.*—The factories mostly situated in the city of Bombay specialising in the preparation of liver products have been mentioned above. The production of these factories showed an increase during the war years because of the fall in imports and an increased demand by military personnel. The future of this industry is doubtful at present because of the fact that in the immediate post-war period there is likely

to be keen competition from imported products. It is, therefore, necessary to give adequate protection to this industry in view of the fact that its products can be utilised as substitutes for food in days of food shortage.

63. *Figures and Approximate Analysis of Consumption.*—The following table gives the imports of principal drugs and medicines in British India during the period 1936-40.

TABLE 6.

Name of the Drug or medicine.	Unit.	1935-36	1936-37	1937-38	1938-39	1939-40
Codliver Oil .. .. .	Lbs.	108,431	106,351	164,924	230,516	219,847
Proprietary and Patent medicines.	Rs.	64,20,669	67,76,845	73,72,972	60,74,672	88,95,981
Quinine Sulphate or Bisulphate.	Lbs.	64,044	67,570	61,600	62,409	58,582
Quinine Hydrochloride or dihydrochloride.	..	13,463	10,374	16,732	13,080	10,642
Other Sorts .. .. .	..	26,103	21,096	26,097	22,846	13,550
Total of quinine salts .. .. .	..	103,610	99,049	105,329	98,135	82,783
Total value of drugs and medicines.	Rs.	2,11,10,538	2,06,83,469	2,36,16,740	2,20,53,230	2,61,20,837

About a fourth of the above quantity imported in British India may be estimated to have been utilised in the Province of Bombay. Thus, the normal requirements of the Province may be estimated as follows :—

Codliver Oil .. .. .	50,000 lbs.
Patent medicines, of the approximate pre-war value of	Rs. 25,00,000
Quinine salts .. .. .	15,000 lbs.
Other drugs of the pre-war value of	Rs. 20,00,000

#### 64. *Scope and Possibilities of Expansion.*—

(a) *Liver and Glandular Products.*—Bombay being a large city where a large number of animals are slaughtered every day for food, is very favourably placed as regards the manufacture of glandular products and other biologicals. But before the manufacture of these products is taken in right earnest, attention must be given to modernisation of slaughter houses whereby the valuable glands can be preserved in cold storage for distribution.

(b) *Vaccines and Sera.*—Vaccines are at present being manufactured at the Haffkine Institute. The production at this institute not only meets the demands of the Province but also a partial requirement of other Provinces. But with the extension of medical facilities, new centres and institutes will have to be opened up to cope with the increased demand. Antitoxins and antisera, produced at the Haffkine Institute have limited demand at present but would be needed more in the coming years.

(c) *Shark Liver Oil.*—Bombay has a coast which abounds in sharks, which is the source of an oil rich in vitamin A. The average sample of shark oil produced in Bombay is 10 to 15 times as potent as one from oil imported from abroad. The requirements of the country in respect of this product are enormous

and Bombay being one of the few maritime Provinces has to supply not only the needs of the Province but also a part of requirements of the country. We may safely assume that Bombay will be called upon to produce one fourth of the total needs of the country.

65. *Location of Future Producing Units.*—As all the facilities required for the large scale manufacture of drugs and pharmaceuticals are available in Bombay it would be an ideal location for plants manufacturing drugs. The suitability of places besides Bombay is limited although a big factory is being placed at Baroda over and above the existing Alembic Chemical Works, Ltd.

66. *Recommendations and Targets of Future Production.*—As already mentioned, the manufacture of drugs and pharmaceuticals requires a number of raw materials which are common to other industries viz. dyestuffs, plastics, rayon and synthetic rubber. The production of these materials must be taken up according to a well stipulated plan so that most of them would be produced in a period of about 5 to 10 years.

Materials required are as follows :—

(1) *Inorganic heavy chemicals.*—Hydrochloric Acid, Sulphuric Acid, Nitric Acid, Chlorosulphonic Acid, Sodium Hydroxide, Potassium Hydroxide, Zinc, Arsenic, Phosphorous Oxychloride, Thionyl Chloride.

(2) *Solvents.*—Ethyl Alcohol, Methyl Alcohol, Ethyl Ether, Acetic Acid, Chloroform, Ethylene Dichloride, Isopropyl Alcohol, Emyl Alcohol.

(3) *Coal distillation products.*—Benzene, Toulene, Aniline, Chloro-Benzene, Phenol, Pthalic-Anhydride, Benzaldehyde, Cresols, Xylenols, and Pyridine.

(4) *Fine chemicals.*—Ethyl Formate, Ethyl-Aceto-Acetate, Ethyl-Oxide, Diethylamine, Acetic-Anhydride, Ethyl-Acetate.

(5) *Miscellaneous chemicals.*—Urea, Thiourea, Dicyanidiamide, Oxalic Acid, Lactose, Starch, Glucose, Activated Carbon.

The manufacture of synthetic drugs (viz. sulpha and synthetic vitamins) is not possible in all the Provinces of the country due to lack of proper facilities and raw materials. These, therefore, should be concentrated at most in two or three Provinces, one of which is Bombay. The targets of production for the Province will be one-third of the target of production for the country. In view of these, the following figures are suggested as targets for production for various items in the Province and should be attained in 5 or 10 years :—

Sulpha Drugs	...	...	200,000	lbs. per annum.
Synthetic antimalarials	...	...	75,000	do.
Penicilin	...	...	250,000	million units per annum.
Stretomycine	...	...	100,000	do.
Arsenicals	...	...	25,000	lbs. per annum.
D. D. T.	...	...	5,000	tons per annum (to be doubled later).
Thiamene Chloride	...	...	2,000	lbs. per annum.
Nicotine Acid	...	...	15,000	do.
Ascorbic Acid	...	...	50,000	do.

Regarding the biologicals, production would depend upon the availability of raw materials. These also should be produced to the fullest capacity so that Bombay fulfills not only its own requirements but also of other parts of India.

## SECTION IV.

## Photographic Chemicals.

67. *General Considerations.*—The photographic chemicals used in the Province form important items, in view of the fact that majority of the film processing laboratories are situated in Bombay forming 60 per cent. of the total India capacity. In this section, the photographic chemicals have been classified as follows:—

A. *General*—

- |                                 |                                       |
|---------------------------------|---------------------------------------|
| 1. Acetone.                     | 18. Cupric chloride.                  |
| 2. Acids—Acetic (Glacial).      | 19. Distilled Water.                  |
| 3. Citric.                      | 20. Formalin.                         |
| 4. Hydrobromic.                 | 21. Gelatine (Hard, medium and soft). |
| 5. Hydrochloric.                | 22. Glycerine.                        |
| 6. Nitric.                      | 23. Methyl alcohol.                   |
| 7. Phosphoric.                  | 24. Phenol.                           |
| 8. Sulphuric.                   | 25. Potassium bromide.                |
| 9. Alcohol, ethyl (pure).       | 26. Potassium chloride.               |
| 10. Alcohol, ethyl (denatured). | 27. Potassium citrate.                |
| 11. Alum, chrome.               | 28. Potassium dichromate.             |
| 12. Ammonia (liquid).           | 29. Potassium iodide.                 |
| 13. Ammonium bromide.           | 30. Potassium thiocyanate.            |
| 14. Ammonium chloride.          | 31. Rochelle salt.                    |
| 15. Ammonium iodide.            | 32. Silver nitrate.                   |
| 16. Barium chloride.            | 33. Sodium chloride.                  |
| 17. Barium sulphate.            | 34. Sodium citrate.                   |
|                                 | 35. Sodium oleate.                    |

\*B. *Optical Sensitisers*—

- |                  |  |
|------------------|--|
| Ortho-chromatic— | 1. Erythrosin.   |
|                  | 2. Eosin.  |
| Panochromatic—   | 3. Erythrosin.   |
|                  | 4. Pinacyanol.   |
| Red—             | 5. Cyanine dyes like<br>Dicyanine, Pinacyanol<br>etc.                        |
| Infra-Red—       | 6. Cyanine dyes like<br>Krypto-Cyanine, Neo-<br>cyanine & Rubra-<br>cyanine. |

\*C. *Desensitisers*—

- |                    |                          |
|--------------------|--------------------------|
| 1. Chrysodin.      | 3. Pina-kryptol, green.  |
| 2. Pheno-safrinin. | 4. Pina-kryptol, yellow. |

*Note.*—\*These chemicals will be in demand when industry manufacturing photographic chemicals comes into existence.

*Chemicals required in Processing.***A. Developing—**

- |  |                               |
|--|-------------------------------|
| Reducing—1. Amidol.                    | 6. Phenylenediamine (o- & p-) |
| 2. Amidophenol (para.).                | 7. Pyrocatechol.              |
| 3. Glycerine.                          | 8. Pyrogallol.                |
| 4. Hydroquinone.                       | 9. Sodium sulphite.           |
| 5. Metol.                              |                               |
| Accelerators—1. Borax.                 | 4. Sodium biphosphate.        |
| 2. Potassium carbonate.                | 5. Sodium carbonate.          |
| 3. Potassium hydroxide.                | 6. Sodium hydroxide.          |
| Restrainer—1. Potassium bromide.       |                               |
| Preservative—1. Acetic acid (Glacial). |                               |
| 2. Potassium metabisulphite.           |                               |
| 3. Sodium bisulphite.                  |                               |

**B. Fixing—**

- Dissolvent for unexposed parts of silver halides—1. Hypo (sodium thiosulphate).  
2. Potassium cyanide (rarely).
- Hardener—1. Alum, chrome. 2. Alum, potash.

**C. Reduction—**

- |                            |                                    |
|----------------------------|------------------------------------|
| 1. Ammonium persulphate.   | 6. Potassium oxalate.              |
| 2. Ferric chloride.        | 7. Sodium & Potassium dichromates. |
| 3. Iodine.                 | 8. Potassium permanganate.         |
| 4. Potassium cyanide.      | 9. Water.                          |
| 5. Potassium ferricyanide. |                                    |

(N.B.—After reduction, the material is developed using the chemicals and processes mentioned above).

**D. Intensification—**

- |                            |                          |
|----------------------------|--------------------------|
| 1. Ammonium sulphocyanide. | 5. Mercuric chloride.    |
| 2. Citric acid.            | 6. Mercuric iodide.      |
| 3. Copper sulphate.        | 7. Potassium dichromate. |
| 4. Lead nitrate.           | 8. Uranium nitrate.      |

**E. Toning—**

1. Ammonium sulphocyanide + gold chloride.
2. Barium sulphide.
3. Dimethyl glyoxime + nickel tartarate or nitrate.
4. Ferric ammonium citrate
5. Gallic acid
6. Potassium chloroplatinate + Phosphoric acid.
7. Platinum perchloride + Sodium formate or formic acid.
8. Sodium or potassium citrate.
9. Sodium sulphide and Liver of Sulphur.
10. Vanadium chloride.

**F. Mountings—**

1. Arrow-root.
2. Dextrine.
3. Gelatine.
4. Starch.

## (Preservatives)—

1. Chloral hydrate.
2. Chrome alum.
3. Oil of Cloves.
4. Oil of Wintergreen.
5. Phenol.

Up to now, all these chemicals have been imported from overseas, manufacturers such as the E. Merck, Kahlbaum (in Germany) or the British Drug House in England, or the Lumiere Cie in France. With the establishment of the fine chemicals industry as envisaged in the foregoing section, it will be possible to meet these requirements by the indigenous production.

68. *Present Production.*—Factories have been started in this Province for the manufacture of important photographic chemicals on a large scale and the present position could be shown by the following table:—

Name of Chemical.					Production (in tons).
1. Sodium Thiosulphate	...	...	...	...	600
2. Sodium Sulphite	...	...	...	...	300
3. Sodium Bisulphite	...	...	...	...	330
4. Sodium Meta-Bisulphite	...	...	...	...	50

In view of the above, it can be seen that there is a nucleus of production for photographic chemicals in this Province. It would, thus, appear that the production of the other fine chemicals required by various consuming units can be undertaken in Bombay.

69. *Consumption.*—The main consuming centres of photographic chemicals are enumerated below:—

The Famous Cine Laboratory, Tardeo, Bombay.

The Bombay Talkies, Malad, Bombay.

Filmistan Ltd., Goregaon, Bombay.

Rajkamal Film Studios, Parel, Bombay.

Lakshmi Production Ltd., Andheri, Bombay.

Kodak Processing Laboratory, Cadell Road, Bombay.

The Prabhat Studios, Poona.

From the figures available up to now, the position regarding the consumption of important photographic chemicals can be summed as follows:—

Name of Chemical.					Quantity consumed annually (in tons).
Sodium Sulphite (photographic)	...	...	...	...	150
Sodium Thiosulphate	...	...	...	...	200
Sodium Bicarbonate (photographic)	...	...	...	...	100
Chrome Alum (photographic)	...	...	...	...	5

The rest of the chemicals as outlined in the previous paragraph are very widely variable and depend upon the processing activities of different cine laboratories.

## SECTION V.

## Textile Chemicals.

70. *General Considerations.*—The chemicals considered in this Chapter fall in the following categories :—

- (1) Heavy chemicals used in textiles.
- (2) Fine chemicals used in textiles.
- (3) Starch and starch derivatives processed for textiles.

The heavy chemicals used in textile industry have been indicated in the adjoining table. The present production of these chemicals in the Province and the future production as envisaged in the Chapter II, would cope with the demands by this industry. Regarding the fine chemicals, both organic and inorganic, a mention has been made in the previous section of this chapter and it will appear that the requirements of textile industry with regard to the following chemicals will be dealt with by production in this Province.

Acetate of iron.	Hydrogen Peroxide.	Sodium ferrocyanide.
“ of sodium.	Hydrosulphite of soda.	“ nitrite.
Acid Boric.	Magnesium chloride.	“ perborate.
“ Chromic.	Potassium dichromate.	“ peroxide.
“ Creosylic.	Potassium ferrocyanide.	“ silicate (water
“ Hydrochloric.	Potassium permanganate.	“ glass).
“ Oxalic.	Soap, soft.	“ sulphide.
“ Salicylic.	Soda ash.	“ thiosulphate.
“ Sulphuric.	Sodium aluminate.	Turkey Red Oil.
Copper Sulphate.	“ bicarbonate.	Vegetable Tallow.
Glauber's Salt.	“ bisulphite.	
Glue.	“ chlorate.	
Glycerine.	“ chloride.	

As regards starch, the present position for production in the Province is as follows :—

Name of Factory.	Description of product.	Estimated Production (in tons).	
		1943	1945
Anil Starch Products Ltd. ...	Maize Starch ...	2667	3727
	Chemicals „ ...	2758	2374
Hindustan Colour and Chemicals Ltd. ...		Not known ...	4500

71. *Consumption.*—As regards consumption of chemicals in the Textile Industry, the adjoining tables will give an idea of the off-take of these chemicals both at present and in future. It will be possible to supply the industry with most of its requirements as regards the heavy chemicals, fine chemicals and starch.

72. *Future Production.*—The survey of starch production in the Province has shown that the factories are not run on the most economical and scientific lines. Under the stress of the conditions created by the World-War II, the indigenous starch and derivatives of starch may have been able to find a market but under normal conditions, the present method of production and the technical handling of the raw materials would be hardly considered ideal. It is, therefore, recommended that the present factories should be placed on the most efficient working conditions while protection is granted to them.

The starch industry should be fed by indigenously grown maize of the highest variety in view of the fact that the Indian maize has only about 53 per cent. to 55 per cent. starch whereas the American maize has as high a percentage of starch as 63 per cent. to 64 per cent. This difference in the yield of starch might form the basis of a very keen competition. If the industry has to survive foreign competition, the Department of Agriculture should offer the best varieties of maize to the starch industry.

Extensive researches should be undertaken in a Central Research Institute to develop other sources as starting materials for the production of starch.

No recommendations regarding targets or locations for this industry need be made at this stage.

TABLE 7.

*Consumption of Chemicals in Textile Mills from the Figures Supplied by Ahmedabad and Bombay Millowners' Associations.*

*Heavy Chemicals.*

Name of Chemical.	Consumption in 1944 (Cwt.).			Estimated Normal Consumption (Cwt.).		
	Bombay Millowners' Association.	Ahmedabad Millowners' Association.	Total.	Bombay Millowners' Association.	Ahmedabad Millowners' Association.	Total.
1 Sulphur (black) ..	....	....	4,224	5,406	....	5,406
2 Sodium acetate ..	230	....	230	450	....	450
3 Hydrochloric Acid.	8,570	3,283	11,812	6,277	4,076	10,353
4 Sulphuric Acid ..	42,243	3,262	46,605	20,820	7,085	28,605
5 Alum ..	487	70	557	353	80	442
6 Aluminium sulphate	277	36	313	323	923	1,246
7 Ammonium sulphocyanide ..	3	....	3	....	....	....
8 Antimony salt ..	85	....	85	73	....	73
9 Bleaching Powder ..	7,308	7,183	14,581	12,287	41,430	53,726
10 Borax ..	126	....	126	112	....	112
11 Caustic Soda ..	92,393	12,715	105,108	84,663	30,250	114,922
12 Chrome Alum ..	840	....	840	70	....	70
13 Copper sulphate ..	62	22	84	150	12	162
14 Iron sulphate ..	5,715	600	6,315	2,162	82	2,234
16 Sodium sulphate ..	7,710	60	7,770	7,300	445	7,754
16 Sodium hydro-sulphite ..	5,350	2,011	7,361	6,004	6,263	12,057
17 Potassium carbonate.	626	....	626	845	....	845
18 Sodium dichromate	1,201	....	1,201	105	....	105
19 Potassium chlorate	5	....	5	3	....	3



TABLE 7—contd.

Name of Chemical.	Consumption in 1944 (Cwt.).			Estimated Normal Consumption (Cwt.).		
	Bombay Millowners' Association.	Ahmedabad Millowners' Association.	Total.	Bombay Millowners' Association.	Ahmedabad Millowners' Association.	Total.
20 Potassium ferro- cyanide ..	26	---	26	25	....	25
21 Sodium carbonate ..	52,350	30,919	89,269	56,288	32,765	89,048
22 Sodium aluminate ..	117	---	117	204	....	204
23 Sodium bicarbonate ..	2,279	---	2,279	2,081	....	2,081
24 Sodium bisulphite ..	136	122	258	274	143	417
25 Sodium chlorate ..	18	....	18	108	....	108
26 Sodium chloride ..	69,895	....	69,895	55,444	....	55,444
27 Sodium nitrite ..	178	....	178	246	....	246
28 Sodium perborate ..	38	....	38	97	....	97
29 Sodium peroxide ..	2	---	2	42	....	42
30 Sodium silicate ..	4,398	....	4,398	3,522	....	3,522
31 Sodium sulphite ..	1,754	145	1,899	2,035	227	2,262
32 Sodium hyposulphite ..	1	16	17	74	298	372
33 Tri-sodium phosphate ..	80	....	80	163	....	163
34 Sodium sulphide ..	2,151	....	2,151	1,015	....	1,015
35 Hydrogen peroxide ..	25	1,345	1,370	414	2,405	2,909
36 Potassium dichro- mate ..	144	....	144	183	....	183
37 Liquid chlorine ..	....	77,258	77,258	....	1,290	1,290
38 Liquid bleach (hypo-chlorite solution) ..	....	58,313	58,313	....	59,007	59,007
39 Sodium chlorite ..	....	17,830	17,830	....	13,160	13,160
40 Nitric acid ..	....	2	2	....	10	10
41 Lime ..	....	13,921	13,921	....	11,841	11,841
42 Liquor ammonia ..	....	12	12	....	16	16
43 Caustic Potash ..	5,023	5,013	11,236	471	12,882	13,353
44 Ferric sulphate ..	....	2	2	....	2	2
45 Sodium sulphate (anhydrous Na <sub>2</sub> SO <sub>4</sub> ) ..	....	17	17	....	25	25
46 Zinc chloride ..	....	755	755	....	2,021	2,021

*Fine Chemicals and Textile Auxiliaries.*

Name of chemical.	From figures supplied by Bombay Millowners' Association.		From figures supplied by Ahmedabad Millowners' Association.
	Consumption in 1944 (Cwt.).	Estimated normal consump- tion (Cwt.).	Average annual consump- tion during 1936-44.
1. Congo red	400	272	14
2. Indigo	110	138	27
3. Vat dyes	1,972	2,314	2,436
4. Acetic acid	1,094	1,105	239
5. Formic acid	49	5	11
6. Oxalic acid	25	36	9
7. Salicylic acid	283	331	3
8. Tannic acid	172	117	6
9. Amicrol	59	35	.....
10. Aniline oil	7	536	7
11. Chlorenol	5	.....	30
12. Dispersol	180	218	16
13. Glucose	421	248	743
14. Glue	281	296	243
15. Glycerine	906	1,750	390
16. Starch	35,109	34,557	4,224
17. Glycine	100	5	15
18. Gum	1,739	2,439	241
19. Mutton tallow	32,675	30,351	14,634
20. Novofermosol	122	73	54
21. Paraffin wax	669	677	354
22. Pine oil	137	334	12
23. Soap soft	3,497	25,938	872
24. Soap flakes	1,411	1,509	855
25. Turkey red oil	5,713	6,870	922
26. Vegetable tallow	5,870	3,851	95

## CHAPTER IV.

## WOOD-DISTILLATION, COAL CARBONISATION AND PETROLEUM REFINING INDUSTRIES.

73. *General.*—Coal carbonisation and coal products form an extremely important grouping of the chemical industry. This Province has not the mineral coal resources for supplying coke to the iron and steel industry which may justify the installation of large scale coal carbonisation industry. It is, however, possible to install certain industries which would make use of certain products of the coal carbonisation industry. The following Sections have been incorporated in this Chapter:—

1. Destructive Distillation of Wood.
2. Coal Gas and Coal Tar Products.
3. Dyestuffs.
4. Petroleum Refining.

## SECTION I.

## Destructive Distillation of Wood.

74. *General Considerations.*—The distillation of hard wood for charcoal with the recovery of the volatile by-products, pyroligneous acid and wood tar should replace in this Province the old process of making charcoal by the slow burning of a pile of wood covered with earth.

In the early days of wood distillation, charcoal was the only product and no attempt was made to recover other volatile materials. But while chemical industry was still a mere struggling infant, the recovery and refining of pyroligneous acid and tar became an important item. The by-product liquid of hard-wood distillation yields principally methanol, acetic acid and acetone. A multitude of other materials is present in pyroligneous acid and tar, but in small proportions. Their recovery is of only minor importance. The tar yields Guaiacol, solvent oil and pitch. All these products are of considerable commercial importance, especially in chemical industries. Methanol is a good solvent for shellac, other gums and resins; it is used as a denaturant for alcohol and as a raw material for the manufacture of formaldehyde. Acetic acid and acetic anhydride play a major role in the production of acetate silk (rayon).

Wood distillation plants were originally built to supply a large charcoal market. However, with the advent of coke for use in blast furnaces and development of superior domestic heating devices, the industry found that the charcoal market was shrinking rapidly. Dwindling business meant dwindling profits and it became necessary to make a more complete recovery of wood distillation products. Aside from charcoal, methanol, methylacetone, lime acetate, and tar began to be recovered by the distillers. The recovery of the by-products revived the industry to a very large extent. These considerations apply more specially to highly technical countries like U. S. A. and Germany, but, as far as India is concerned, the production of charcoal will always find a ready market for a long time to come. As such, instead of making charcoal by the old process, it would be profitable to resort to wood distillation.

Beginning with 1920, the industry has beset with another difficulty—the competition of synthetic chemicals. Chemical competition developed rapidly to the point where synthetic chemical industries were able to compete, particularly in the production of methanol and acetic acid and finally to the point of controlling the markets for these products. But more complete recovery of distillation products by fractionation of tars helped the industry to survive.

From the above it is clear that a certain permanent demand for charcoal plus a continuous activity towards complete recovery of products seems to be the formula for future successful operations in the industry.

This is the state of affairs with U.K., U.S.A., and other highly technically advanced countries. In India the situation is quite different. We have no wood distillation industry in the Province, the requirements of charcoal being met by the old method.

75. *Present Production in the Province.*—From the recent information received an attempt has been made by the Bombay Wood Distillation Co., Ltd., to put up a factory (capacity 8,000 tons per year) for wood distillation. The operations are likely to start early.

76. *Factors relative to production—Results of Investigations regarding wood distillation in India.*—A reference to the Forest Research Institute, Dehra Dun, regarding the possibilities of using Indian hardwood for distillation has revealed that, on the average, the following yields may be obtained :—

	Per cent.
Charcoal ... ..	40
Acetic acid ... ..	3.6
Methyl alcohol ... ..	1.4
Tar ... ..	9

It appears that the investigations at the Forest Research Institute have not been complete to the extent of obtaining other fractions from the pyroligneous liquor.

The following results have been communicated by the Mysore Iron and Steel Works Ltd., as actually obtained in their hardwood distillation plant :—

*Average yield per ton of seasoned hardwood.*

1. Charcoal ... ..	6-7 Cwts.
2. Calcium acetate (grey) ... ..	Not measured.
3. Non-condensable gases ... ..	Not measured.
4. Methyl alcohol ... ..	2 gallons.
5. Soluble tar ... ..	4 gallons.
6. Pitch ... ..	25 lbs.
7. C. P. Menthol ... ..	40 per cent. of crude alcohol.
8. Methyl acetone ... ..	20 per cent. of crude alcohol.

The Mysore Iron and Steel Works are not manufacturing other products such as methyl acetone, acetic acid, etc.

Regarding the wood distillation industry, H. Trotter of the Indian Forest Service, opined that wood distillation was not a profitable proposition in India but since that time developments have taken place and he himself has added: "It is possible, however, that the recent development in the wood distillation industry, namely, the direct conversion of pyroligneous liquors into acetic acid without going through the intermediate stage of lime acetate may make a considerable difference in the industry. This new process was discovered by Suida, an Austrian professor, and his process is now being worked by two small plants in France and Yugoslavia, and an American plant is also trying it on a factory scale. If the process proves successful, it will greatly reduce the cost of manufacture of acetic acid, which is used in large quantities in Ceylon, Java and the Malay States, in the rubber industry. It is still possible, therefore, that India may find it profitable to manufacture acetic acid for those countries which are much nearer to her shores than those of Europe and America".

Since Trotter wrote the above, conditions have improved so far as the economics of the industry are concerned:—

(1) All the charcoal produced can be readily sold in Bombay and Delhi at a handsome price. This is not merely a war-time demand, as it is likely that charcoal will continue to be in demand and fetch a good price even after the war. A condition precedent, however, is that the existing indiscriminate manufacture of charcoal by all and sundry which goes on in the forests at present, should be prohibited. Local demand will also increase, as a great deal of charcoal will be used in the Province itself in Producer Gas plants.

(2) All the by-products can be fully utilised in the country in the industries that have been or are likely to be started in the post-war period.

Large quantities of acetic acid will be absorbed in the textile and rubber industries in the manufacture of cellulose lacquers, and in artificial silk industry. Wood alcohol will be required in varnish industries as formaldehyde. The latter in itself is a useful preservative and is also used for making a plastic glue for cementing peeled veneer in the plywood manufacture. Wood tar can be utilised for asphaltting roads and as a preservative for the large number of poles that will be needed for transmitting power from the proposed thermal stations.

The only objection that remains to starting wood distillation will be that firewood is readily saleable as such, but it is forgotten that the local consumption of firewood is very small compared to the quantities burnt to make charcoal for consumption in towns and cities. In fact as will be shown later on, large quantities of charcoal are imported in Bombay proper and in the various districts of Bombay from outside. If, however, the Province has wood distillation plants of fairly big size at two or three suitable places in the forest areas, the industry would prove of considerable benefit.

77. *Market conditions and factors relative to off-take of products.*—The main products of wood distillation industry would be—

1. Charcoal.
2. Non-condensable gases.
3. Methyl alcohol.
4. Soluble tar.
5. Ketones.
6. Acetic acid.
7. Creosote.

Generally speaking, reasonably good prospects of the complete off-take of these products in the markets of the Province would be envisaged. The following are the figures of present production and consumption of charcoal in the Province :—

*Production of charcoal per year.*

					Tons.
Thana North	...	...	...	...	27,000
Thana West	...	...	...	...	23,000
Thana East	...	...	...	...	23,300
Kolaba	...	...	...	...	29,000
Belgaun	...	...	...	...	8,000
West Khandesh	...	...	...	...	1,000
Panch Mahals	...	...	...	...	1,400
Dharampur	...	...	...	...	3,000
				Total	115,700

*The actual consumption of charcoal in the Province per year is*

					Tons.
Bombay City	...	...	...	...	225,000
Bombay Suburbs	...	...	...	...	50,000
Poona	...	...	...	...	24,000
Surat	...	...	...	...	25,000
Ahmedabad	...	...	...	...	40,000
Sholapur	...	...	...	...	3,000
Nasik	...	...	...	...	6,600
Satara	...	...	...	...	2,000
				Total	375,600
				or roughly	400,000

(The above figures are supplied by the Assistant Director, Civil Supplies.)

The gap between production and consumption of charcoal in the Province is so large, that the installation of wood distillation factory at suitable places and producing wood charcoal for the surrounding areas could be considered justified.

The other products of wood distillation would be absorbed in the Province.

78. *Analysis of Consumption.*—The products of wood distillation industry are expected to be consumed as given in the following Table :—

(On basis of only one factory distilling about 45,000 tons of wood per year, i.e., 150 tons per day.)

Name of the Product.	Consuming Industry.	Estimated quantity consumed.	Remarks.
Charcoal	Domestic purposes	13,000 Tons.	Will meet just a fraction of the total demand in the Province.
Non-Condensable gases	Will be used in the factory.	225,000,000 cft.	
Methanol	As an industrial solvent for paints, varnishes, etc.	660 tons.	
Ketones	Do.	65,000 gallons.	
Acetic Acid	Various chemical industries and later on rayon.	1,500 tons.	
Tar	.....	1,620,000 gallons.	
Creosote	.....	146,000 gallons.	

79. *Scope and Possibilities of Future Production.*—In view of the market for the products of wood distillation, the installation of at least one or two wood distillation factories in the Province of Bombay is necessary. The raw materials namely, hard wood required for such a factory are available in abundance in the forests of (i) Karwar and Belgaum (S. Division). Similarly (ii) in the Northern part of the Province, forests of Dang near Billimora would also provide suitable hard wood for the recovery of the important products from pyroligneous liquor. In connection with the suitability of hard wood available in this Province for wood distillation industry, the results of investigations by Sudborough and Watson, may be referred to in the Table given above.

80. *Recommendations.*—The likely suitable location for wood distillation plant depends upon factors such as nearness to the supply of wood, the cheapness of raw materials and the ultimate use of the products which are to be made. With this regard, two possible locations could be indicated : (i) Forest in North Kanar (ii) Dang Forests in Gujarat. These locations can be approached from the sea, and they have also ample supply of water for industrial purposes. More detailed survey of planning for fixing up definite sites for the plants will have to be carried out either by the Government of Bombay or by party proposing to put up a wood distillation factory.

(i) The most economic unit for the wood distillation industry would appear to be a factory distilling 100 to 150 tons of hard wood per day.

(ii) The Provincial Government may undertake the complete industrial survey of availability of hard wood with a view to establish the factory of the size mentioned above.

(iii) An efficient system of forest conservation may be developed with a view to make the hard wood available to the factory continuously, as also with a view to conserve the forest resources.

(iv) It is suggested that the industry be allowed to be put up by a private party subject to the supervision of the Provincial Government as regards the conservation of forest resources.

(v) The Provincial Government may exact from the party an assurance that the most efficient plant for the distillation of wood and pyroligneous liquor recovery will be installed by the prospective party. Arrangements may be made by the Government to assure the party of complete off-take of the charcoal produced by the industry, in the Province at a fair price.

(vi) The factory should provide facilities for training and absorb trained personnel on reasonable salary basis.

## SECTION II.

### Coal Gas and Coal Tar Products.

81. *General Considerations.*—The coal gas and coal products industry exists only in one place in the Province at present. The carbonisation of coal is carried out by the Bombay Gas Co. Ltd., for supplying coal gas for domestic and industrial purposes in the city of Bombay. In the process of producing coal gas, the following are obtained as by-products :—

- (a) Gas Coke.
- (b) Gas Coal Tar.
- (c) Distillate Oils.
- (d) Refined Naphthalene.

These products bring extra revenue to the manufacturer of coal gas for town supply.

82. *Present Production and Factors Relative to Production.*—The present production capacity per annum of the Bombay factory is as follows :—

(i) Coal Gas (Cal. value of 450 B.T.U. per cubic feet).	966,266,000 c. ft.
(ii) Gas Coke ... ..	32,698 tons.
(iii) Coal Tar ... ..	2,724 tons.
(iv) Distillate Oils ... ..	113 tons.
(v) Naphthalene Plates ... ..	6 tons.

The present production in the city of Bombay supplies only a small fraction of the population and if all the needs for gas fuels for heating, lighting and industrial purposes are to be supplied by town gas, the capacity of the producing unit would have to be enlarged considerably.



83. *Market Condition and Factors Relative to Off-take of indigenous Products.*—Coal gas being a convenient fuel, with increased production, it would be possible to utilise gas to a much larger extent for industrial operations.

All the gas produced by the Bombay Gas Co. is at present used by only a part of the population. The by-products find easy markets in industry, for road making and for manufacture of disinfectants. The gas coal tar is at present disposed of as such, and not distilled to yield valuable by-products.

84. *Recommendations regarding Target of Future Production.*—The Bombay Gas Co. has already in view plans for expansion of its factory, which would still be insufficient for serving the whole city.

With the expansion of industries in the various towns of the Province and for the purpose of supplying convenient fuel for domestic and industrial purposes, it is suggested that the various large industrial plants for the production of coal gas may be distributed as follows:—

Name of Town.	Estimated capacity of Coal Carbonisation Plant (in million cubic feet per annum).
Bombay	3,000
Ahmedabad	1,000
Surat	400
Poona	500
Sholapur	300
Total	5,200

The production capacity for the plants to be installed has been estimated according to the population of these towns. The consumption of bituminous coal for these units will be 300,000 tons per year, and the by-products produced per annum will be as follows:—

Gas Coke	160,000 tons.
Coal Tar	14,000 "
Distillate Oils	500 "
Naphthalene Flackes	30 "

The coke can find easy market as a domestic and industrial fuel.

The distillate oils are used in the manufacture of disinfectants.

The coal-tar will be used for wood preservation and road making and the naphthalene for industrial purposes. Both these by-products may be utilised by the dyestuff industry which is discussed later. The large quantities of coal-tar on distillation would yield benzene, toluene, naphthalene and anthracene all of which are important raw materials for dyestuff industry. The pitch obtained on distillation could be employed in construction of roads. The distillation products will form only a fraction of the requirements of the dyestuff industry and other requirements of the Province. For example, benzene will be entirely consumed in this Province in the manufacture of D. D. T. of which fairly large quantities are envisaged to be produced by the caustic soda-chlorine factories likely to be installed in Bombay.

### SECTION III.

#### Dyestuff Industry.

85. *General Considerations.*—The manufacture of dyestuff forms one of the basic branches of chemical industries as it is one of the largest consumers of organic and inorganic chemicals. The development of the dyestuff industry brings in its wake all round industrialisation of the Province because of the various industries such as the heavy chemical industry, the pharmaceutical industry and the coal distillation industry which are all connected with the manufacture of dyestuff. The Dyestuff Exploratory Committee set up by the Government of India on the recommendation of the Board of Scientific and Industrial Research have already collected valuable data regarding the possibility of manufacture of dyestuffs in India.

86. *Present Production and Factors Relative to Production.*—There has been no dyestuff manufacturing industry in this country mainly due to the following reasons :—

The heavy chemical industry in the country has not yet reached a stage when all the requirements of the dyestuff industry could be met by the indigenous production. Complete utilisation of the available resources of coal-tar has not been undertaken to an extent which would be required for a dyestuff factory of a reasonable proportion. The monopolisation of the manufacture of important dyestuffs by foreign firms and the imports of all the dyestuffs requirements of the textile industry from these few manufacturers have created economical conditions which were not conducive to the development of dyestuff industry in the country. However, we are now reaching a stage when our heavy chemical industry with its proposed expansion would be able to supply a considerable amount of the heavy chemicals, required for the establishment of this industry. At the same time the coal-tar distillation industry may also be developed to supply the required quantities of organic chemicals for the same.

87. *Market Conditions and Factors Relative to Off-take of Indigenous Products.*—The market for the dyestuffs is provided by the large number of textile mills in the country. With quality product produced locally at competitive rates the textile mills would utilise the indigenous products. To maintain a reasonable level of prices between the indigenous and imported materials during the infancy stage of the industry, it would be necessary :—

(i) to raise the tariffs on the imported materials for a fixed period,

- (ii) to restrict the imports to a certain extent,  
 (iii) to compel the textile industry to use a certain percentage of indigenous dyes and  
 (iv) to subsidise indigenous production, if necessary.

88. *Consumption.*—

TABLE 8.

*Consumption of different groups of dyestuffs in India.*

Group of Dyes.	Annual consumption in lbs.
Basic dyes	516,400
Acidic dyes	459,900
Chromes	44,200
Other alizarines	8,800
Alizarine paste	1,800,900
Alizarine powder and lumps	11,000
Direct dyes	2,344,900
Sulphur dyes	3,550,300
Indigo	675,600
Vat paste	208,400
Vat powder	463,900
Brenthols	2,165,800
Indigosols	46,800
Special dyes	2,278,700
Total	14,575,600

i.e. about 6,500 Tons.

89. *Scope and Possibilities of Production.*—For the establishment of this industry the two main considerations are :—

- (i) Availability of market and  
 (ii) Possibility of production,  
 (a) Availability of suitable raw material.  
 (b) Other factors relative to production.

In the establishment of this large industry, it would be necessary to proceed step by step since we have to start right from the beginning. The manufacture of dyestuff-intermediates and about fifty important dyestuffs may be taken up as the first step. Later on, the establishment of the complete dyestuff industry which would include the manufacture of all the intermediates for the dyestuffs and a number of heavy chemicals required in the manufacture of dyestuffs could be undertaken.

A large number of basic raw materials and a number of chemicals are necessary for the dyestuff industry. The requirements per annum of the various basic raw materials and heavy chemicals are given in Table No. 9 :—

TABLE 9.

*Requirements of Heavy Chemicals in the manufacture of Dyestuffs.*

Raw Materials and Heavy Chemicals.	Quantity required annually (in tons).
1. Ammonia ... ..	1,216
2. Bauxite (55 per cent. $Al_2O_3$ ) ... ..	546
3. Bromine ... ..	41
4. Chlorine ... ..	2,132
5. Chrome ore (50 per cent. $Cr_2O_3$ ) ... ..	1,260
6. Copper ... ..	114
7. Fluospar ... ..	13
8. Iodine ... ..	50 lbs.
9. Iron ... ..	501
10. Lead ... ..	77
11. Limestone (75 per cent. $CaCO_3$ ) ... ..	7,557
12. Magnesium Carbonate ... ..	167
13. Mercury ... ..	1
14. Phosphorus ... ..	14
15. Potassium Chloride ... ..	814
16. Potassium Nitrate ... ..	100
17. Pyrolusite (80 per cent. $MnO_2$ ) ... ..	300
18. Selenium ... ..	5
19. Sodium Chloride (including that used for chlorine). ... ..	26,975
20. Sodium Sulphate ... ..	2,032
21. Sulphur ... ..	5,528
22. Zinc ... ..	77

As can be seen some of the above materials are at present available and a large number of them is envisaged to be manufactured in the Province. In planning the future development of the heavy chemicals industry in the Province the requirements of the dyestuff industry have been considered. It would be necessary to import only a few materials such as copper, fluospar, lead, mercury, selenium, sulphur and zinc from outside.

The basic raw materials required for the manufacture of dyestuffs are tabulated below with their annual consumption for the establishment of the dyestuff industry for the whole of India.

TABLE 10.

Name of Heavy Chemical.	Annual requirements in tons.	Present production in Bombay Province in tons (1944).	Deficiency.	Target of production for coming 5 years (in tons).
Acid Chlorsulphonic ...	60	.....	60	.....
Acid Hydrochloric, Ordinary tech. (sp. gr. 1.18).	1,700	.....	.....	.....
Acid Hydrochloric, Conc. free from sulphuric acid.	250	981	1,019	3,000
Acid Fusing 39 per cent. ...	5	.....	.....	.....
Acid Nitric, ord. tech. ...	4,500	425	4,025	6,500
Acid Sulphuric, conc. ord. tech. (1.84).	10,000	9,120	880	55,000
Acid Sulphuric monohydrated (100 per cent. sulphuric acid).	600	.....	.....	.....
Acid Sulphuric fuming (oleum) 15.18 per cent. ...	80	.....	.....	.....
25 per cent. ...	1,000	.....	.....	.....
40 per cent. ...	300	.....	.....	.....
60 per cent. ...	600	.....	.....	.....
68 per cent. ...	20	.....	.....	.....
<i>Bases.</i>				
Liquor Ammonia (sp. gr. 0.9)...	250	.....	.....	.....
Lime (fresh CaO) (60-65 per cent.).	500	Sufficient to meet the demand.		
Chalk 75 per cent. ....	550	.....	.....	.....
Caustic Potash ...	500	Nil.	500	1,500
Soda Ash ...	1,800	Cannot be accurately stated.		60,000
Caustic Soda ...	4,000	Do.	.....	31,000
Potassium Carbonate ...	50	.....	50	Not fixed.
Sodium Bicarbonate ...	10	Cannot be accurately stated.		2,000
<i>Salts.</i>				
Aluminium sulphate dry ...	30 of anhydrous (58.4 of hydrated).	1,194	.....	8,000

TABLE 10—*contd.*

Name of Heavy Chemical.	Annual requirements in tons.	Present production in Bombay Province in tons (1944).	Deficiency.	Target of production for coming 5 years (in tons).
<i>Salts—contd.</i>				
Aluminium chloride	500	}	Demands can be met.	
Ammonium chloride	20			
Copper sulphate	400	371	29	1,000
Cupric chloride	2	}	Demands can be met.	
Cuprous chloride	1			
Ferric chloride	2			
Phosphorous chloride	50			
Phosphorous Oxychloride	5	.....	.....	.....
Potassium nitrate	100	.....	.....	.....
Potassium chloride	15	50	.....	3,000
Sodium acetate	80	.....	.....	.....
Sodium acetate (fused)	40	.....	.....	.....
Sodium bisulphite	20	50	.....	600
Sodium bromide	1	.....	.....	.....
Sodium borofluoride	5	.....	.....	.....
Sodium chloride	10,000	.....	.....	.....
Sodium chlorate	10	.....	.....	.....
Sodium dichromate	1,000	1,042	.....	2,500
Sodium hydrosulphite	40	.....	.....	.....
Sodium hypochlorite (15 per cent.)	300	3,000	.....	5,000
Sodium nitrite	200	.....	.....	.....
Sodium pyrosulphate	40	.....	.....	.....
Sodium sulphide crystals (9H <sub>2</sub> O)	2,500	119	2,381	4,500
Sodium sulphate (10H <sub>2</sub> O)	200	4,386	.....	4,000
	(Also 2,000 for manufacture of Na <sub>2</sub> S).			
Sodium sulphate (anhyd.)	200	.....	.....	.....
Sodium thiosulphate	20	238	.....	400

TABLE 10—*concl'd.*

Name of Heavy Chemical.	Annual requirements in tons.	Present production in Bombay Province in tons (1944).	Deficiency.	Target of production for coming 5 years (in tons).
<i>Salts—concl'd.</i>				
Sulphuryl chloride	...	75	.....	.....
Sulphur dichloride	...	60	.....	.....
Zinc chloride	...	50	150	600
<i>Metals.</i>				
Irons filings	...	500	.....	.....
Zinc	...	50	.....	.....
<i>Non-metals.</i>				
Bromine	...	40	.....	.....
Chlorine gas (in cylinders)	...	800	Cannot be stated correctly.	17,500
Iodine	...	50 lbs.	.....	.....
Sulphur	...	750	.....	.....
Selenium	...	5	.....	.....
<i>Oxides.</i>				
Litharge (95 per cent. $PbO_2$ )	...	10	.....	.....
Manganese dioxide (80 per cent. pyrolusite).	...	300	.....	.....
Mercuric oxides (yellow)	...	1	.....	.....
<i>Gases.</i>				
Ammonia	...	5 (Also 1,047 for nitric acid manufacture.)	No definite data is available regarding the production of these chemicals; but it may be assumed that no difficulties would be encountered in procuring them owing to the very small requirements of these in the dyestuffs industry.	.....
Carbon dioxide	...	150		.....
Phosgene	...	5		.....
Sulphur dioxide	...	30		.....
Hydrogen	...	25		.....

Next to be considered are the organic chemical raw materials which are grouped into the coal-tar products and the aliphatic raw materials. The following table gives the requirements of coal-tar chemicals required for the dyestuff industry.

TABLE 11.

*Requirements of Coal Tar Organic Chemicals.*

Name of Chemical.	Total requirements.	Total production (all India).
Benzene puro ... ..	400,000 gals.	2,417,000 gals. benzole 90's.
Tolvene puro ... ..	125,000 "	374,000 gals.
Naphthalone puro ... ..	1,000 tons.	1,100 tons.
Anthracene puro ... ..	500	120
Pyridine ... ..	2,000 gals.	225 gals.
Carbazole ... ..	15	Nil.
Solvent naphtha ... ..	4,000 gals.	288,500 gals.

The purification of Benzene up to a quality required in the dyestuff industry is not being carried out by the distillers of coal-tar. All the available coal-tar is not being processed for the recovery of the distillation products. With the development of the metallurgical coke industry, the progress of which is bound up with Development of the iron and steel industry, and proper recovery of coal-tar distillation products it would be possible to supply the needs of the dyestuff industry from indigenous sources.

Following is the table indicating the quantities of aliphatic raw materials required in the manufacture of dyestuffs.

TABLE 12.

*Requirements of aliphatic organic chemicals.*

Name of Chemical.	Total requirements.	Total production (all India).
Alcohol ord. ... ..	125 tons. }	28,500 tons.
Alcohol absolute ... ..	36 tons. }	
Methyl alcohol ... ..	286	420
Acetic acid (40 per cent.) ... ..	50 }	.....
Acetic acid glacial ... ..	100 }	.....
Acetic anhydride ... ..	150	Nil.
Formaldehyde 40 per cent. ... ..	20	85
Glycerine ... ..	125	1,850
Ethyl chloride ... ..	30	...
Turkey Red Oil ... ..	5	Manufactured, but quantity not known.

Of the above chemicals, methyl alcohol and acetic acid will be available from the hardwood distillation industry proposed to be installed in the Province. Acetic anhydride and formaldehyde may be obtained from the acetic acid and methyl alcohol.



90. *Location of Future Units of Production.*—It is necessary, from economic considerations, to undertake the manufacture of dyestuffs on a large scale. In consideration of the present requirements of our country, it would be necessary to centralise the manufacture in only one centre. The raw materials required for the manufacture are the heavy chemicals and the organic coal-tar products. It is considered more advisable to transport the coal-tar products to the place of manufacture instead of transporting the huge quantities of heavy chemicals required for the processes. Another advantage of locating the industry in the neighbourhood of heavy chemicals industry is the fact that the transportation of chlorine, nitric acid, sulphuric acid and such other dangerous chemicals is avoided. Thus Bombay may be a suitable location for the establishment of the dyestuff industry on a scale large enough to supply the all India requirements in view of the proposals to develop heavy chemical industry. Another definite advantage in this location is the immediate neighbourhood of the consuming textile industry so that the dyestuffs have to be transported within limited distances and a close contact is maintained between the technical personnel of the manufacturing and the consuming industries. Technical labour is required for the efficient working of these specialised processes in which respect Bombay is the most suitable place. Other requirements such as power, water, etc., would be easily available.

91. *Recommendations.*—The Sub-Committee make the following recommendations to the Government of Bombay with regard to the proposed dyestuff industry :—

From the announcements in the papers we understand that an Indian dyestuff industry is shortly to be established by the joint effort of Messrs. Tata Sons Ltd. and Messrs. Imperial Chemical Industries Ltd. We feel that the neighbourhood of Bombay city will be a very suitable location for the dyestuff factory, and that the establishment of the dyestuff industry in the Bombay Province will be of material assistance in the development of the chemical industries as a whole. It is well known that the dyestuff industry is a large scale consumer of the heavy chemicals such as hydrochloric acid, sulphuric acid, nitric acid, caustic soda, soda ash and chlorine and the products and processes of the dyestuff industry are closely related to numerous organic chemical industries, such as fine chemical and pharmaceuticals, explosives, synthetic plastics and solvents. The dyestuff industry is in fact the basis on which a general organic chemical industry can be built and it will, therefore, be of the utmost advantage to the Province to have the new industry located in the Bombay area. We recommend that the Government of Bombay should offer all possible aid to the dyestuff industry if it is located in Bombay. Among the facilities which may attract the industry to Bombay may be mentioned :—

- (i) Assistance in acquiring land with an adequate water supply.
- (ii) Supply of power.
- (iii) Modification of excise policy, which will encourage the growth of the dyestuff, pharmaceutical and fine chemical industries.
- (iv) Transport facilities.

The immediate target should be fixed at 6,500 tons of dyestuffs to be produced annually. The production might be increased as the demand of the textile mills and other consumer increases.

## SECTION IV.

**Petroleum refining industry.**

92. *General Considerations.*—Except in the extreme north (Rawalpindi) and extreme north-east (Assam), India has no oil refineries, presumably because, so far, Burma, which formed an integral part of the Indian Empire, supplied most of the needs of India.

Geographically, Bombay Province, situated on the west coast of India, is not blessed with mineral fuels, such as coal and oil. And, as we recently experienced during the last war, the inter-transport from Bengal and Bihar make the import of coal in Bombay not only costly but difficult to transport. If one can visualise, the whole of Europe being fed with coal from the Balkan countries, it would sum up the condition of India being supplied with coal from Bengal and Bihar—India a continent as big as Europe. Again, in normal times, oil fuel is always cheap on the west coast and hence it is preferred to coal, apart from the other advantages such as freedom from smoke nuisance during its use, ease of control in its operation and handling and lack of ashes. All these factors are in favour of using oil fuel as against coal hauled from long distances. At present, three or four foreign firms are handling this business of supplying the industry with the required fuel. A refinery installed on the West coast of India can refine the crude oil and separate the fractions such as aviation spirit, motor petrol, kerosene oil, lubricating oil, liquid paraffin, white oil, solid paraffin and asphalt, the use of which we need not describe here, as these are familiar substances in our daily life today.

93. *Case for installation of petroleum refining industry in Bombay.*—Immediately we consider this industry of refining crude oil in Bombay, the natural question arises as to how to secure the crude. Excepting Rumania and Russia in Europe, none of the countries have supplies of crude oil, and yet, all the countries including United Kingdom have got refineries, and, all of them have been securing their requirements of crude. India can follow the same example. India has got further advantage in that alongside the West coast of India are situated all the crude oil producing countries, such as Persia, Bahrein, Bahrein Island, Abyssinia etc., where crude oil is produced and refined. A cursory glance at the refining capacities of the various oil companies producing crudes will convince anybody that there is always a surplus of crude which the refineries on the spot cannot handle, and, there has been in the past a competitive selling of the crude to the refineries of Europe. Under the circumstances, no difficulty is visualised in securing crude oil for the refinery to be established in the Bombay Province.

One may also ask why we should refine crude oil in India when we are getting all the ingredients at competitive rates from the various refineries, such as in Burma, Persia and in Bahrein Island. The answer is that, apart from the kerosene, petrol, lubricating oil and others described above, a number of useful products is available from the refinery 'waste' which were wastes so far, but which are now available as raw materials for new industries for the future, such as plastics (thiokol, polyvinyl halides, methacrylates, glypatal resins and dozens more). The products and their names mean little to most of us, but we are conscious of the tasks which we would like them to perform—to set us free from dependence on tropical products, hard to obtain in peace and lost to us in war; to cut short the slow, natural, weather-dependent processes of growth and long cultivation; the conquest of weight; the search for the unbreakable media with which to make crockery; cold-resistant and heat-resistant materials; new beauty in colour and surface for our homes and household articles; new cleanliness and therefore new healthfulness; long life for articles

which once wore out too soon—all these possibilities are latent in the crude oil, but they are all lost to our industry, if they are left behind in America, in Persia, in Mexico or in Russia.

No community proposing to play a part in the world of to-morrow can possibly afford to let others refine their crude oil for them : such a policy means depriving the future of its brightest industrial promise.

94. *Scope of the Industry.*—In the early stages of the industry, most of the crude oil was waste. The very petrol on which our civilisation now depends was once thought waste. All that could then be usefully employed of nature's original mixture was the part that would burn the lamps, and it was clearly wisest to distil the kerosene at the source of supply and export it to the ends of the earth in finished form. Those days are over. To-day, there is scarcely any part of nature's crude oil which has not its industrial value. One of the most important pioneering achievements of an oil refinery concerns the 'waste' extracted during the purification of oil to produce white oil and liquid paraffin. From the sulphuric acid and hydrocarbons are formed compounds called Petroleum Sulphonates, which are extracted with alcoholic caustic soda. They are valuable as emulsifiers which form the base of soluble oils with good anti-corrosive qualities and as detergents. From the very process of refining oil for a given purpose, new products with new uses are constantly arising—another reason why every fully developed industrial country must aim at doing its refining at home.

From the point of view of transporting a minimum of waste, few cargoes can now be regarded as more economic than crude oil. A far more important reason why an industrial country must import the raw material rather than the finished products is that in the crude oil are found raw materials for new industries. Though scientists, now-a-days, use most of the crude oil, we now know that hundreds of new uses, even more important than the older ones, are going to be found.

Without crude oil to distil here in India, India will be deprived of the basic raw materials for the new industries of the future.

At present there are only two refineries in India, one at Rawalpindi and the other at Attock. Most of our oil and petrol reaches us ready refined. Most of the wealth in the original crude oil is left behind to form the basis of industries abroad. We are put in the position of having to buy abroad an increasing number of goods which we could very well make at home.

An Indian Oil Refinery in the heart of the industrial area in Bombay would supply lubricating oil to make a million wheels to run smoothly and bring to the Indian industry many of those parts of crude oil which were 'waste' yesterday, are valuable by-products of to-day, and, perhaps, to-morrow will be far more important wealth than even lubricating oil or petrol themselves.

The other countries have become great industrial leaders because they produced goods through their coal and iron. In the chemical age they themselves are beginning to realise the necessity of distilling crude oil and distilling in their own countries. India should follow the same example if we want to realise the plastic age that is coming.

95. *Recommendations : (a) Target of future production in the Province.*—To begin with a "simple refinery" with an annual throughput of half million tons of crude oil, comprising a distillation plant, a combined reforming and cracking plant, the necessary chemical treatment plant, a vacuum distillation unit to produce up to 50 to 60,000 tons of asphalt and about 10,000 tons of cheap lubricating oils including the necessary tankage, jetty etc., may be put up.

Later on, an additional plant to manufacture 100 octane aviation spirit can be put on the same site with a small additional cost to produce 25,000 tons of 100 octane aviation spirit. A plant can also be added for producing high class lubricating oils including vacuum fractionation plant, a solvent extraction and solvent dewaxing plant, acid and hot clay treatment plant and make India, or, at least, Bombay Province, independent of the supplies of high grade lubricants in times of emergency.

(b) *Location*.—Such a refinery should be situated in the proximity of a deep water jetty where tankers up to 35 feet draft can berth safely. It does not matter if this jetty is a few miles away from the refinery, as the crude oil can be pumped quite easily from the tankers. It would be, of course, essential for the refinery to have road and railway connections.

(c) Private enterprise, it is understood, is willing to undertake such a project provided protection in the form of a small duty, of say about Rs. 15 per ton, on petrol and kerosene and about Rs. 10 per ton on fuel oil, can be given by the Government in the early stages of this venture, as, in the early period of such refinery, the teething troubles to put the plant in a continuous working order, would, otherwise, stifle the venture in its birth.

## CHAPTER V.

## GLASS, POTTERY, CERAMICS AND REFRACTORIES.

## SECTION I.

## Glass Industry.

96. *General Considerations.*—The World War I has first shown the need of science for applied industries, and if our Province is to progress it can only do so by scientific development; and scientific development means more laboratories, more research work, and more glassware used. One of the greatest events in the entire history of glass was brought about by the intensive application of scientific methods to industrial production. Glass which was once only an article of artistic taste, has emerged as a material of wide utility and strategic importance. Indeed glass besides steel and rubber is largely responsible for the progress of science and technology. Many scientific instruments and apparatus of the most complex kind depend on the glass industry. Glass, along with plastics, which is made from inexhaustible resources may be expected to replace metals in a variety of uses and thus help the conservation of metallic resources which have their limitations. Glass is now universally regarded as a "Key industry" or as it is sometimes called "PIVOTAL" industry.

The Provincial and Central Governments should take increasing interest in developing and fostering this "Key" Industry. Sir A. Chatterton has very forcibly recorded his opinion in the Indian Munitions Hand Book on this point. He writes: "The Glass Industry has come to stay but without aid from the State, it is likely to make very slow progress in the future".

An extract from the report of Lord Balfour of Burleigh's Committee on commercial and industrial policy after the first Great War, will be very interesting at this moment in this connection. "We are satisfied that the continuance of commercial and scientific assistance and of detailed control on the lines already followed will be necessary for a considerable period. This necessity is, we believe, fully admitted by the manufacturers themselves, who recognise also that such assistance must have its object and conditions the attainment and maintenance of the highest standards of quality. It is clear, moreover, that in order that the industries may have time and opportunity to adapt their organisation to peace conditions and to train an adequate supply of skilled workers, very speedy measures of protection against foreign competition will be required at the outset in view of the great strength and reputation of the German firms".

The Industrial Commission (1916) has also very forcibly and clearly stated that the State should take the lead, employ experts and place them in charge of practical works. Unfortunately in India no substantial help was rendered or any steps in the above direction were taken by the State whole-heartedly.

97. *Present Production.*—The glass industry of the Bombay Province is divided into five trade sections under the following heads:—

- (1) Hollow-ware including lamp-ware and table-ware.
- (2) Bottle-ware.
- (3) Pressed-ware and fancy goods.
- (4) Scientific-ware.
- (5) Bangles.

Taking into account the production of glass articles in the Province during the last ten years, the out-put of the glass industry to-day has greatly increased; and in several lines, the present productive capacity of the existing glass factories, is sufficient to meet the total requirements of the Province, provided of course, that the glass manufacturers are assured of adequate transport facilities and supplies of the necessary raw materials, refractories, coal and oil, and the glass manufacturers on the other hand concentrate their energies on improving the quality of production by resorting to the application of scientific methods in the industry.

The majority of the factories that have been started during the Second Great War had to struggle very hard against innumerable difficulties, due partly to inexperienced control and lack of trained technical personnel in the works and partly to acute short supplies of raw materials, chemicals and good refractories at very high rates. There are at the present moment over 30 concerns manufacturing bottles, hollow glass-ware, scientific wares; out of these, about 19 glass factories in Bombay and Bombay suburbs are mainly concentrating on the manufacture of bottles and their monthly production is over 2000 tons. One glass factory (Industrial Engineering Apparatus Co.) in Bombay is wholly devoting her energies to the manufacture of scientific ware of the pyrex type. There are also two or three other factories manufacturing scientific glass-ware but on a small scale. These and other factories situated outside this Province were able to meet a considerable part of the country's requirements mainly due to the stoppage of imports. As more industries and research educational laboratories would come into existence during the next five years, the present demand would increase several fold. The quality and precision of the articles produced need however considerable improvements and should be brought to the level of imported articles.

Regarding the quality of bottles it must be said without any hesitation that in order to stand foreign competition and to maintain the present production capacity, the quality of the bottles has to be improved considerably and labour saving blowing machines with the necessary type of furnaces shall have to be installed. When steps are taken in this direction, the bottle industry will be able to stand on its own legs without any fear of foreign competition.

*Lamp-ware.*—There are about six factories manufacturing quality goods. The notable factories are (1) Vijay Glass Works, Bombay, (2) The Bombay Glass Work Ltd., Bombay, (3) Crystal Glass Works Ltd., Sant Road, (4) Paisa Fund Glass at Talegaon and (5) Ogale Glass Works Ltd., Ogalewadi.

The following table gives the figures of production of various types of glass-ware in 1943-44 and the raw materials consumed by them :—

	In Nos.		In Tons.
Bottles ... ..	800,000	gross	35,000
Tumblers, jars ... ..	200,000	"	
Specialised types of scientific apparatus, etc. ... ..	50,000	"	5,000

*Raw materials consumed.*

Sand ... ..	...	...	20,000	Tons.	
Soda ash ... ..	...	...	6,000	"	
Lime ... ..	...	...	4,000	"	
Borax ... ..	...	...	1,000	"	and above

Most of the bottle factories in Bombay are using broken glass for remelting and blowing bottles. The furnaces are run on liquid fuel; the capacity of these furnaces for blowing bottles vary from three tons to ten tons per day but with the introduction of liquid fuel, the question of good refractories was overlooked resulting thereby in shortening the life of the furnace and also deteriorating the quality and enhancing the cost of manufacture. If the liquid fuel oil is to be used by the glass manufacturers, Government must come forward to render all possible help in respect of power, technical help, refractories and chemicals and so on. Half-hearted attempts will never help the manufacturers, if they are to march with the times and face foreign competition.

98. *Factors relative to Production.*—As is widely known, the chief raw materials for this industry are silica, soda ash, lime, etc., and chemicals like borax, arsenic salts, zinc oxide, barium carbonate, potassium nitrate, selenium, cobalt, manganese dioxide, cadmium sulphide, are required for fining and colouring the glass and producing special quality glass.

Most of the manufacturers of this Province import silica of sufficient purity, from Bargarh, and Logarh (U. P.) and some of them get their supplies of silica from Nizam's dominions or Sawai Madhaopur (Rajputana). Soda ash is of course available from the importing agencies. Lime is available in Bombay Province.

The bulk of production of these factories finds its way in the Provincial markets. Owing to the restriction on railway line for booking and the non-availability of priority (Licensing) certificate to export goods to foreign countries, manufacturers are handicapped in meeting with the demands of their overseas customers. During the war period, a major fraction of the production was supplied to the Government to meet war demands; in some cases entire production was utilised for military purposes. With more freedom of movement of raw materials, chemicals, etc., and rise in standard of living of the population, the consumption of glass articles would show a marked increase in the years to come.

99. *Market Conditions and Factors relative to the off-take of Indigenous Products.*—As stated above, most of the production of factories in the Province is absorbed in local markets. During the war years, a major fraction of the production was supplied to the Government to meet war demands—in some cases, the entire production was utilised for military purposes.

In spite of the comparative rise in production, only a small quota came in for civilian consumption. The main factor for this was the scarcity of raw materials and soda ash which were strictly rationed.

With more freedom of movement of raw materials and the rise in standard of living of the population, the consumption of glass materials would show a marked increase in the years to come.

100. *Present Consumption.*—As already pointed out, most of the production was designed to meet war orders. As such, the amount of consumption of glass-ware for civilian purposes during the last few years would not serve as a guide to

indicate the requirements of the Province. The following Table No. 13 of imports of glassware in the port of Bombay for years 1934-35 to 1938-39, will serve to indicate the extent of consumption in the Province :—

TABLE 13.

Commodity.	Unit.	Imports of glassware in Bombay.				
		1934-35.	1935-36.	1936-37.	1937-38.	1938-39.
Bangles .. ..	Rs.	21,59,711	16,52,806	17,34,150	18,57,697	13,45,572
Beads and False Pearls .. ..	"	5,69,310	6,47,638	3,81,557	7,42,873	5,00,270
Scientific Glassware .. ..	"	27,724	25,071	64,570	95,257	90,158
Sheet Glass and Plate .. ..	"	8,31,927	8,52,330	7,23,271	9,09,318	8,64,885
	Sq. feet	7,154,628	8,455,395	7,600,260	6,133,252	8,398,937
Bottles (Soda-water) .. ..	Rs.	2,43,797	2,35,233	2,08,148	2,06,566	2,02,704
	Gross	10,416	11,538	10,726	12,847	12,335
Other Bottles .. ..	Rs.	6,10,372	6,32,085	5,46,832	7,06,102	6,67,598
	Gross	2,95,166	3,01,753	2,10,077	3,72,100	2,71,279
Tableware .. ..	Rs.	1,49,920	1,16,065	1,85,166	3,69,450	3,23,798
Funnels etc. .. ..	"	2,33,678	2,44,105	2,51,525	3,33,733	2,51,724
Other Glassware .. ..	"	16,64,032	10,46,420	9,18,993	9,88,580	6,12,335
Total Glassware .. ..	"	58,90,471	54,50,898	5,04,216	62,99,645	48,59,044

#### 101. Scope and Possibilities of Expansion in Production.—

(1) *Bangle Factories.*—A glance at the table will convince any intelligent reader that Bombay port on an average imports glassware to the extent of Rs. 57,06,908, out of these, bangles figures top the list. Next to it other glassware, then bottles and then sheet and plate glass and so on. There are very few factories in this Province, manufacturing bangles. Their total sales will not exceed Rs. one lakh. These Province's needs are therefore met with by bangle manufacturers of Firozabad in the United Provinces which is a big centre of glass industry. Though bangles are articles of civil consumption and not a war commodity, still the needs of the civil population have to be met with and here is a field for starting more bangle factories which in course of time produce bangles to the taste of women folks who are the consumers.

(2) *Beads and False Pearls.*—Beads and false pearls is another line that has to be tackled during the post-war programme as there are no glass factories worth the name in the whole of India for making beads and false pearls.

(3) *Sheet Glass Plant.*—There is also a scope for starting a sheet glass factory in view of the tremendous building activity which is envisaged to take place in the Province as also in view of the rapid industrialisation of the Province, as at present there is no factory in the Province producing sheet glass.

A word of caution is however necessary. The manufacturing of sheet glass plant is highly technical and requires therefore a number of technical personnels. At the present moment these technicians are not available and so they shall have to be trained before any such venture undertakes to manufacture it. There are chances of heavy losses in the beginning. It is therefore recommended that substantial help, both in kind of money and technical, may be given to private venture to install a factory producing at least a few hundred tons of sheet glass



of various grades and thicknesses per month. While selecting the site for such a factory, all factors affecting smooth running of the concern should be carefully studied by body of experts, industrialists and Government technical advisers.

102. *Target of Production.*—The following statement of targets of production during the first five years for the different trade sections of the glass industry is recommended and trust it will serve the purpose of the Province.

	Pre-war Production 1933-33.	Pre-war imports 1933-33.	Pre-war total consumption	Target.	Present production capacity.
	Rs.	Rs.	Rs.	Rs.	Rs.
Bangles	.. 20,000 approximately.	13,00,000	13,20,000	6 lakhs	1 lakh.
Beads and False Pearls	.. Nil.	5,00,000	5,00,000	2 lakhs	Nil.
Scientific Glassware	.. Negligible	50,000	50,000	4 lakhs	2 lakhs.
Sheet Glass	.. Nil.	4,00,000 including plate glass.	4,00,000	20 tons a day.	Nil.

103. *Recommendations.*—(1) The first and foremost aim should be to raise the scale of output to such a level and attain such a quality that the total needs of the Province can be met wholly by local production.

(2) In respect of articles which are not yet produced in this country, the aim should be to start production without delay.

(3) Stress should be laid on improving the quality which would compare with similar articles from foreign countries.

(4) Good sand requisite for the manufacture of large quantities of glass may be available on the North Kanara coast of the Province. From these deposits, sand required by the industry in Bombay could be easily transported by coastal sea freight. Facilities for easy and cheap transport be afforded to the manufacturers.

(5) Soda ash which is another important raw material should be permitted to be transported to Bombay by sea route from the centres of production such as The Tata Chemical Factory at Mithapur (Okha Port).

(6) In view of the tremendous building activity which is envisaged to take place in the Province as also in view of the rapid industrialisation of the Province, it is expected that large quantities of sheet glass will be consumed. At present, there is no factory in the Province producing sheet glass. It is therefore recommended that help may be given to private venture to install a factory producing at least 20 tons of sheet glass of various grades and thicknesses per day.

(7) A place near about Bombay where coastal traffic can reach with adequate facility should be selected for the location of this factory.

## SECTION II.

### Pottery, Ceramics and Refractories Industries.

104. *General Considerations.*—Pottery industry consists of the following articles:—

- (1) Building bricks, roofing tiles.
- (2) Drainage pipes.
- (3) Refractories.
- (4) Sanitary ware.

- (5) Crockery.  
 (6) Porcelain insulators.  
 (7) Chemical ware.

In foreign countries, this industry has developed enormously in the last 30 years, and to-day all the important industries require articles made from clays in various forms and shapes. The industry in India is still in its infancy and there is good scope for further development in the Province.

105. *Present Production.*—There are at present the following factories situated in the Province of Bombay, viz. Bombay Potteries and Tiles Ltd., Bombay, and Messrs. Navroji Vakil & Co., Ahmedabad, and two big-sized factories in States, viz. Parsuram Pottery Works, Than and Morvi Potteries Ltd. at Morvi. The factory in Bombay manufactures sanitary-ware, crockery, laboratory chemical ware, glazed tiles, refractories and acid-proof chemical-ware. The factory at Ahmedabad manufactures pickle jars, fire bricks, and salt-glazed sanitary-ware. The factory at Dērol in Panch Mahal District is now closed. The factories situated in the States are mainly engaged in production of sanitary-ware and pickle jars. The following table gives the production of two of the representative factories :—

Classification.	Unit.	Production in 1939.	Production in 1944.
Sewage Drain Pipes .. .. .	.. Tons.	3,500	4,200
Crockery ware .. .. .	.. Dozens	500	14,000
Fire bricks .. .. .	.. Nos. (in 00,000) Tons.	11	5
Refractory ware .. .. .	.. Tons.	40	240

The value of the total production of all the factories was approximately Rs. 25 lakhs in 1944-45, out of which the factories in the States had a share of Rs. 20 lakhs.

106. *Factors relative to Production.*—The chief raw materials necessary for the manufacture of pottery are fire clay, china clays, plastic clays, quartz, felspar, talc, bauxite, magnesite and other chemicals. From the information that is available we can say that in the Province there is abundance of various kinds of raw materials used in pottery.

107. *Market conditions and factors relative to off-take of Indigenous products.*—During the war years imports from foreign countries were on decline and in some cases like crockery and acid-proof porcelain had completely stopped; there was, thus, an impetus given to indigenous production which showed a steep rise. An idea of consumption in the Province can be formed from the fact that some of the factories doubled or even tripled their production during the war years. The following Table No. 14 gives the value of imports of Pottery-ware in Bombay for the years 1938-39 to 1939-40 :—

TABLE 14.

*Imports of Pottery-ware in Bombay.*

Commodity.	1938-39 in Rs.	1939-40 in Rs.
Sanitary ware ... .. .	4,22,289	4,26,438
Other kinds not classified ... .. .	3,50,038	2,85,434
Porcelain electrical ... .. .	39,469	50,193
Porcelain other than electrical ... .. .	8,49,743	8,27,105
<b>Total ...</b>	<b>16,61,539</b>	<b>15,89,170</b>

It might be noted here that excepting the Bombay factory no other factory manufactures goods of special types and quality required for modern industries.

To the growing household needs must be added the increased demands of new industries started in war time, which are important consumers of pottery ware. If the experience of war years serves as a guide, we can safely say that pottery ware is capable of being manufactured economically in the Province, though to stabilise the industry in post-war years some sort of protection would be necessary in initial stages.

108. *Analysis of consumption.*—Due to the great variety of products manufactured and the large number of industries utilising these products, it would be difficult to give detailed figures for the analysis of consumption. The figures given in the above paragraph can give an idea of the consumption of pottery ware as used in—

1. Building trade.
2. Household requirements.
3. As refractories in industries.
4. Laboratory requirements.

109. *Scope and possibilities of expansion of Production.*—As already pointed out, this industry is entitled to the claim of being called a basic industry as its products find use in practically all industries. With the industrialisation programme of the Province gathering momentum and the raising of standard of living of the people, there is a vast scope of development in post-war period.

With improved forms of machinery and foreign trained technical assistance the indigenous products would be in the position to compete in quality with the foreign products.

Most of the existing units are planning to expand their production in view of bright prospects of off-take by the consumers. The following estimates submitted by two of the factories under survey (same as concerned in Section I-B) serve to illustrate the rising trend in production :—

Stone ware pipes and fittings	...	...	...	9,000 tons.
Crockery ware	...	...	...	60,000 dozens.
Refractories and bricks	...	...	...	8,000 tons.

The total production might be double the production for the year 1944-45.

110. *Location of future producing units.*—The Sub-Committee are of the opinion that two types of ceramics factories may be recommended to be put up in the Province. The first set would consist of factories situated in big cities, one each like Bombay, Baroda or Ahmedabad supplying most of the industrial requirements and a part of the household demands. These must be large-scale plants involving a capital expenditure of Rs. 25 lakhs or more. In addition to these, smaller units (requiring a capital of not more than one lakh) may be put up in smaller towns where the facilities of raw materials and power supply are available. The products of these latter factories may be absorbed by the local markets.

Before recommending particular sites for larger factories it is necessary to have a complete Geological survey of the Province.

111. *Target of future production.*—In view of the likely increase in building activity and expansion in the markets for household pottery ware, the Sub-Committee recommend that the production of the following products may be permitted to the extent mentioned against each product :—

Products.	Quantity to be produced per annum.
<b>1. Sanitary Wares and Fittings—</b>	
Indian W. C. Pans 18", 20", 23", 25" and 27"	Nos. 60,000
'P' traps	" 60,000
'S' traps	" 2,500
Wall and corner urinals	" 4,000
European closets P and S type	" 20,000
Wash basins	" 5,000
" " corner	" 1,000
Laboratory sinks	" 3,000
Half Rond Channels	" 4,000
Stand for wash basins	" 1,000
Foot rests	Pairs 8,000
<b>2. Tiles and Bath-room Fittings—</b>	
White glazed tiles (6" × 8" and 6" × 3 per cent.)	Dozens 800,000
White glazed channels	" 20,000
White glazed cups	" 10,000
White glazed cappings	" 5,000
Non-slip vitreous tiles white	Brass 200
Blue tiles	" 20
Coloured glazed tiles	Dozens 100,000
" " embossed	" 20,000
Coloured channels	" 10,000
Coloured glazed strips	" 10,000
<b>3. Hospital Equipment and Sundries—</b>	
Feeding cups	Dozens 1,500
Bed pans	" 100
Mortar and Pestle No. 1, 2, 3, 4, 5 and 6	" 1,000
Porcelain pipes 6", 9", 12" and 15"	" 2,000
Dyeing beakers	" 100
Porcelain pot Byes Dia. 4", 4½", 5" and 6"	" 500
Porcelain thread guides	Gross 2,000
Laboratory chemical wares (crucible and evaporating dishes)	" 1,000
Other porcelain equipment for industries	Tons 100

Products.	Quantity to be produced per annum.	
<b>4. Insulators—</b>		
Insulators .. .. .	Nos.	1,500,000
<b>5. Refractory goods—</b>		
Fire bricks .. .. .	„	800,000
Fuel covers .. .. .	„	2,000
Boiler setting blocks .. .. .	„	2,000
Arch bricks .. .. .	„	200,000
Special refractories .. .. .	Tons.	1,000
Burnt clay powder .. .. .	„	500
Boiler floats .. .. .	Dozens	50

112. *Recommendations.*—To stabilise the industry and facilitate its growth, the Sub-Committee make the following recommendations:—

- (1) Geological survey of raw materials.
- (2) Cheap power supply.
- (3) Acquisition of land for putting up factories.
- (4) Facility to import machinery from U. S. A. and Germany.
- (5) Assistance of technical personnel from abroad to put up tunnel furnaces and erection of automatic machinery.
- (6) Cheap transport for raw materials.
- (7) Establishment of a central research centre by the Department of Industries.

113. *Bricks.*—The case of bricks in the group of pottery-ware specially calls for attention as these would be required in large quantities for the various construction schemes undertaken by the Government and private enterprise. Most of the present production is centred in Kalyan in Thana District which supplies the needs of building trade in Bombay. Quality of these bricks is such that they cannot be used without being plastered. If better qualities of clays are supplied for bricks, more durable types of bricks can be manufactured and there would be a proportionate saving in the cost of building. It is, therefore, advisable to put up plants with modern equipment producing about 1 crore of bricks per annum as there would be no difficulty in finding ready markets for these. This recommendation is strengthened by the fact that the region round about Bombay alone supplies about 10 crores of bricks per year.

## CHAPTER VI.

## CEMENT AND CEMENT PRODUCTS.

114. *General Considerations.*—The following are considered under this section :—

1. Portland Cement.
2. Cement Flooring Tiles.
3. Asbestos Cement Products.
4. Hume Pipe Manufacture.

The history of cement production in India makes an interesting study laying bare as it does the major economic forces governing a large scale industry. An industry of comparatively recent origin, it reached a critical stage threatening its very existence, due to the cut-throat competition between the two producing groups. The Tariff Board in its report on cement industry in 1925 recommended certain grants for protection to the industry and it was only when the merger comprising the Associated Cement Companies was effected that things returned to normal. Since then the demand for cement has been continuously increasing and the war time needs of the Government have given an impetus towards raising the production capacities of various cement factories in India.

Of the industries consuming cement, the Cement Flooring Tiles Industry has developed in our country during the last 15 years. Formerly, practically all flooring tiles and articles of marble were imported from Italy. This rising industry was faced with the situations created by conditions of war at an early stage. It suffered due to shortage of cement issued for civilian use, the drop in construction of residential houses and general stoppage of building activity in the Province. Difficulties of transport of raw materials and finished goods also contributed to the woes of the industry. The restricted imports of flooring tiles from abroad was the only relieving feature in favour of this industry.

The other industry consuming cement is the manufacture of asbestos cement products such as sheets, roofing materials, pipes, etc. There is only one large concern manufacturing asbestos cement goods in the Bombay Province viz., Messrs. Braithwait Asbestos Cement Co. Ltd., at Mulund.

115. *Present Production in the Province.*—There is at present no cement factory within the British territory of the Province. Both the factories producing cement are situated within limits, of Indian States, one at Dwarka and the other at Porbunder.

The following Table No. 15 gives an approximate idea about the production of cement and the consumption of cement for products manufactured from it in 1943. These may be viewed in the light of the figures of all India production of cement which attained the level of two million tons in 1943.

TABLE 15.

Name of Product.	Figures for annual production of cement products and consumption of cement in the consuming industries (in tons) in the Province of Bombay.	
1. Portland Cement (consumption in the Bombay Province).	204,362	
2. Cement Flooring Tiles (Production)	...	25,000
3. Asbestos Cement Products (Production)	...	48,750
4. Hume Pipes (Production)	...	...
		5,000

The production of cement tiles has fluctuated to a large extent during the war years. Some of the manufacturers had to stop production due to various difficulties amongst which were the scarcity of cement and the difficulties of transport. The annual production of asbestos cement products as such has remained practically steady during the period 1940-43, the average being about 70,000 tons of asbestos cement products.

#### 116. *Factors Relative to Production.*—

*Portland Cement.*—As is widely known the chief raw materials required in the manufacture of high-grade Portland cement are limestone, clay and gypsum. The absence of a complete geological survey of the Province proves a handicap in pronouncing accurate opinion regarding the possibilities of obtaining raw materials in particular locations. From the information available to the Sub-Committee there are definite indications that limestone and clay of good quality suitable for cement manufacture are available at some places in the Province, particularly at Sevalia in Kaira District, North Gujarat, to the extent that the present resources may last at least for 60 years on the basis of 200,000 tons of cement produced per annum.

Gypsum is not available in large quantities; and it shall have to be imported in the Province (recent investigations have proved workable deposits in the Junagadh State in Kathiawar and in Cutch). Rajputana is likely to fulfill the gypsum requirements of the industry.

The power requirements for the new cement factories to be established in the Province in Kaira District could be supplied by the Electric Grid System envisaged to be installed shortly by the Government of Bombay between Ahmedabad and Baroda. It is envisaged that High Tension Cable System of 22,000 KV will be extended between the two terminal stations. The installation will be of the magnitude of 30,000 KW. This project would save the prospective party the cost of installing a power plant of their own.

*Cement Flooring Tiles.*—The main difficulty that this new industry had to face was the scarcity of cement during recent years. With the plans to expand the cement industry in India and to install new factories in the Bombay Province this shortage will no more be a limiting factor. Marble chips, marble powder an

pigments were imported from abroad. During the war-period local marble has been utilised for the manufacture, but better survey work and selection of marble of fine quality will go a long way in improving the quality of the flooring tiles manufactured from indigenous marble chips and powder.

*Asbestos Cement Products.*—Cement required by the factory situated in Bombay is at present brought from Central Provinces. If cement factories are established in the Province it may be possible to utilise a portion of the production for the manufacture of asbestos cement products. Asbestos fibres are imported from abroad at present. It may be possible to utilise indigenous asbestos if a survey is made to obtain asbestos of good quality (long fibres) requisite for this purpose.

117. *Market Conditions and Factors Relative to Off-take of Indigenous Products.*—The cement requirements of Ahmedabad and Gujarat markets are principally supplied by the Lakheri Works of The A. C. C.; and Bombay is supplied with cement from the Shahbad Works as also by the Okha and Porbunder Cement Works. The market for cement is likely to expand due to the increase in construction of buildings, grand trunks roads, town communication road, etc., and due to its larger use in the manufacture of cement flooring tiles, asbestos cement and Hume pipes.

118. *Analysis of Consumption.*—The following table gives an approximate idea of the allocation of consumption of cement in different industries :—

TABLE 16.

*Consumption of Cement.*

Name of Industry.	Cement consumed in 1943 as per figures supplied by the manufacturers (in tons).		
1. Construction of buildings, roads, etc.	...	...	228,607
2. Cement Flooring Tiles	...	...	25,000
3. Asbestos Cement Products	...	...	48,750
4. Hume Pipes	...	...	5,000
		Total	307,357

119. *Scope and Possibilities of Expansion in Production.*—The war-time demands were responsible for an increase in production in India from about 1,500,000 tons at the beginning of war to about 2,000,000 tons at the peak period. In spite of this demand having ceased the requirements for construction of buildings, roads, bridges, hydro-electric and irrigation work are likely to increase the consumption of cement considerably. This general increase in consumption of cement in the country would also affect this Province; hence it would be necessary to increase production of cement to cope with this demand.



The A.C.C. under their expansion programme intend to put up a cement factory at Sevalia with an annual capacity of 100,000 tons which they hope to enhance by another 100 per cent. at the completion of the first stage. They have received the sanction of Government of India to put up a factory of 100,000 tons capacity at Porbunder. A new cement factory of an equivalent capacity is being constructed in Jamnagar State ; and further a licence has been granted to the A. C. C. for a factory to be installed at Port Veraval in Junagadh State.

With the increased construction of buildings the consumption of cement flooring tiles will have to be stopped up thus utilising large quantities of cement in this industry. A similar increase in the consumption of cement in the asbestos cement products and Hume pipes manufacture is also envisaged in the coming years.

The annual consumption of cement in different constructional activities in the coming five years is estimated to be as follows :—

	Tons.
1. Construction of buildings, roads, bridges, hydro-electric and irrigations works.	400,000
2. Cement flooring tiles ... ..	50,000
3. Asbestos Cement Products ... ..	100,000
4. Hume Pipes Manufacture ... ..	10,000
Total ...	5,60,000

120. *Location of Future Units of Production.*—Even if the Province is called upon to produce 400,000 tons of cement out of the total estimated requirements of about 600,000 tons, there is still room for two more factories in the Province. As to the location of the proposed factories for the manufacture of cement several places have already been selected by the manufacturers. In doing so they have examined the quality of available raw materials, availability of power or possibility of producing their own power and transportation facilities. Most suitable locations appear to be: Porbunder, Port Veraval in Junagadh State, Jamnagar State and Sevalia in Kaira District. Generally each factory may produce 100,000 tons of cement per annum.

121. *Target of future production.*—The target of production of cement and cement products (in terms of consumption of cement) for the coming five years may be fixed at about 600,000 tons per year as shown in the paragraph 119.

## CHAPTER VII.

## INEDIBLE OILS, SOAPS, PAINTS AND VARNISHES.

122. *General.*—The vegetable oil industry in India generally and in the Province particularly, would form a very important section of the general industrial pattern that is going to take shape in the immediate future. It will be correct to describe the vegetable oil industry as one of the basic industries in the country and its importance is perhaps as great as either the textile industry, or the heavy chemicals industry that are going to develop here. This is in view of the fact that vegetable oil industry would be the starting point for many other important industries that are going to be developed in the future. Although it would have been in the fitness of things to have considered the entire vegetable oil industry—both edible and inedible oils—, in this Chapter the committee have considered only the inedible oils and their various derivatives.

The sections considered in this Chapter are as follows :—

*Section 1.*—Inedible Oils.

*Section 2.*—Soap Industry.

*Section 3.*—Paints, Varnishes, etc.

The opinion of this committee is that in the future planning the vegetable oil industry should be considered on the basis of a basic industry and should be treated as a large scale industry.

## SECTION I.

## Inedible Oils.

123. *General Considerations.*—The comparatively higher percentage of acreage under cultivation for oilseeds, the varied requirements of oils for industrial purposes and the better facilities of internal transport and export of oilseeds make the oilseeds crushing an important industry in the Province. The crushing of seeds for the extraction of oil is done by methods ranging from the most primitive to highly efficient mechanical processes. Only a small percentage of seeds is crushed by ghanis. A major part is crushed by expellers. There is also an oil-extraction plant installed in the Province. Various types of seeds such as groundnut, linseed, rape and mustard, sesamum and safflower are used for crushing purposes; but in this report attention is concentrated on the non-edible oilseeds most important of which are castor seed, mowra seed and karanja seed. The production of oil from edible seeds is discussed only in cases where these are also utilised for industrial purposes.

124. *Present Production.*—The following table No. 17 gives the quantity of non-edible oilseeds milled annually in the Province. The figures represent the statistics supplied by the Agriculture Department, Government of Bombay.

TABLE 17.

Seed.					Quantity milled per year. Tons.
Castor seed	...	...	...	...	22,300
Mowra seed	...	...	...	...	7,500
Linseed	...	...	...	...	6,000
Karanja seed	...	...	...	...	500
				Total ...	36,300

Taking the percentage of oil extraction as 40, about 14,000 tons of oil from non-edible oilseeds are normally produced every year. This quantity is entirely utilised for non-edible and industrial purposes. It is important to note that oils derived from many edible oilseeds and cocoanut are also utilised for industrial purposes. Thus the total amount utilised for non-edible and industrial purposes, is more than indicated above.

There is also an additional source of oil for inedible purposes in the form of "soap stock" produced in the neutralisation and refining of oils at "Vanaspati" factories. The present availability and the estimated availability are shown in the following table. The figures are arrived at on the basis of average 2 per cent. of "Free Fatty Acids" present in the groundnut oil treated for refining.

Area.	Present availability.	Estimated availability.
	Tons.	Tons.
Bombay .. .. .	2,250	2,750
East Khandesh .. .. .	185	281
Baroda State .. .. .	313	313
Kathiawar .. .. .	150	563
Gujarat .. .. .	Nil.	125
Total ..	2,898	4,032

The following oil-bearing materials in addition to those mentioned above need consideration :—

*Cotton-seed.*—This seed has been long neglected, at least in this Province, in spite of its abundance (380,000 tons annual production). The seed gives besides the oil, valuable by-products as lint, hulls and protein-rich cake. The practice of feeding whole cake is very wasteful and must be stopped. Cotton-seed oil technology has been highly developed in the U.S.A. and there should be no difficulty in applying it here with suitable modifications. Refined cotton-seed oil is a good edible oil and will also give a better hydrogenated product. In case it does not find use as an edible product, it can be used for soap-making with considerable advantage.

*Kardi (Safflower).*—This gives a good drying oil which will supplement linseed oil.

*Rape and mustard.*—Recovery of oil from these varieties should be encouraged as it can be suitably blended and modified to produce a lubricating oil from it.

*Tallow and Bone-grease.*—If slaughter houses are going to exist in the Province, efforts should be made to recover the fat from the animal matter and residues as well as from bones that are collected at various places in the Province. Tallow and bone grease are good soap-making fats. They may be also split to give fatty acids.

*Miscellaneous fats.*—There are some valuable fats obtained from seeds which are either not systematically collected or are not available in plenty, but which could be cultivated. Only two instances are cited here.

*Pisa*.—A forest product containing 90 per cent. lauric acid which is a valuable raw material for synthetic textile auxiliaries.

*Kokum butter*.—A major source of stearic acid and for edible purposes.

125. *Factors Relative to Production*.—As pointed out in the opening paragraph, the pressing of oil from oilseeds is being done to a small extent by small ghanis put up in villages near the centres of production. Very large quantities of seeds are, however, crushed in big mills situated in towns and cities where the oilseeds are transported. As the oil from non-edible seeds is utilised mostly for industrial purposes, the extraction of oil by big mills situated in towns or cities where there is a ready market for the oils has a distinct advantage:—

(1) Production of oil by the village ghani is disadvantageous from the viewpoint of industrial economic considerations inasmuch as about more than 12 to 15 per cent. of the available oil will be left unexpelled. The mechanical expellers, however, would leave only 7 to 8 per cent. of oil.

(2) Most of the oilcake will be utilised for agricultural purposes. As such it will be very uneconomic to leave a very high percentage of oil in the oilcake residue. This is in view of the fact that the residual oil (besides being wasted) is definitely harmful to the soil if allowed to be retained by the oilcake.

(3) If the industry has to flourish, installation of oil extraction plants at suitable centres should be considered. By this process, it would be possible to treat either inedible oilseeds or even the oilcake for extraction treatment. It must be mentioned, however, that oil to be used for edible purposes should be produced either by ghanis or by expellers in view of the fact that there are prejudices against the use of edible oil produced by extraction process. Oils for inedible purposes may be advantageously obtained by extraction. Generally, oilcakes may be handled by extraction to remove the oil retained in them. The oil left behind by this process in the cake is from 0.5 per cent. to 1.0 per cent. Such a cake would be eminently suitable for purposes of developing mixed fertilizers. The fact that oil obtained by this method will have to be refined before it is used for edible purposes is not lost sight of.

126. *Present Consumption*.—The following table 18 would indicate the extent of usage of oils derived from edible oilseeds for industrial purposes in 1942-43:—

TABLE 18.

Seeds.	Production of Oils (in tons).	Requirements for industrial purposes.
1. Rape and Mustard ... ..	Negligible	.....
2. Sesamum ... ..	6,500	Negligible.
3. Linseed ... ..	2,000	2,700
4. Groundnut ... ..	120,000	10,000 (for soap).

To this must be added the supply of non-edible oils which is entirely utilised for industrial purposes.

The consumption of oils in the two major industries viz., soap and paints and varnishes, at their present stage of development is roughly 30,000 tons and 10,000 tons respectively.

127. *Factors Relative to Off-take of Indigenous Products.*—Some inedible vegetable oils produced here will form important starting materials for and will be utilised to a very wide extent in some of the important industries of the Province, such as :—

- Soap industry.
- Paints and Varnish industry.
- Polymerised oils industry.
- Lubricants industry.
- Textile auxiliaries industry.
- Leather industry.

It is, therefore, necessary that large amount of inedible oils should be produced. It is estimated that the oils will be consumed as follows :—

Name of the Oil.		Estimate of consumption in industries during the coming 5 years.	
1. Castor Oil	... ..	Textile Auxiliaries such as Turkey Red Oil, etc.	10,000 tons.
	... ..	Blended lubricants	5,000 ..
	... ..	Medicinal and Miscellaneous	1,000 ..
	... ..	Total	16,000 ..
2. Mowra Oil	... ..	Soap Industry	10,000 ..
	... ..		(On the basis of producing about 60,000 tons of soap.)
3. Linseed Oil	... ..	D. B. Linseed Oil for Paints and Varnishes	20,000 tons.
	... ..	Linoleum production and products of Polymerised Linseed Oil	10,000 ..
	... ..	Total	30,000 ..
4. Karanja Oil	... ..	Not important.	

128. *Recommendations and Target of Future Production—Other New Industries.*—The use of fats for soap, paints, varnishes, etc. is now quite common and must increase. The technical processes are, however, changing very rapidly so as to give not only a better soap or a better varnish but also some newer types of products. This rapid progress has been due to a clear understanding of the composition of various fats and of the application of new techniques in methods of processing. Some of the new processes on which new industries can be based are the following :—

(1) *Splitting of fats and distillation of fatty acids.*—There is always a market for stearic, oleic and similar acids of technical and chemical qualities. The salts of fatty acids and other derivatives are used as driers, germicide agents and components of lubricating greases, water-proofing agents, cosmetic preparations, varnishes and paints.

(2) *High Pressure Hydrogenation.*—Preparation of surface active and textile auxiliary agents.

(3) *Dehydration and isomerization of oils.*—Drying oils from castor oil. A better drying oil from linseed oil.

(4) *Solvent fractionation of oils.*—

(5) *Low temperature fractionation of oils.*—Both these enable an oil to be separated into an edible, a soap-making and a drying fraction.

As regards the location of future producing units vegetable oil factories having the most modern equipment for the extraction of oil should be considered as likely centres of production of inedible oils. No special indication for the location of oil extraction plant is necessary to be made.

As already stated large amounts of inedible oils would be required to implement the scheme of industrialisation in the Province. It is, therefore, necessary to make the Province as self-sufficient as possible in this respect. The Committee, therefore, recommend that improved methods of cultivation of oil seeds must be introduced to ensure the higher production per acre. It is also the opinion of the Sub-Committee, that keeping in mind the target of planned production as suggested by the Committee, exporting of oil seeds or oils, to foreign countries would be an unwise policy.

Further with the gradual industrialisation of hitherto backward areas of the Province the oil crushing industry can be spread over the areas of cultivation of oil seeds and thus escape the draw-backs of concentration in few areas.

Oil extraction units utilising solvents may be encouraged to be put up by the existing oil factories in Bombay.

More useful studies in oil technology with a view to develop the linoleum (oil cloth) industry should be undertaken.

129. *New Processes.*—The progress of oil industry is not only in the direction of manufacturing new products, but in the modification of a complete change of the existing plant and machinery. There is a distinct trend towards the use of continuous methods. Thus solvent extraction of oil seeds, refining and hydrogenation of oils, soap manufacture, distillation of fatty acids, etc. are gradually changing from batch into continuous operations.

130. *Government's Part in Promoting the Oil Industry.*—The above description is enough to indicate the very high level at which the oil industry abroad is working. To achieve that level capital and technicians must be forthcoming in large numbers. Capital will be readily available if the process and plant can be demonstrated under working conditions. Since miniature and pilot plants are available without much difficulty, the first thing Government need to do is to establish a pilot plant laboratory and keep the plants running over extended periods with the help of a technically trained personnel. Not only immense data of great practical value will be available, but the industrialists will not need any more convincing proof and inducements to start new industries.

## SECTION II.

## Soap Industry.

131. *General Considerations.*—The production of soap has been carried out on a fairly large scale in the Province. Some of the most well-known factories of India producing soap, like the Lever Bros., Ltd., Tata Oil Mills Co., Godrej Oil and Soap Co., and Swastik Oil Mills Ltd., are located in Bombay. The production of soap in the Province has been an outcome of plurality of products in recent years. Firstly the concentration of 'Vanaspati' industry has taken place in the Province and the manufacture of soap has mostly progressed as an adjunct of these oil mills. This statement, however, does not preclude the fact that some soap factories have grown independently in the Province.

Up to now the raw materials except oils, required for the manufacture of soap were mostly imported into the Province. The high figure of the imports of caustic soda and soda ash can be accounted for by this fact.

132. *Present Production.*—The available figures for toilet and laundry soap production in the Province have been shown separately in the two tables given below :—

TABLE 19.

*Laundry Soap.*—

Annual production between				No. of factories.	Actual annual production (in tons).
0	1,000 tons	...	...	2	325
1,000	3,000 "	...	...	2	3,790
3,000	6,000 "	...	...	2	9,800
Above	6,000 "	...	...	1	10,000
Total				7	23,915

In addition to the above factories there are small scale factories mostly in Gujarat and in Belgaum manufacturing soap by crude method. Thus the approximate production of laundry soap in the Province may be estimated at 40,000 tons per year.

TABLE 20.

*Production of Toilet Soap.*—

Annual production between				No. of factories.	Actual annual production (in tons).
0	600 tons	...	...	2	950
600	1,200 "	...	...	2	2,100
1,200	3,000 "	...	...	1	2,900
Above	3,000 "	...	...	1	3,000
Total				6	8,950

The production of toilet soap thus is to the extent of 9,000 tons per year.

On the basis of the figures of release of caustic soda for the production of soap in Bombay Province as supplied by the Chemicals Directorate, Government of India, the total production of soap may be estimated between 45,000 tons to 50,000. This is on the assumption that the 3,600 tons of caustic soda released for this purpose would give twelve times the production of soap. It is further to be borne in mind that the distribution of caustic soda was strictly rationed and was roughly on the basis of 75 per cent. of the normal requirements of the soap manufacturers.

133. *Factors Relative to Production.*—The soap industry in the Province could be said to have a considerable development judged by normal standard. This can also be seen from the fact that the location factor of soap industry in the Province is as high as 8·2. This, however, should not be taken to mean that there is no scope of development of this industry, in the Province. In fact more recent developments in the technology of soap, more of up-to-date equipment of manufacture and more rigorous control of the production line would have to be the features of soap industry that would grow in the Province.

134. *Market Conditions and Factors Relative to Off-take of Soap.*—The following table gives the consumption of soap per head of the population in various countries in normal years :—

TABLE 21.

						Lbs.
U. S. A.	...	...	...	...	...	23
Holland	...	...	...	...	...	22
Denmark	...	...	...	...	...	20
Great Britain	...	...	...	...	...	18
Canada	...	...	...	...	...	17
Poland, Yugoslavia, Bulgaria each	...	...	...	...	...	4

Considering the present market conditions and the trend for patronising indigenous production it would appear that the consumption of soap in the Province in the coming five years could be taken as 6 lbs. per annum, per capita. On population basis this works out in round figures to about 56,000 tons of annual soap production in the Province.

The production of soap by improved methods could be so cheap as to make the finished product available at 3 as. per lb. while the present cost is about 8 annas per lb.

135. *Figures and Approximate Analysis of Consumption.*—The production of soap in the Province has to cater for the following three consumers :—

- (1) Domestic use.
- (2) Laundry establishments.
- (3) Textile industry.

The production of soap will have to flow these channels of consumption.



136. *Scope and Possibilities of Expansion in Production.*—In view of the fact that the oil industry in the Province has reached a high degree of concentration, large amount of soap stock would be available for the industry. As such the 'Vanaspati' factories located in the Province can be made the centres of soap industry. Again caustic soda factories are also being envisaged to be put up at suitable places such as Bombay city, Ahmedabad and places in Kathiawar. These will act as feeder-centres supplying caustic soda to the neighbouring oil mills. Both of these considerations present good possibilities of expansion of this industry in the Province.

137. *Location of Future Producing Units.*—As stated above the oil mills in the Province would also be the centres of production of soap. Keeping this in mind the following are suggested as suitable locations for the industry.

- (a) Bombay
- (b) Khandesh (Pachora)
- (c) Baroda
- (d) Jamnagar
- (e) Porbunder.

138. *Target of Future Production and Recommendations.*—The target of production of soap in the Province during the coming five years could be recommended as follows :—

					Initial stages.	Later stages.
1. Toilet soap	...	...	...	...	10,000 tons.	15,000 tons.
2. Laundry soap	...	...	...	...	50,000 „	80,000 „

These figures include only domestic consumption.

In indicating these figures, reference has been made to the actual proportion of consumption of toilet and laundry soap which works out to be roughly 1 : 6.

The most economic unit of production of soap would be 15-tons per day plant but it would appear that except for the bigger concerns, other oil factories would prefer 10-tons per day unit.

139. *Glycerine.*—The production of glycerine is sufficient to meet the present demands of the Province and when necessary it would be exported, as required, at the important soap producing units. It is important to note that this Province can export glycerine if necessary.

## SECTION III.

## Paints and Varnishes.

140. *General Considerations.*—The production of paints and pigments in this Province has been carried out by factories such as Goodlass Wall Ltd., Holmes & Co. They have been engaged in producing paints, chiefly wet paints by mixing pigments with media such as boiled linseed oil and other oils. Some of these are also producing varnishes. It must be pointed out, however, that in this Province no serious attempts have been made uptill now to establish a full-fledged paints and pigments industry, although there is quite a developed market and important raw materials are available in the country. The following paints are recommended to be produced in this Province :—

- (i) Dry colours and pigments including ochres and barytes.
- (ii) Paste paints.
- (iii) Mixed paints.
- (iv) Enamel paints.
- (v) Distempers.
- (vi) Solvents and other plasticizers.

141. *Present Production.*—From the figures available regarding the production of paints and allied products, it is evident that the production is far behind the times. Table No. 22 below gives the information regarding production by important factories in the Province :—

TABLE 32.

	Production in 1939 (Cwts.).	Production in 1943 (Cwts.).
Paste paints	50,000	52,000
Mixed paints	25,000	100,000
Enamels	500	200
Varnishes	8,000	50,000
Dry colours	Negligible.	Negligible.

142. *Factors relative to Production.*—While considering the production of materials related to paints and pigments, it can be stated that this Province is favourably situated as regards raw materials which enter into production of the following types of mineral pigments :—

1. White pigments.
2. Yellow and orange pigments.
3. Green pigments.
4. Black pigments.
5. Lead pigments.

Again the existing paint factories in the Province can be considered as suitable centres of production of paints, in view of the fact that some of them are well equipped

for the production of double boiled linseed oil. It is significant to note that amongst the factories producing paints in this province, there is no Indian concern. The present factories are all owned by foreign manufacturers. It will be correct to state that these factories are not real production centres of paint inasmuch as they import the necessary starting materials such as colours, pigments from their other concerns in Europe and carry out mixing operations. It will be necessary to put up a full-fledged paints industry in this Province. In order to bring about this the common pigments will have to be manufactured by the factories producing paints.

From technical considerations, Bombay and places near about Bombay are well situated as far as the availability of technical personnel and skilled labour to work in the factories are concerned.

143. *Market Conditions and Factors Relative to Off-take of Indigenous Production.*—The off-take of various classes of paints in this Province has been quite considerable and if this Province had well developed paints and pigments industry, it would be able to cope with the daily increasing demands of these materials. To give an idea of the extent of increase of these products a reference might be made to the attached Table No. 23 which shows the imports of various kinds of paints in British India during the years 1935-40.

Although the figures of paints and pigments shown in the table under reference are relative to All-India imports, it can be suggested that Bombay, in view of its position and technical advantages, can produce not only for its own consumption but can also export a part of this production to other Provinces not so favourably situated.

144. *Analysis of Consumption.*—It is needless to point out the various ways in which these products would be utilised in the immediate future as far as this Province is concerned. These products would find use in the following :—

1. Internal and external decorations of modern buildings.
2. Engineering structures and in constructions of public utility.
3. Industrial equipment.

The housing problem at present is very acute in the Province and a huge building programme would be necessary to solve this problem satisfactorily. To meet the requirements of this programme not only the existing factories would have to expand their production, but new units would also have to be installed at suitable place in the Province.

145. *Target of Production and Recommendations.*—The Sub-Committee consider the expansion of the following types of paints and pigments as justified in view of the possibilities of increased consumption in future :—

*White pigments.*—These are at present manufactured at only one place in India, in Calcutta area and the output is not sufficient to meet the requirements of the country. Hence, any proposal to produce these pigments in Bombay should be given every possible assistance by the Government.

*Chrome pigments.*—The production at present of this type of pigments is to the extent of 700 tons per month. The industry in the Province is at present handicapped by the fact that many substitutes of chemicals have to be utilised in place of basic chemicals. Facilities, therefore, should be given for the manufacture of the

basic chemicals entering into production. The following are recommended for immediate expansion :—

1. Lemon yellow chrome.
2. Middle yellow chrome.
3. Orange chrome.

*Pigment colours.*—The chief raw material in the production of these pigments is potassium ferro-cyanide which will have to be imported in the initial stages. The advantage in this expansion of this industry lies in the fact that with the importation of this only material and a few others in small quantities, the requirements of paints and ink in the Province can be sufficiently met.

*Distempers.*—Almost all the raw materials required for this industry are available in areas near Bombay and manufacture of a high quality product is possible in the Province. The industry at present suffers from keen competition of imported products, which are manufactured by big financial combines abroad and which are in a position to supply these products at comparatively cheap rates. Government protection is, therefore, necessary to put this industry on a sound footing. Suitable varieties of this product can be utilised not only in plastering walls but also on asbestos sheets, metal wood, etc. Special varieties can also be prepared in the form of dry powders soluble in water, which can kill bugs and insects, and thus would be very useful in the post-war reconstruction programme.

*Nitro-Cellulose paints.*—These types of paints are useful for motor industry, in railway departments, etc. ; but their manufacture requires a number of solvents which are not at present available in India. If facilities could be offered in making these solvents available to the manufacturing units, this industry could flourish well in the post-war period. For the products reviewed herein no targets could be suggested in view of the fact that a correct picture of consumption is not available.

TABLE 23.

## TABLE OF IMPORTS OF PAINTS AND PIGMENTS.

Name.	Quantity in Cwts.					Value in Rupees.				
	1935-36.	1936-37.	1937-38.	1938-39.	1939-40.	1935-36.	1936-37.	1937-38.	1938-39.	1939-40.
1. Barytes .. ..	13,458	7,441	9,314	9,045	2,149	36,624	24,123	38,415	35,705	7,426
2. Paris blue .. ..	18,206	15,041	17,705	15,114	14,113	802,696	632,476	715,559	638,134	622,816
3. Graphite .. ..	10,627	10,569	11,094	8,383	10,504	135,084	131,436	155,722	113,902	122,641
4. Genuine dry red lead ..	36,761	15,573	7,544	7,016	8,523	512,140	254,269	189,980	134,683	182,007
5. Reduced dry red lead ..	3,443	1,846	2,712	347	58	34,144	20,880	46,341	8,101	1,100
6. Genuine white lead ..	12,665	13,589	8,299	7,164	5,509	255,402	273,179	203,481	158,806	144,546
7. Reduced dry white lead ..	911	66	9	12	4	14,387	760	537	310	152
8. Genuine moist white lead ..	3,084	2,732	1,694	649	2,575	66,348	65,178	54,626	19,805	83,712
9. Reduced moist white lead ..	1,117	1,371	1,353	1,248	769	26,274	34,092	35,539	31,813	20,871
10. Dry lithophone.. ..	23,318	29,661	37,045	31,286	46,248	227,964	266,186	345,413	287,527	530,311
11. White moist paints ..	4,842	758	181	390	330	86,842	12,975	3,197	6,583	8,065
12. Genuine dry Zinc white ..	1,375	1,788	1,448	10,384	31,901	27,137	36,474	31,414	151,987	521,906
13. Reduced dry Zinc white ..	1,300	532	1,208	640	631	15,643	6,262	13,735	7,761	6,604
14. Genuine moist Zinc white ..	35,140	32,695	16,597	17,889	15,988	763,756	746,257	436,925	492,726	426,183
15. Reduced moist Zinc white ..	976	874	587	827	376	15,824	12,263	8,721	14,195	7,583
16. Other sorts .. ..	204,275	237,869	161,724	142,318	154,205	5,034,751	5,137,060	5,216,810	4,549,907	5,365,887
Total .. ..	371,498	372,425	278,514	253,212	293,933	8,055,625	7,654,770	7,475,515	6,651,950	8,051,810

## CHAPTER VIII.

## ELECTRO CHEMICAL INDUSTRIES.

## SECTION I.

## General.

146. *Power Costs.*—The electro-chemical processes have been adopted on a fairly large basis in the United States of America and many countries of Europe. In this present survey the possibilities of exploiting electro-chemical processes in the Province of Bombay have been examined. In so doing all the factors touching the production of chemicals by the electro-chemical processes have been investigated taking into considerations the local conditions.

In the group of industries that are dealt with in this section the electrical energy must be looked upon as a raw material or commodity capable of promoting certain types of reaction. In the economic analysis of any project envisaged to be adopted in this Province, this energy will have to be treated like any other item of raw material. If the energy consumption is relatively large in proportion to the total cost of production, the industry will have to be located at centres of cheap and plentiful power.

If the electrical consumption is relatively small in comparison to total cost, then other factors will determine location. It is a well known fact that in other countries where electro-chemical processes have been fully exploited the centres of production are located near hydro-electric projects. A well known example is of the Niagara Project where the easy availability of large quantities of cheap power attracted a wide variety of electro-chemical industries. Thus, plants for production of calcium carbide, ferro alloys, abrasives, chlorine, and caustic soda are all situated near the Niagara Project. In the present survey, the Committee have been concerned to find if it was possible to put such industries in or near Bombay. In the post-war period the Bombay Government Grid Scheme is envisaged to be installed and it is also expected that with this Government Grid Scheme and the Tata Hydro-Electrical project it would be convenient to establish electro-chemical industries taking power from either of these sources in places such as Kalyan, or Bhandardhara in the Nasik District, or Koyna near the Chiplun Port.

With the completion of these programmes regarding the electrical projects it may be possible to make power available to chemical industries at as low rates as 0.15 annas per kwh. which would suit the establishment of electro-chemical industries in the Province. As against the policy of buying electric power for the electro-chemical industry may also be considered the possibility of generating power by the industry itself by using coal or fuel oil. By the installation of steam turbines for producing such power and utilising low pressure steam for chemical processes it would be possible to divide the cost of raising steam between the generation of power and the generation of processed steam.

147. *Availability of Raw Materials.*—With regard to the electro-chemical industries recommended by this survey to be installed in Bombay Province it may be generally stated that all the necessary raw materials of the requisite quality and in required quantity will be easily made available at the respective places of the various industries considered here. This factor of raw materials, therefore, would appear to be quite favourable and in the interest of the industries considered here-below.

148. *Markets.*—The products of the various chemical industries recommended in this Provincial survey will find an easy market both in the Province, in the neighbouring States and in other Provinces of the country. Bombay being the centre of a rail road system as also a system of sea freight it would be quite possible to find easy and suitable outlets for the various products envisaged to be manufactured by the electro-chemical industries.

149. *The Industries specially recommended for Bombay Provinces.*—The following industries are specially mentioned for the immediate consideration of the Government of Bombay so that the installations may be encouraged in the post-war period in this Province. The Committee have considered the possibilities of putting up calcium carbide industry in the Province. At the present stage, factors regarding powers, raw materials, location, etc., are not favourable to this industry.

## SECTION II.

### Aluminium Industry.

150. *General Considerations.*—The Province of Bombay has excellent deposits of bauxite particularly situated near Belgaum, as well as in Thana District and in Kaira District. These deposits can be exploited for the production of aluminium in the Province.

The trend in the world production of aluminium can be best expressed by the following table :—

TABLE 24.

Year.	Quantity produced.	Remarks.
1935	250,000 tons.	Generally supplied 75 per cent. of the total productions.
1938	600,000 tons.	The production has increased considerably since 1938 on account of the impetus given to this industry by war.

Regarding the above it is significant to note that to-day Canada leads the production of aluminium (after the fall of Germany) in spite of the fact that that country has no workable deposits of bauxite and gets its ores from South America.

151. *Figures of Present Production.*—The present production of aluminium in India is summarised in the following table :—

TABLE 25.

Name of the Company.	Estimated capacity of production.	Actual production.
The Indian Aluminium Co. Ltd. (1937)	2,500 tons.	1,700 tons in the year 1943.
The Aluminium Corp. of India. (Factory at Asansol)	3,000 tons.	1,000 tons.

152. *Factors related to Production of Aluminium.*—The Province of Bombay has the advantage of having hydro-electrical power which would be available at cheap rates for the production of aluminium. The availability of good quality of bauxite in the same region as that served by the hydro-electrical system adds considerably to the advantage of locating the industry in the Province.

153. *Market conditions and Factors relative to Off-take of Products.*—The following Table No. 26 shows the consumption of aluminium in India as revealed by its imports into the country :—

TABLE 26.

Year.					Quantity in tons.	Value in lakhs of Rs.
1926-27	...	...	...	...	4,861	95.09
1927-28	...	...	...	...	6,744	118.51
1928-29	...	...	...	...	6,330	107.75
1929-30	...	...	...	...	8,551	142.35
1930-31	...	...	...	...	6,417	100.63
1931-32	...	...	...	...	1,971	20.66
1932-33	...	...	...	...	1,218	22.18
1933-34	...	...	...	...	1,974	32.59
1934-35	...	...	...	...	2,623	38.22
1935-36	...	...	...	...	3,175	45.11

The maximum consumption shown by the tables has reached a level of almost 9,000 tons per year in 1930. Thereafter the drop shown by the table could be attributed to the decline in the prices of copper and brass vessels which flooded the markets outclassing the use of aluminium cooking utensils.

In the days to come, this metal is going to play an important role in the manufacture of alloys used in the aircraft industry as well as in the manufacture of parts for railway rolling stock and other mechanical parts. In view of these the demand for aluminium in India is likely to rise, and it is reasonable to fix up the target of producing 30,000 tons of aluminium for the whole of India. Bombay Province can look forward to putting up a factory producing and marketing at least 3,000 tons of aluminium per year.

154. *Analysis of Consumption.*—Amongst the variety of aluminium goods manufactured from semies domestic aluminium utensils are the most important. During the war due to the restricted imports furnaces were installed to melt and refine the scrap and the metal produced was processed into sheets and circles in rolling mills. The production of domestic utensils also got an impetus during the war years. As a result of this the industries consuming aluminium are well established both as regards the rolling of sheets and circles and the manufacture of aluminium utensils. A number of these concerns are located in the Bombay Province, and would be able to consume the aluminium proposed to be produced in the Province.



155. *Scope and Possibilities of future Production.*—Keeping this project for the Province of Bombay in view, the Committee would recommend to put up a plant for the manufacture of 10 tons of metallic aluminium per working day. In making this suggestion the Committee have considered the factors concerning :—

- (i) Availability of raw materials.
- (ii) Availability of processing chemicals.
- (iii) Electrical energy in post-war period.
- (iv) Suitable site.
- (v) Marketing possibilities.
- (vi) The general prospects and prosperity of the industry.

*The Raw Materials.*—The important raw materials necessary for the production of metallic aluminium are :—

Bauxite.

Coke.

Coal-tar pitch.

Cryolite.

Caustic soda.

The Committee are of the opinion that all these materials except cryolite will be available in plenty at or nearabout Bombay. The possibilities of getting cheap raw materials of the requisite quality have been examined here-below :—

(1) *Bauxite.*—If the Government of Bombay decide to permit the installation of aluminium factory in the Province, there is admirably suited source of raw material for this industry. It is situated in the Thana District on the Tungar Hill about 30 miles from the city of Bombay. This would provide all the requisite bauxite for the aluminium factory to be placed nearabout. It has been estimated that this hill has about 140 acres of bauxite, and the estimates show that about 750,000 tons of bauxite suitable for aluminium production will be available. At the rate of 12,000 tons of bauxite requisite for producing 3,000 tons of aluminium this source of bauxite would last at least for 60 years. This would reveal that on this basis a suitable site near Bombay, would be the ideal situation for putting up the factory proper. The quality of bauxite available has been found suitable and after purification of alumina obtained from representative samples, this bauxite showed 99·34 per cent.  $Al_2O_3$  content.

Over and above, the other advantages such as availability of hydro-electrical power, shipping facilities and the availability of large quantity of water, Bombay Province has the further advantage of having bauxite deposit located in the same region. Bauxite deposits in Belgaum District and near Koyna, where hydro-electrical power is proposed to develop will also form suitable raw material. A thorough prospecting of these deposits will have to be undertaken before a final decision is made for the location of a plant.

(2) *Fuel*.—This industry will require large quantities of fuel. In this particular suggestion regarding putting up the factory to utilise Tungar Bauxite, the Bayer Process for the production of alumina will have to be used. Bombay being a port, as also a site suggested for this industry being easily approached by country-crafts, coal would be available for the industry. Similarly, coke and furnace oil for drying bauxite could be conveniently reached to the factory. It has been estimated that per 1 ton of aluminium produced, 4·5 tons of coal, 0·8 ton of coke and 0·5 ton of furnace oil will be required. The normal prices for these materials are such that their price will not materially affect the cost of production. From this view point also the situation of a factory near about Bombay or near Chiplun would be a very convenient factor.

(3) *Coke and Coal-tar pitch*.—Coke and coal-tar pitch will be required for the production of electrode requisites in the aluminium industry. All these materials will be easily available from the Burma Oil Co., Ltd., now that normal conditions are slowly returning. The total cost of all these materials as delivered at the factory will not exceed Rs. 30 per ton. This figure compares quite favourably with the price obtaining in foreign countries where aluminium has been manufactured. Coal-tar pitch suitable for electrodes will be available in the Province itself when a suitable wood distillation plant as envisaged in this survey is installed at a place like Billimora or in North Kanara quite near Bombay.

(4) *Cryolite*.—Cryolite which is the chief constituent of the electrolyte for dissolving alumina is the only material which must be imported from countries like Greenland. The imported price of refined cryolite will be quite favourable if the Government of India would allow the imports of this material free of duty. The Provincial Government will have to approach the Central Government for such concessions in the interest of the industry.

(5) *Caustic soda*.—This country had been importing caustic soda. Ever since 1943, however, India has gone into production of this chemical and this Province itself, as envisaged by the present survey will have factories producing caustic soda. If as suggested in Chapter II the caustic soda factory for the Province of Bombay is installed in Bombay, it is reasonable to suggest that caustic soda will be available at a fairly low price for this industry. The concentration of heavy chemicals industry, and the electro-chemical industries near about Kalyan is calculated to bring about not only easy distribution of chemicals to consuming industries, but such distribution will be to the mutual advantage of these industries as far as cost and convenience are concerned.

*Considerations regarding Electrical Energy*.—Electrical energy will be consumed to a very large extent. Estimates show that 18,000 to 21,000 kw. per ton of aluminium will be consumed. Electrical energy, therefore, forms a very important single item controlling the cost of production of aluminium. It is, therefore, very necessary that plenty of cheap electrical power should be made available continually to the plant producing metallic aluminium. This will be achieved if the Koyna scheme comes into existence at an early date. It has been envisaged in the scheme that it will start with an initial installation for producing 40,000 kw. This installation will meet the requirements of the aluminium industry in Bombay.

Further with regard to the above it can be stated that in the programme of expansion, the Tata Hydro-Electrical Power Scheme would be in a position to supply electrical energy at quite reasonable rates. The cost of such power should

be about 0·10 to 0·15 as. per kw. The power may be bought from the Tata Hydro-Electrical Power Supply Co., Ltd., or from the Bombay Government Grid. If it is to be bought from Tatas it may be recommended that the Government of Bombay may approach the Tata Hydro-Electrical Power Supply Co., Ltd., with the proposal so that it may be possible in good time to complete the arrangements for the supply of electrical power.

Alternatively the Grid System as envisaged by the Government of Bombay for the supply of electrical energy may also contemplate measures which would facilitate the supply of electrical energy as discussed above. The installation of such a factory should be taken into consideration by the authorities while making provisions for the project.

156. *Location of the Factory.*—In suggesting the site for the aluminium factory which may be put up in the Province of Bombay, factors regarding raw materials, continuous supply of fresh water, transport facilities, cheap labour, easy availability of power and all relevant factors have been considered. In view of this the most suitable site which can be suggested is near Kalyan on the River Ulhas. This site has the following advantages :—

1. Large amount of bauxite near about.
2. Fresh water in the Ulhas River.
3. The rail road and water transport facilities.
4. Availability of processing chemicals such as caustic soda.

Although in many aluminium producing countries the general practice is to locate the alumina producing and reducing plants at separate suitable places, in the present case it can be suggested that both the units, viz. alumina producing and metal producing sections may be placed *pari passu*. This suggestion is, however, to be examined from all view points when the detailed scheme is prepared for the installation of an aluminium factory in Bombay Province.

157. *Target of Production and Recommendations.*—In view of what has preceded above it is suggested that if a factory producing 10 tons of metallic aluminium per working day be established in Bombay bright prospects could be held out reasonably to the prospective financiers. It is, therefore, suggested that the plans for the intallation of an aluminium factory be taken up by the Government of Bombay, on the following lines :—

- (i) To provide for 10,000 kw. at 0·10 to 0·15 as. per kw.
- (ii) To make available facilities which may be required by the manufacturer in establishing the industry.

### SECTION III.

#### Other Chemicals Depending upon Electro-Chemical applications.

In this section the production of hydrogen peroxide is considered.

158. *General Considerations.*—Hydrogen peroxide is manufactured by the electro-chemical process by electrolysing a solution of dilute sulphuric acid and distilling the resulting solution of per sulphuric acid under vacuum. The process does not require any special raw materials except small quantities of sulphuric acid. The main requirement is the electrical power. It is considered suitable to put up a plant for hydrogen peroxide in conjunction with other electro-chemical

159. *Present Production and Factors relating to Production.*—No hydrogen peroxide is being manufactured in the Province by the electro-chemical process.

If hydrogen peroxide is produced electrolytically at a centre where electric power is cheaply available, it might be possible to produce it at a cheap rate so as to be able to find markets for it.

160. *Consumption of Hydrogen Peroxide.*—The present consumption of hydrogen peroxide is very low as it is not being manufactured to any considerable extent, but with larger productions at economical rates, the material can find its own market as is shown by its import during normal times for bleaching of cloth and for special bleaching processes.

161. *Future Possibility of Production.*—It is envisaged that it would be possible to find a market for about 500 tons of hydrogen peroxide per year during the coming 5 years. The target for manufacture of hydrogen peroxide is, therefore, fixed at 500 tons of 120 volume hydrogen peroxide per year. This would require a daily consumption of about 27,000 K.W.H. of electrical energy. Thus, it will be conveniently located at a site where cheap electrical power is available and where there is already an arrangement for converting A.C. power to direct current. These conditions would be satisfied at an industrial concern which is already manufacturing electro-chemicals.

## CHAPTER IX.

## PLASTICS INDUSTRY.

162. *General Considerations.*—The following are considered in this section :—

1. Phenol-formaldehyde plastics.
2. Amino-formaldehyde plastics.
3. Cellulose Acetate and Nitrate.
4. Natural plastics—Casein, Shellac.

Plastics have come to be used in every day life in the form of utility articles as well as mechanical and electric parts. They are also used in various industries such as radio, automobile and aircraft industries. These various types of plastics enumerated above have different utility according to their properties. Phenol-formaldehyde type has been replaced to a considerable extent by the amino-formaldehyde plastics and the cellulose plastics in the manufacture of transparent and delicate articles. However, the use of phenol-formaldehyde will continue because of its cheapness in the manufacture of utility goods as well as mechanical and electric parts. Cellulose acetate and nitrate plastics find a large use in the manufacture of photographic and motion films and to a lesser extent in cellulose-ware and injection moulded cellulose acetate articles. These plastics also find a use in the manufacture of paint basis, sheets of the cellophane type and in the synthetic fibre industry.

Natural plastic shellac finds an important use in the manufacture of gramophone records.

163. *Present Production.*—Only a very small quantity of the synthetic moulding powder is being made in the Province. This is of the phenol-formaldehyde type and the manufacture consists of mixing imported phenol and formaldehyde with indigenous wood flour. The present mixing capacity is 100 tons per year. The installed capacity is for a production of 600 tons of moulding powder annually.

Regarding the natural plastics the casein is manufactured locally in the Province whereas shellac is being imported from outside the Province. The total figures of production of casein in the Province are not available but a rough estimate may be made from the quantity of casein transported from the largest casein producing centre Anand. For the year 1943 this quantity was 3,062 tons.

164. *Factors relative to Production.*—The industry of moulding plastic wares from imported moulding powders has developed recently in India. Bombay is the largest centre for this moulding industry. The manufacture of moulding powders has not yet developed in our country because of the recent installation of the moulding industry as well as the immature state of our chemical industry which supplies the raw materials used in the manufacture of moulding powders. The present requirements of moulding powder are being met by imports from U.K. and U. S. A. but with the expansion of our chemical industries and the consequent availability of cheap raw materials it should be possible at an early stage to manufacture all the required moulding powders locally.

Of the natural plastics, casein is manufactured locally mostly by the acid process and not by the rennet process from skimmed milk obtained from dairies manufacturing butter. According to the consumers the quality of this casein is unsuitable because of its lack of uniformity.

165. *Market Conditions and Factors Relative to Off-take of Indigenous Products.*—The moulding industry is at present in an early stage of development and it is envisaged that the suitable increase in the consumption of moulding powders will occur in the coming years. Practically all the present requirements are met by imported moulding powders and hence it would be possible to find an easy market for the indigenous products, provided it is manufactured at competitive rates and of the required quality.

The existing film industry consumes an amount of raw films sufficient enough to justify the establishment of the Cellulose-nitrate industry. The industries consuming Cellulose-acetate for films, fibres, lacquer base and plastic goods are yet in a state of development and are likely to be consumers of a large amount of this material.

166. *Figures of Consumption.*—The following table gives the figures of consumption of moulding powders at present and the estimated consumption according to the data supplied by the moulders of plastic goods :—

TABLE 27.

Name of Plastic material.	Present annual consumption (in tons).	Estimated annual consumption for 1946-47 according to the data from manufacturers.
1. Phenol Formaldehyde .. ..	350	900
2. Amino Formaldehyde .. ..	100	300
3. Cellulose nitrate and acetate .. ..	Small quantity	100
4. Casein .. ..	50	100
5. Shellac .. ..	26	26

The above figures represent the estimates made by the present manufacturers for 1946-47 on the basis of the moulding machinery installed by them and available immediately in view of the imports ordered out. The consumption of moulding powders for coming five years according to the envisaged development of plastic industries with its consuming industries would be much higher than that estimated by the manufacturers.

167. *Scope and Possibilities of Expansion in Production.*—

(i) *Phenol Formaldehyde.*—The production consists of the manufacture of the raw materials phenol formaldehyde and the manufacture of moulding powder by mixing the chemicals with filler material such as wood flour or soyabean meal and other chemicals. The production of phenol in the province is already being contemplated by manufacturers of electrolytic caustic soda and chlorine by chlorobenzene method.

Formaldehyde forms a raw material for plastics of the phenol formaldehyde type, the amino-formaldehyde type as well as the casein type. It also finds other use in the form of methyl alcohol obtained as one of the products of the hard wood distillation industry or by the direct synthesis.

(ii) *Amino-formaldehyde*.—The raw materials required are urea or thiourea and formaldehyde. Urea may be produced from ammonia by fixation of nitrogen which is already recommended as one of the industries that may be developed in the Province. Wood pulp or wood flour of uniform consistency or mineral materials may be utilised as filler materials.

(iii) *Cellulose acetate*.—The raw materials required are cotton linters, acetic acid, acetic anhydride and sulphuric acid. Acetic acid and anhydride will be available at cheaper rates when the manufacture of these materials is undertaken on a large scale. The other raw materials are available locally.

(iv) *Cellulose nitrate*.—All the raw materials required in the production are available locally and are likely to be available at more economical prices with the contemplated reorganisation and expansion of the provincial industries.

On the assumption of about 75 full length feature films and 150 short films per year produced in the area in which raw films could be supplied by the Province of Bombay with an average of 20 copies for each of the full length features and 50 copies for the shorts, the requirements of raw films would be nearly 50,000,000 feet per year. The photographic films may be included in this consumption as they form a minor percentage compared to motion films. The consumption of cellulose nitrate on the above assumption in this industry would be about 100 tons per year.

(v) *Casein and shellac*.—Large quantities of these raw materials are available from the natural resources on hand and the utilisation of this plastic raw material requires the manufacture of both these products on an economical scale and to a standard of quality which would suit the manufacturers of plastic goods.

168. *Location of Future Units of Production*.—The manufacture of moulding powders may suitably be undertaken in the city of Bombay or suburbs as the chief requirements for this industry are heavy chemicals which are manufactured to a large extent in Bombay. The existing moulding industry already established in Bombay could be supplied easily with the required moulding powders if they are manufactured locally.

The availability of trained labour and other industrial and business facilities would be additional advantages available in Bombay.

169. *Target of Production*.—The following table gives the target of production of plastic moulding powders for the coming five years in consideration of the expected expansion in the consuming industries. Column 3 indicates the requirements of raw materials for each of the moulding powders.

TABLE 28.

Name of the Plastic	Target of annual production (in tons)	Annual requirements of raw materials for the proposed target	
		Name of raw material	Quantity (in tons)
1. Phenol-formaldehyde ..	1,500	Phenol .. ..	627
		Formaldehyde .. ..	405
		Wood Flour .. ..	780
		Sulphuric Acid .. ..	2
		Hexamethyl Tetramine .. ..	56
		Pigment .. ..	19
		Calcium Stearate .. ..	10

Name of the Plastic	Target of annual production (in tons)	Annual requirements of raw materials for the proposed target	
		Name of raw material	Quantity (in tons)
2. Amino-formaldehyde ..	600	Urea .. ..	252
		Formaldehyde .. ..	252
		Wood pulp or wood flour .. ..	240
		Curing agents dye—lubricant ...	11
3. Cellulose acetate ..	300	Cotton Linters .. ..	210
		Acetic anhydride .. ..	600
		Acetic Acid .. ..	975
		Sulphuric Acid .. ..	30
4. Cellulosenitrate ..	300	Cotton Linters .. ..	180
		Nitric Acid (100%) .. ..	300
		Sulphuric Acid (100%) .. ..	150
5. Casein ..	....	Casein .. ..	} Figures not available.
		Formaldehyde .. ..	
		Caustic Soda .. ..	
		Sodium Sulphide .. ..	
6. Shellac .. ..	....	Shellac .. ..	} Figures not available.
		Carbon black clay and copal. .. ..	

170. *Recommendations.*—The following recommendations are made for the establishment of this new industry in the Province :—

(i) All help required by the manufacturers in establishing the industry may be made available by the Government.

(ii) Facilities must be made available for the import of manufacturing machinery for the development of the industries manufacturing the raw materials as well as the moulding powder industry.

(iii) In the earlier stages it may be necessary to protect the new industry by restricting the imports from abroad or by the introduction of Tariff duties on imported material.



TABLE 29.

Information regarding manufacture of Plastics.

Plastic Raw Material	No. of factories using the raw material	Consumption in tons per year		Source of raw material	Price of raw material	Economically allowable price of raw material	Varieties of articles manufactured.	Remarks.
		1945	1946-47 estimated					
1. Celluloid	.. 2	Nil	.. 12 tons tubing	U. K.	.. 5-10 shillings per lb.	5 sh.	Bangles, soap boxes, umbrella handles, etc.	No manufacture during 1945-46 because of lack of raw materials. As yet no imports of celluloid sheets or tubing have been possible. The manufacturers are interested in expansion of the industry by importing machinery for thermoplastic moulding powders.
2. Shellac	.. 1	Shellac 26 tons. Clay 34 tons.	Shellac 26 tons. Clay 34 tons.	Local	.. Shellac Rs. 80/90 per bag.	Rs. 18/20 per bag.	Gramophone records.	Prices of raw materials rose gradually and the quality deteriorated. The filler material was originally imported from Japan under the name of Stone Powder. Due to stoppage of import of this material, clays and powdered sea-shells were locally procured. The imported material was more suitable because of its cheapness and low density.

3.	Casein	..	1	24 tons	..	48 tons	..	Local	..	Rs. 1,000-2,000/ per bag.	..	Buttons, Sheets, tubes, rods.	Raw material obtained locally is mostly prepared by the Acid process and the quality is not uniform. The prices have been increasing gradually during recent months. In February 1946 the price was Rs. 1,015/ton, whereas in April 1946 it was Rs. 2,035/ton.
4.	Casein Glue	..	1	Glue 1 ton. Lac 1 ton. Timber 130 tons.	....			Local	..	....	..	Frames and other moulding.	....
5.	Phenol Formal- dehyde Urea Formaldehyde Cellulose Ace-		7	448 tons	..	1,136 tons	..	U. S. A., & local.	K., Imported Re. 1/ lb. Local Re. 1/14 to Rs. 2/lb.	8 as. to 10 as.		Radio knobs, tele- phone blocks tele- phone fuse panels, toilet articles, do- mestic articles, bottle caps, stationery arti- cles.	Raw material mainly used is phenol-formaldehyde and to a lesser extent urea formaldehyde. The consumption of cellulose acetate is very low as yet. There is only one concern dealing in the manufacture of Moulding Powder. The phenol-formaldehyde moulding mixture is prepared from imported phenol-formaldehyde and indigenous wood flour. The manufacture of Moulding Powder from basic raw materials has not yet been undertaken by any manufacturer.

## CHAPTER X.

## GENERAL RECOMMENDATIONS AND SUMMARY OF THE REPORT

## SECTION I

## General Recommendations.

The following general recommendations are made by the Committee for the consideration of the Provincial Government.

- (1) It is recommended that the Geological survey and forest survey of the resources entering into the chemical industry should be undertaken by the Government.

This recommendation has been made in view of the fact that the chemical industry of the Province should develop according to a fixed programme. It will be, therefore, essential and important to find out how far chemical industry in the Province can utilise the mineral resources and the raw materials available here. In order to ascertain such sources fairly accurately, not only a geological survey will have to be undertaken but it will be necessary to carry out extensive prospecting of the mineral resources. This prospecting would include the following investigations :—

(a) Location of mineral resources ; particularly the following :—

- (1) Bauxite.
- (2) Gypsum.
- (3) Barytes.
- (4) Lead, zinc, copper and tin ores.
- (5) Ochres and coloured earths.
- (6) Silica deposits suitable for glass industry.
- (7) Clay deposits suitable for pottery industry.
- (8) Asbestos.
- (9) Mica.
- (10) Felspar.
- (11) Kayanite.

(b) The extent of mineral deposits both in area and depth.

(c) Total quantities of each mineral available if used in certain quantities per year.

(d) Quality and suitability of mineral resources for particular chemical industries.

So far no such prospecting has been undertaken either by the Central Government or the Provincial Government as far as the mineral resources of the Province are concerned. Absence of any authoritative information on the lines mentioned above was a serious handicap in the work of the present Committee in the matter of providing accurate figures of available raw materials.

A similar prospecting of forest resources entering into chemical industry should also be undertaken. Absence of authoritative information regarding the forest resources has seriously handicapped the Committee in the matter of making any definite remarks regarding the availability of hard wood and bamboo resources of the forests of the Province which are raw materials for industries such as paper, rayon etc. Repeated inquiries from the Committee to the Forest Department Officers remained unfruitful. It would appear the Department had no information required by the Committee. It is, therefore, absolutely necessary that the Forest Department maintain useful records which could be pressed into service of the public. This could be only done if there was a proper survey of the forest resources made and records maintained with the particular object in mind. Such records should be easily available to the prospective industrialists. This suggestion has been made in view of the fact that even a Committee appointed by the Government of Bombay found it difficult to get the information wanted.

- (2) It is recommended that more intimate contacts between the chemical Research Laboratories of the Province and the industrialists should be established in the interests of progress of the industry in the Province.

The Committee have found during their investigations that most of the existing factories producing chemicals and chemical products lack proper technical guidance. They have been following methods of production which have been found inefficient and uneconomic. In chemical industry, more than in any other industry, the element of obsolescence plays an important part. On account of daily progress being made in the field of chemical engineering, processes and equipment become obsolete overnight. For example, an electrolytic cell which may have been quite efficient might get inefficient overnight when viewed in comparison with a newer type of cell. It is on account of this factor that the producers have to be wide awake to the up-to-date researches and discoveries; such a desirable condition would not ensue unless a more intimate contact existed between the research institutions and industrialists. It is, therefore, recommended that such a contact be established by publishing facts and figures regarding chemical industry and inviting industrialists to get interested in the latest advances in the field of chemical industry. This activity can perhaps be undertaken by the research institutions of the Province and preferably by the Industrial Research Laboratories of the Department of Industries of the Government of Bombay. To find out the ways and means of achieving this object will be within the scope of a special committee which may be appointed by the Government of Bombay.

- (3) It is recommended that a "Permanent Provincial Advisory Committee for Chemical Industries" be appointed by the Government of Bombay.

From what has preceded in the previous pages wherein an extensive programme of industrialisation of the Province has been indicated, it would appear that the installation of chemical industries in the Province would necessitate a day-to-day examination of the problems and factors relative to chemical industry. The handling of such factors, problems and investigations may be profitably left to the Provincial Advisory Committee recommended above. Similar committees exist in countries where chemical industries have developed on a planned basis. The views of the present Committee regarding such a body are outlined as follows :—

(a) *Scope.*—The permanent Provincial Advisory Committee for chemical industry should have the following scope :—

- (i) To lay down the general policy of chemical industries in the light of the present report.

(ii) To plan in detail for the various chemical industries in the Province and to advise the Government that such a plan shall be implemented in the best interests of the industrial pattern of the Province.

(iii) To examine proposals and projects submitted by various industrialists to put up factories or centres of production in the Province and to advise the Government if such and such a project would work in the best interests of the industrial economy of the Province.

(iv) To co-opt from time to time technical experts subject to the approval of the Government to help the Committee in deciding the merits of the projects submitted to it by the Government.

(v) To find ways and means to establish contact between the technical and science institutions and industrialists so as to bring about efficiency and economy in chemical production throughout the Province.

(vi) To establish representation in the all-India bodies, such as the National Planning Committee, concerned with the planning of industry in the country and to coordinate the activities of the chemical industry in the Province with a view to bring about a common basis of planning for industry.

(b) *Composition of the Committee.*—Keeping in view the scope outlined above, and its importance relative to the process of industrialisation in the Province, the composition of the Committee is suggested on the following lines :—

(i) *Chairman*—An unofficial person having an extensive experience of economics and management of chemical industry of the Province.

(ii) Unofficial nominee of the Minister-in-Charge of industries from amongst the members of the Provincial Legislature.

(iii) Representative of the Bombay Province Chemical Manufacturers Association.

(iv) The Director of Industries of the Government of Bombay.

(v) A technical expert having varied experience of planning for chemical industry and erection of plants producing heavy chemicals.

(vi) Director of the Bombay University Department of Technology.

(vii) Representative of glass and ceramics industry.

(viii) A representative of Royal Institute of Science, Bombay.

(ix) *Secretary*—Industrial Chemist with the Department of Industries, Government of Bombay.

## SECTION II

### Summary of Report.

#### I. Sulphuric Acid and its Derivatives.

(i) *Raw Materials.*—Raw sulphur will have to be imported. Methods for the utilisation of indigenous pyrites and sulphur bearing ore could be developed. Bauxite and other raw materials for sulphates are available.

(ii) *Target of Production* :—

Name of the Material.		Target. Tons.
1.	Sulphuric Acid .. .. .	52,500
2.	Nitric Acid .. .. .	6,500
3.	Hydrochloric Acid .. .. .	3,000
4.	Acetic Acid .. .. .	1,925
5.	Oxalic Acid .. .. .	100
6.	Ferric Alum .. .. .	3,000
7.	Aluminium Sulphate .. .. .	5,000
8.	Potash Alum .. .. .	1,100
9.	Epsom Salts .. .. .	1,500
10.	Ferrous Sulphate .. .. .	1,500
11.	Copper Sulphate .. .. .	1,000
12.	Sodium Sulphate .. .. .	6,000
13.	Zinc Chloride .. .. .	} 1,000
14.	Zinc Sulphate .. .. .	
15.	Superphosphates .. .. .	25,000

(iii) *Organisation of the Industry*.—The industry should be organised by private capital. Government should support it by providing facilities and help whenever necessary.

(iv) *Specific Recommendations*.—The Committee recommend :—

(a) That expansion of the industry and new plants of sulphuric acid may be permitted to be installed on the most efficient and modern basis of equipment. Contact process acid plants producing 25 tons per day of sulphuric acid, should be considered economic units of production as far as new installations are concerned.

(b) That the Lead Chamber Plants in operation in the Province be scrapped and their production be substituted by contact acid manufacture, wherever economically possible.

(c) That in view of the proximity of consuming industries, places near Bombay and Ahmedabad are suitable locations for the further expansion of the industry.

(d) That the rayon and dyestuffs industries, if and when installed in the Province, should manufacture their own requirements of this acid at their sites.

(e) That the latest method of utilising gypsum for the manufacture of the acid, thus making the industry independent of imported sulphur, be adopted if economical as and when the results of the working of this process are made available by the experimental plant suggested to be put up by the Government of India.

## II. Alkali and Chlorine Products.

(i) *Raw Materials*.—Brine is the starting material for electrolytic caustic soda. The other important factor is electrical energy, as it is consumed in large quantities.

### (ii) *Target of Production* :—

Name of the Chemical.	Target. Tons.
1. Soda Ash .. .. .	41,000
2. Sodium Bicarbonate .. .. .	2,000
3. Caustic Soda .. .. .	31,000 (20,000 by electrolytic process and 11,000 by causticisation.)
4. Chlorine (liquid compressed) .. .. .	17,500
5. Bleaching Powder .. .. .	6,000
6. Calcium and Sodium Hypochlorites .. .. .	5,000 (in terms of 30 per cent. chlorine.)
7. Sodium Chlorate .. .. .	1,500
8. Potassium Chlorate .. .. .	2,000
9. Caustic Potash .. .. .	1,500
10. Potassium Carbonate .. .. .	6,500 (2,000 for Caustic Potash.)

(iii) *Organisation of the Industry*.—The industry should be allowed to be developed by private capital. Its claims to Government protection should be favourably considered.

### (iv) *Specific Recommendations* :—

(a) The Province must be made self-sufficient with regard to these chemicals.

(b) Bombay and suburbs are suitable locations for this industry in view of very favourable conditions in respect of cheap electricity, availability of salt and market.

(c) Common salt should be provided at a duty-free rate. Manufacture of salt of purity required by these industries should be encouraged.

## III. Other Heavy Chemicals.

(i) *Raw Materials*.—All the raw materials for the products in this section are available in the Province.

(ii) *Target of Production* :—

Name of Chemicals.				Target.
				Tons.
1.	Sodium Bichromate	..	..	2,000
2.	Potassium Bichromate	..	..	60
3.	Sodium Silicate	..	..	8,000
4.	Sodium Sulphide	..	..	4,000
5.	Potassium Chloride	..	..	3,000
6.	Magnesium Chloride	..	..	8,000
7.	Calcium Chloride	..	..	3,000
8.	Ammonia (Liquor)	..	..	100
9.	Ammonia Anhydrous	..	..	4,350
10.	Sodium Hydrosulphite	..	..	1,500
11.	Sodium Sulphite	..	..	150
12.	Sodium Bisulphite	..	..	600
13.	Sodium Thiosulphate	..	..	600

(iii) *Organisation of the Industry*.—To be organised by private capital.

(iv) *Specific Recommendations*.—

(a) Complete stoppage of imports of bichromates, chromates chrome products and sodium silicate is recommended.

(b) Encouragement should be given for the production of sodium sulphide from sodium sulphate.

#### IV. *Industrial Gases.*

(i) *Raw Materials*.—The gases hydrogen and oxygen can be produced by the electrolysis of water. Oxygen is also obtained as a by-product at hydrogenation-of-oil plants.

(ii) *Target of Production*.—No recommendations can be made at this stage.

(iii) *Organisation of Industry*.—By private enterprise.

(iv) *Specific Recommendations*.—Nil.

#### V. *Inorganic Fine Chemicals.*

Most of the recommendations are covered in the first four sections.

#### VI. *Organic Fine Chemicals.*

(i) *Raw Materials*.—Ethyl alcohol is mostly produced by the fermentation process and should be available in good quantities.



(ii) *Target of Production* :—

Name of Chemical.	Target.
Acetic Acid .. .. .	500 tons.
Ethyl Alcohol .. .. .	1,000,000 gallons
Methyl Alcohol .. .. .	200,000 ,,
Ether .. .. .	600,000 lbs.
Carbon Tetrachloride .. .. .	1,000 tons.

(iii) *Organisation of Industry* :—By private industrialists.(iv) *Specific Recommendations* :—

(a) Bombay, Baroda and Ahmedabad are recommended as suitable places for plants producing organic fine chemicals.

(b) Alcohol manufacture should be carried out in the vicinity of centres of molasses and mowhra flower production in the Province.

VII. *Drugs and Pharmaceuticals.*

(i) *Raw Materials*.—For liver products the raw materials are fresh liver and glands which are obtainable from the slaughter house at Bombay. As regards drugs, obtainable from vegetable sources, the Province is not favourably situated. Starting material for the production of sulphur and allied drugs would be easily available when the dyestuffs industry, recommended to be put up at Bombay, is installed.

(ii) *Target of Production* :—

Name of Drug.	Target.
Sulpha Drugs .. .. .	200,000 lbs.
Synthetic Antimalarials .. .. .	75,000 ,,
Penicilin .. .. .	250,000 million units.
Arsenicals .. .. .	25,000 lbs.
D. D. T. .. .. .	5,000 tons. (To be doubled later).
Nicotinic Acid .. .. .	15,000 lbs.

(iii) *Organisation of the Industry*.—By private capital.(iv) *Specific Recommendations* :—

(a) Modernisation of slaughter houses is considered essential for putting the liver products manufacture on a sound basis.

(b) The shark liver oil industry should be given every assistance to expand.

### VIII. *Photographic Chemicals.*

(i) *Raw Materials.*—Most of the organic and inorganic fine chemicals form the starting materials for the manufacture of this group of chemicals.

(ii) *Target of Planned Production.*—The targets of important chemicals used for photography are given in chapter on fine chemicals.

(iii) *Organisation of the Industry.*—By private capital.

(iv) *Recommendations.*—A nucleus for the production of these chemicals already exists in Bombay. This factory should be encouraged to manufacture all the chemicals required for use in the Province.

### IX. *Textile Chemicals.*

(i) *Raw Materials.*—Most of the heavy inorganic chemicals are already discussed in a previous section. Starch is generally processed from maize obtainable in the Province.

(ii) *Target of Planned Production.*—No specific targets are fixed.

(iii) *Organisation of Industry.*—By private capital.

(iv) *Specific Recommendations :—*

(a) Cultivation of maize from best quality seed should be undertaken and encouraged by the Department of Agriculture for the manufacture of starch, to enable the industry to compete with imported products.

(b) Extensive research should be undertaken to develop other sources of starting materials for the production of starch.

### X. *Coal Gas and Coal Tar Products.*

(i) *Raw Materials.*—Coal which forms the starting material for all the products is imported in the Province from other Provinces.

(ii) *Target of Production :—*

Name of Product	Target.
Coal Gas .. ..	5,200 million c.ft.
Gas Coke .. ..	160,000 tons.
Coal Tar .. ..	14,000 ,,
Distillate Oils .. ..	500 ,,

(iii) *Organisation of the Industry.*—Public Limited Companies.

(iv) *Specific Recommendations.*—Bombay, Ahmedabad, Surat, Poona and Sholapur are suggested as suitable sites for location of coal gas plants in view of their consuming capacities.

### XI. *Destructive Distillation of Wood.*

(i) *Raw Materials.*—Hardwood, which is available from the forests of the Province.

(ii) *Target of Production.*—In the initial stages a factory distilling 100 to 150 tons per day is suggested to be installed.

(iii) *Organisation of the Industry.*—By private capital, subject to Government supervision as regards the conservation of forests.

(iv) *Specific Recommendations.*—Two possible locations are indicated for this industry, one which can be supplied by wood from forests of N. Kanara ; the other near Billimora in Gujarat.

### XII. Dyestuffs Industry.

(i) *Raw Materials.*—A number of inorganic chemicals is required in the manufacture of this industry. Many of these with the exception of sulphur would be available in the Province when the suggested programme of development of chemical industry comes into operation. Of the necessary organic chemicals methyl alcohol, acetic acid, benzene and some of their derivatives would be available in the Province. The rest of the organic chemicals would have to be imported from outside.

(ii) *Target of Production.*—The immediate target is fixed at 6,500 tons of dyestuffs to be produced annually.

(iii) *Organisation of the Industry.*—By private capital, subject to necessary supervision in respect of quality.

(iv) *Specific Recommendations.*—Bombay is suggested as a suitable site for this industry.

### XIII. Petroleum Refining Industry.

(i) *Raw Materials.*—The crude oil to be refined can be obtained from countries along side the West coast of India such as Persia, Bahrein, etc.

(ii) *Target of Production.*—About  $\frac{1}{2}$  million tons of crude oil might be distilled annually in the beginning.

(iii) *Organisation of the Industry.*—By private capital.

(iv) *Specific Recommendations.*—Nil.

### XIV. Glass Industry.

(i) *Raw Materials.*—Of the necessary raw materials, lime is available in plenty in the Province and soda ash is marketed through imported agencies. Silica of the requisite quality not being available has to be imported from the U.P. or Nizam's Dominions.

(ii) *Target of Production.*—The target indicated for sheet glass plant is 6,000 tons per year.

(iii) *Organisation of the Industry.*—The industry should be organised by private enterprise and the Government should provide necessary facilities to transport and import machinery.

(iv) *Specific Recommendations* :—

(a) The Committee recommend that the production of bangles should be increased so as to make the Province self-sufficient.

(b) Soda ash should be permitted to be transported to Bombay by sea-route from the inland centres of production.

(c) The Committee recommend that a factory handling about 20 tons of sheet glass per day should be put up in the Province to meet the demands of the tremendous building activity. Bombay is considered a suitable location for the proposed factory.

XV. *Potteries, Ceramics, and Refractories Industry.*

(i) *Raw Materials*.—From the information that is available there is an abundance in the Province of various kinds of raw materials used in pottery.

(ii) *Target of Production*.—Kindly refer to paras. 111—P. 67 and 113—P. 68.

(iii) *Organisation of the Industry*.—By private capital.

(iv) *Specific Recommendations* :—

(a) Geological survey of raw materials.

(b) Cheap power supply.

(c) Cheap transport for raw materials.

(d) Establishment of a Central Research Centre.

XVI. *Cement and Cement Products.*

(i) *Raw Materials*.—Lime stone and clay are available in some places in the Province while gypsum will have to be imported from neighbouring Provinces.

(ii) *Target of Production*.—Portland Cement—560,000 tons.

(iii) *Organisation of the Industry*.—By sound financial concern.

(iv) *Specific Recommendations*.—Nil.

XVII. *Inedible Oils.*

(i) *Raw Materials*.—Some of the inedible oilseeds are available in plenty.

(ii) *Target of Production*.—Nil.

(iii) *Organisation of the Industry*.—By private capital.

(iv) *Specific Recommendations* :—

(a) Modern processes on which new industries can be started should be encouraged to be undertaken in the existing factories.

(b) The Government should put up a pilot plant laboratory to keep the industry informed of the latest methods in oil technology.

## XVIII. Soap Industry.

(i) *Raw Materials*.—Most of the raw materials excepting oil were up to now imported in the Province.

(ii) *Target of Production* :—

	Initial Stages	Later stages
	Tons.	Tons.
(a) Toilet soap ..	10,000	15,000
(b) Laundry soap ..	50,000	80,000

(iii) *Organisation of the Industry*.—The existing factories are sufficiently well organised to undertake expansion in production.

(iv) *Specific Recommendations*.—Nil.

## XIX. Paints and Varnishes.

(i) *Raw Materials*.—The requirements of this industry are so varied that it would be difficult to give a list of the raw materials required.

(ii) *Target of Production*.—The expansion of the following types of paints and pigments is justified in view of the possibilities of increased consumption :—

(a) White pigment.

(b) Chrome pigment.

(c) Pigment colours.

(d) Distempers.

(e) Nitro-cellulose paints.

(iii) *Organisation of the Industry*.—By private capital.

(iv) *Specific Recommendations*.—Nil.

## XX. Aluminium Industry.

(i) *Raw Materials*.—Bauxite is the starting material for the production of aluminium. Electrical energy is used in such a big quantity that it can be classified as a necessary raw material. Cryolite will have to be imported from abroad.

(ii) *Target of Production*.—3,000 tons per year.

(iii) *Organisation of the Industry*.—By private enterprise.

(iv) *Specific Recommendations* :—

(a) The Committee are of the opinion that a site near Kalyan affords great facilities for putting up a factory producing metallic aluminium.

(b) The Committee recommend that the Government of Bombay should provide for 10,000 kw. electrical power at 0.10 to 0.15 as. per kw.

*XXI. Minor Electro-Chemicals.*

(i) *Raw Materials.*—The raw materials for hydrogen peroxide are a solution of diluted sulphuric acid. Electrical energy plays an important part in the process.

(ii) *Target of Production.*—500 tons of hydrogen peroxide per year.

(iii) *Organisation of the Industry.*—By private capital.

(iv) *Specific Recommendations.*—The hydrogen peroxide plants should be put up side by side with other electro chemical industries.

*XXII. Plastics Industry.*

(i) *Raw Materials.*—Of the natural plastics, casein is manufactured in the Province by the acid process. Phenol and formaldehyde which form the basic materials for other types of plastics are imported from abroad.

(ii) *Target of Production :—*

	Tons.
(a) Phenol formaldehyde .. .. .	1,500
(b) Amino formaldehyde .. .. .	600
(c) Cellulose acetate .. .. .	300
(d) Cellulose nitrate .. .. .	300
(e) Casein—No definite target can be given.	

(iii) *Organisation of the Industry.*—By private capital.

(iv) *Specific Recommendations :—*

(a) Facilities for the imports of machinery should be made available to the industries.

(b) Protection should be granted to the moulding powder manufacture by restricting imports or by introduction of Tariff duties.

**CONCLUSION.**

In submitting the Report of the Chemical Industries Sub-Committee as embodied in the foregoing pages, the Committee hope that in the interest of the Chemical Industries of the Province, the Government would please implement the most important suggestions made herein. Special attention is drawn to the general recommendations included in the last chapter. The Committee are convinced that the chemical industries and industries dependent upon the application of chemical science hold out a bright future in this Province. In preparing this report, the Committee have kept this conviction before them.

Bombay, dated the 27th August 1946.

C. S. PATEL,  
Chairman.

MATA PRASAD  
L. A. BHATT  
C. P. SHAH  
M. R. MANDLEKAR } Members.

R. K. TRIVEDI,  
Secretary.

Bombay, 27th August 1946.

## APPENDIX A.

*Summarised Supplementary Questionnaire Prepared by the Sub-Committee.*

Name of Factory:—

Name of Chemicals (Products)	Production (in Cwts.)		Estimated production in 1946-47	Cost per unit of production			Analysis of market consumption*
	In 1939	In 1943		1939	1943	1946 (estimate)	

\*Please enter it as (1) Good, (2) Fair or (3) None.

**APPENDIX B.**

*Information Card for Individual Product.*

Remarks on reverse

Name of Factory	Production (in Tons)			Consumption (in Tons)			Analysis of consumption		
	1939	1944	Estimated annual average during 1945-50	1939	1944	Estimated annual average during 1945-50	Consuming Industries	Quantity in tons.	% of Total
							Total ..		100
<b>Total</b>									



REMARKS

(1) The present location of existing factories:—

(2) Ideal location suitable for the Province:—

(3) Cost per unit of production:—

(a) In 1939

(b) Average of 1939-44

(c) Estimated average for 1945-4

(4) Target of production:—

(5) Recommendations:—

## APPENDIX C.

*List of Factories which answered the questionnaire.*

## I. HEAVY CHEMICALS

1. The Dharamsi Morarji Chemical Company, Limited, Ambernath.
2. The Eastern Chemical Company (India).
3. The Golden Chemicals Ltd., Jogeshwari.
4. Haldyn Chemicals, Bombay.
5. Hindustan Colour Chemicals and Manufacturing Co., Ltd., Katlwada.
6. The Indian Oxygen and Acetylene Co., Ltd., Bombay.
7. The Indian Chemicals Company.
8. The Indenters' Syndicate.
9. The Indo African Dyeing Works, Bombay.
10. International Chemical Company, Bombay.
11. Kaloid Chemicals Co., Bombay.
12. The Kesar Sugar Works, Ltd., Goregaon.
13. The Mayurdhwaj Magnesia Works, Ltd.
14. Metachem Limited, Bombay.
15. Mira Chemical Works, Bombay.
16. The Morvi Chemical & Metallurgical Works, Ltd., Morvi, Kathiawar.
17. Nanavati Oil & Chemical Industries, Ltd., Bombay.
18. National Industries Company, Bombay.
19. The Premier Chromate & Chemical Works, Ltd.
20. The Pioneer Chromate Works, Ltd., Bombay.
21. The Pioneer Magnesia Works, Ltd., Bombay.
22. The Phoenix Chemical Works, Bombay.
23. Ramco Chemical Works, Ahmedabad.
24. Messrs. Star Chemicals, Bombay.
25. Sonawalla Industries, Ltd., Bombay.

## II. FINE CHEMICALS

1. The Anil Starch Products Ltd., Ahmedabad.
2. Ar-Ex Laboratories, Bombay.

APPENDIX C—*contd.*

3. Arcies Laboratories, Ltd., Bombay.
4. Bengal Chemical & Pharmaceutical Works, Ltd., Bombay.
5. Bombay-Sewree Chemicals Manufacturing Co., Bombay.
6. Geoffrey Manners & Co., Ltd., Bombay.
7. Cleemo-Pharma Laboratories, Limited, Bombay.
8. Ahura Chemical Products, Bombay.
9. The Kitamal Chemical Industries, Ltd., Bombay.
10. Messrs. Maneklal Auxiliary Products, Bombay.
11. Star Paint & Oil Industries, Bombay.
12. Sirdesai Brothers, Ltd., Bilimora.
13. Shri Dhootpapeshwar, Panvel, Ltd., Panvel.
14. Standard Chemical & Pharmaceutical Co., Bombay.
15. Syntetic (India), Ltd., Bombay.
16. Teddington Chemical Factory, Ltd., Bombay.
17. Unichem Laboratories, Bombay.
18. The Zandu Pharmaceutical Works, Ltd., Bombay.

## III. COAL CARBONISATION AND COAL PRODUCTS

1. The Bombay Gas Company, Ltd., Bombay.
2. Poona Coal Briquette Factory, Poona.

## IV. MISCELLANEOUS PRODUCTS

1. Bake-O-Brass, Ltd., Bombay.
2. The Bestolite Moulding Co. of India, Ltd., Andheri.
3. The Chemical Moulding Manufacturing Co., Ltd., Bombay.
4. Hindustan Plastics Industries.
5. The Ford Ink, Co., Bombay.
6. J. W. F. Chemical Works, Ghatkopar.
7. Iwacom, Limited & Art Bangles, Ltd.
8. L. K. Plastics.
9. The National Gramophone Record Manufacturing Co., Ltd.
10. The National Mantle Manufacturing Co., Bombay.

APPENDIX C—*contd.*

11. Narbudda Valley Chemical Industries, Rajpiple.
12. The Panchal Steel & Bakelite Industries, Ltd.
13. Rubako Industries.
14. Star Bakelite Manufacturing Co.
15. Sanghavi & Co., Bombay.
16. Shree Krishna Industrial Works, Bombay.
17. The Standard Products Manufacturing Co., Kurla.

## V. GLASS, CERAMICS, BRICKS &amp; REFRACTORIES

1. The All-India Bottle Supplying Co.
2. Acme Tiles Factory.
3. Agarwal Glass Works, Bombay.
4. All-India Glass Works, Kurla.
5. Bombay Potteries & Tiles, Ltd., Bombay.
6. Bombay Glass Works, Ltd., Bombay.
7. Messrs. Bharat Tiles & Marbles, Ltd.
8. Balbhim Keshav Chawan's Brick Kiln, Poona.
9. The Crystal Glass Works, Panchmahals.
10. Forward Engineering Co., Bombay.
11. Kajgar Co-operative Industrial Association, Ltd., Belgam.
12. The Mahalakshmi Glass Works, Ltd., Bombay.
13. Mahadeo Genuji Shinde, Brick Kiln, Poona.
14. The Modern Tiles Co., Bombay.
15. Messrs. Nowroji N. Vakil & Co., Ahmedabad.
16. Ogale Glass Works, Ltd., Satara.
17. Patel Tiles Company, Bombay.
18. Paisa Fund Glass Works, Talegaon.
19. Paisa Fund Pottery Works, Talegaon.
20. R. R. Shirke's Brick Kiln, Poona.
21. The United Glass Works, Andheri.
22. Vijay Glass Works, Bombay.

APPENDIX C—*concl'd.*

## VI. SOAPS AND OILS

1. Bombay Soap Factory, Bombay.
2. Balloon Soap Factory.
3. The Bassein Paint & Varnish Co., Bombay.
4. Goodlass Wall Limited, Bombay.
5. Godrej Oil & Soap Company, Bombay.
6. Godrej Soaps Ltd., Bombay.
7. Gujarat Oil Mills & Manufacturing Co., Ltd., Ahmedabad.
8. Hardcastle, Waud & Co., Ltd., Bombay.
9. Holmes & Co., Ltd., Bombay.
10. Indian Vegetable Products Ltd., Bombay.
11. The Jagdish Industries Ltd., Porbunder.
12. Kamala Soap & Chemical Works, Bombay.
13. Ralli Brothers Ltd., Oil Mills.
14. The Swastik Oil Mills Ltd., Bombay.
15. Messrs. Star Paint & Oil Industries.
16. The Satara Oil Mills, Satara.
17. The Saturn Refinery, Surat.
18. Shree Krishna Oil Mill Co., Ahmedabad.
19. The Tata Oil Mills Company, Ltd., Bombay.
20. Thakorlal Bhailalbhaj & Co., Oil Mill, West Khandesh.
21. Zenith Varnish Works, Bombay.

## APPENDIX D.

*Statement showing the quantity and value of imports of chemicals into the Province of Bombay from foreign countries.*

Name of chemical	Quantity (in cwts.)		Value (in Rupees)	
	1943-44	1944-45	1943-44	1944-45
<b>1. Acids—</b>				
(a) Acetic (pyroligneous) .. .. .	8,489	11,902	732,599	867,162
(b) Carbolic .. .. .	1,069	2,580	109,837	250,720
(c) Citric .. .. .	1,040	1,647	153,375	237,702
(d) Hydrochloric .. .. .	....	25	138	2,324
(e) Nitric .. .. .	....	8	....	1,323
(f) Oxalic .. .. .	257	348	22,086	21,896
(g) Sulphuric .. .. .	....	23	....	11,092
(h) Tartaric .. .. .	553	464	168,161	120,010
(i) Othersorts .. .. .	9,383	13,487	766,468	1,084,336
<b>2. Alum .. .. .</b>	<b>2,450</b>	<b>3,385</b>	<b>45,706</b>	<b>46,415</b>
<b>3. Aluminous sulphate .. .. .</b>	<b>8,516</b>	<b>35,646</b>	<b>60,690</b>	<b>257,944</b>
<b>4. Ammonia and the salts thereof—</b>				
(a) Anhydrous ammonia .. .. .	....	29	....	4,965
(b) Carbonate and bicarbonate of ammonia.	2,679	10,058	112,946	397,510
(c) Muriate of ammonia .. .. .	6,359	13,544	175,924	313,212
(d) Others .. .. .	4,342	3,075	435,543	....
<b>5. Arsenic and its oxides .. .. .</b>	<b>18</b>	<b>240</b>	<b>3,055</b>	<b>....</b>
<b>6. Bleaching materials—</b>				
(a) Bleaching powder, Cal. hypochlorate chloride of lime.	49,996	47,302	439,163	....
(b) Other sorts .. .. .	....	....	....	....
<b>7. Calcium compounds—</b>				
(a) Calcium carbide .. .. .	3,050	31,113	58,629	....
(b) Calcium chloride .. .. .	208	103	13,365	....

APPENDIX D—*contd.*

Name of chemical	Quantity (in cwts.)		Value (in Rupees)	
	1943-44	1944-45	1943-44	1944-45
8. Chlorine, liquid .. .. .	....	....	....	....
9. Copperas (ferrous sulphate)— ..	31	29	2,444	2,234
10. Copper sulphate .. .. .	10,353	11,612	532,330	480,841
11. Disinfectants—				
(a) Naphthalene .. .. .	398	2,808	24,518	148,083
(b) Others .. .. .	5,122	10,349	281,970	475,520
12. Glycerine .. .. .	5	22	643	2,481
13. Lead compounds—				
(a) Acetate .. .. .	124	2,243	5,336	92,018
(b) Litharge .. .. .	55	....	2,002	7
(c) Others .. .. .	13	223	1,829	12,087
14. Magnesium compounds—				
(a) Chloride .. .. .	2	2	162	184
(b) Sulphate .. .. .	263	247	13,518	10,508
(c) Others .. .. .	2,748	4,514	83,101	177,442
15. Phosphorous all kinds .. .. .	953	615	184,455	98,074
16. Potassium compounds—				
Bromate .. .. .	....	....	....	....
Sulphate .. .. .	81	200	11,870	18,811
Oxide of potassium .. .. .	336	327	37,219	33,750
Other sorts .. .. .	4,319	3,767	1,130,718	837,530
Compounds—				
Carbonate .. .. .	36,795	28,527	363,124	298,081
Sulphate .. .. .	19,936	23,254	551,535	728,944
Bicarbonate .. .. .	402,583	640,085	2,873,061	5,446,764
Oxide .. .. .	472	560	26,991	32,958
Other .. .. .	401,190	308,846	6,156,292	4,912,508

## APPENDIX E.

*Statement showing the existing and Estimated Production of Vegetable Ghee in the Province of Bombay including adjacent States.*

	No. of Factories		Total of (1) & (2)	Production Capacity (in tons)		Total of (3) & (4)
	(1) Bombay Province	(2) Adjacent States		(3) Bombay Province	(4) Adjacent States	
(i) In Production ..	7	2	9	92,650	12,000	104,650
(ii) Under Construction ..	..	1	1	..	6,000	6,000
(iii) Being assisted under Expansion Scheme.	2	4	6	10,500	19,000	30,000
Total ..	9	7	16	1,03,150	37,500	140,650

Existing All-India Production = 128,200 tons.