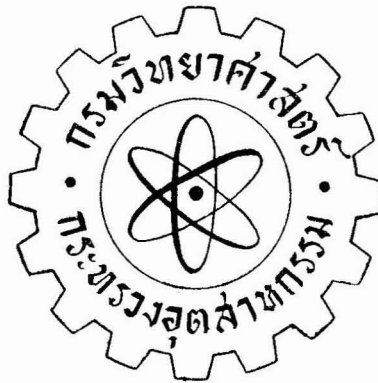


MINISTRY OF INDUSTRY

BANGKOK, THAILAND



DEPARTMENT OF SCIENCE

14th REPORT

From 1947 to 1948

INTRODUCTION

This is the Fourteenth Report of the Department of Science covering the work performed during the years 1947 and 1948. Since I took over this office, four overdue reports Nos. 10 to 13 have been issued. The Fifteenth Report covering the work performed in 1949 and 1950 is expected to be published in 1951.

The Report is intended to make public results of scientific investigations and routine work of the Department and also to show the progress made by the Department in its aim to help develop the country scientifically.

Only certain of the more interesting results are included; however those interested in other aspects or topics not published in the Report, may submit enquiries to the Department which will try its best to give satisfaction.

Dr. Charng Ratanarat

Director-General

Department of Science
Ministry of Industry
December 1950.

STAFF

1948

Director-General

Dr. Charng Ratanarat, Dr. phil. nat.
(magna cum laude)

OFFICE OF THE SECRETARY OF THE DEPARTMENT

Secretary

Singto Ratanakasikara

Correspondence Section

Head of Section

Ong Thadasih

Assistant

Tatiya Laelertpol

Assistant

Swasdi Komalapelin

Assistant

Rambhai Suvakara

Library Section

Librarian

Miss Proesiri Bhekanandhana, B.A.

Assistant

Mrs. Ora-Aree Sriamphai, Dip.
Chem.

Accounts Section

Head of Section

Siri Chuvidhya, B.S.C.

Assistant

Mani Nutaman

Assistant

Aree Lohajala

Stores Section

Head of Section

Siri Suvanpathma

Assistant Chemist

Miss Sumalee Namankalakul, B.Sc.

Assistant Chemist

Mrs. Subanne Buacharoon, Dip.
Chem.

SCHOOL OF PRACTICAL CHEMISTRY

Director

Dr. Charng Ratanarat, Dr. phil. nat.
(magna cum laude)

Assistant Director

Pue Rochanapuranda,
B.S. (Chem.), Dip. Ind. Chem.

Senior Chemist
Assistant Chemist
Assistant Chemist

Sangar Sharasuvarna, C.D.A. (Hons.)
 Mrs. Pathum Therawatana, B.Sc.
 Miss Kamolawan Krishnachuda,
 Dip. Chem.

DIVISION OF CHEMISTRY

Senior Chemist

Luang Vichien Dhatukarn, L.ès Sc.,
 I.C.

Forensic Chemistry Section

Chemist
Chemist
Assistant Chemist

Prem Banijpol, B.Sc.
 Bumpen Savavasu, B.Sc.
 Kchit Sankhavasi, Dip. Chem.

Metallurgy Section

Chemist
Assistant Chemist
Assistant Chemist

Vongse Naewbanij, A.A.
 Sompule Suyasinto, Dip. Chem.
 Lert Sahassananda, Dip. Chem.

Opium Dross Control Section

Chemist
Assistant Chemist

Assistant Chemist
Assistant Chemist

Surin Milindalekha, Dip. Pharm.
 Miss Rungtavan Bunnag, B.S.
 (Pharm.)
 Chamnong Pugglanandana
 Chinda Bunyamit, Dip. Chem.

Water Analysis Section

Chemist

Assistant Chemist
Assistant Chemist

Pravat Isarankura Na Ayudhya,
 Dip. Ed.
 Miss Sam-Ang Singhadeja, B.Sc.
 Mrs. Tiraporn Vongsratana, Dip.
 Chem.

Fuel Section

Chemist
Assistant Chemist

Banbota Sudhikam, B.S. (Chem.)
 Chong Bunnag

General Analysis Section

<i>Chemist</i>	Miss Priya Chandravekin, B.Sc.
<i>Assistant Chemist</i>	Chalad Virayodhin
<i>Assistant Chemist</i>	Charungchantana Phalajivin, B.Sc. (Pharm.)
<i>Assistant Chemist</i>	Sangob Bunyakiatti, B.S. (Pharm.)
<i>Assistant Chemist</i>	Tekaryu Jinanavin, Dip. Chem.

DIVISION OF INDUSTRIAL CHEMISTRY

<i>Senior Chemist</i>	Yos Bunnag, B.Sc., M.Sc., A.R.C.S., D.I.C.
<i>Chemist</i>	Mrs. Anu Osathanonda, B.S. (Bot.)
<i>Chemist</i>	Mrs. Snith Subsaeng, B.Sc.
<i>Assistant Chemist</i>	Boonyiam Meesuk, B.A. (1st. class Hons.), M.A., Dip. Chem. Eng.
<i>Assistant Chemist</i>	Riddhi Subhanka, B.Sc., B. Chem. Eng., M.S. (Chem. Eng.)
<i>Assistant Chemist</i>	Mrs. Vilai Devakul
<i>Assistant Chemist</i>	Miss Soodchai Dharmacharoen

Ceramics Section

<i>Chemist</i>	Manoon Prachankadee, Sc.B. Chem.
<i>Chemist</i>	Mrs. Bunlom Tevayananda, B.Sc.

Food Section

<i>Chemist</i>	Mrs. Phannipa Paenpatana, B.Sc.
<i>Chemist</i>	M.L. Anong Nila-Ubol, B.Sc.
<i>Assistant Chemist</i>	Miss Ratsamiepen Siribaed Bi- suddhi, B.S.E.
<i>Assistant Chemist</i>	Mrs. Virada Thisyamondala
<i>Assistant Chemist</i>	Puan Proysuwana, Dip. Chem.
<i>Assistant Chemist</i>	Nimit Verabandha, Dip. Chem.

Alcohol and Alcoholic Beverages Section

<i>Assistant Chemist</i>	Miss Viengvibha Kanakakara, B.Sc.
<i>Assistant Chemist</i>	Narong Eum-Udom, Dip. Chem.
<i>Assistant Chemist</i>	Chamras Sukrangsarn, Dip. Chem.

Ores and Rocks Section

<i>Chemist</i>	Mrs. Sakuntala Bhodhiprasat, B.Sc.
<i>Assistant Chemist</i>	Miss Viyada Bunyaryun, B.Sc.
<i>Assistant Chemist</i>	Klow Dejdamong, Dip. Chem.
<i>Assistant Chemist</i>	Miss Poonsab Paulpuntin, Dip. Chem.
<i>Assistant Chemist</i>	Udom Sookkham, Dip. Chem.

DIVISION OF INDUSTRIAL RESEARCH

<i>Senior Chemist</i>	Nara Boon-Long, B.Sc., M.Sc.
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Physics Section

<i>Assistant Chemist</i>	Lau Lauhabandhu, Dip. Ed.
<i>Assistant Chemist</i>	Miss Suradee Bupavesa, B.Sc.

Testing Strength of Materials Section

<i>Assistant</i>	Vacant
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Workshop Section

<i>Chemist</i>	Parl Na Pombejra, B.Sc.
<i>Assistant Chemist</i>	Vichira Sakoramunkala, Dip. Chem.
<i>Assistant Chemist</i>	Yotaka Hinsheranandana, Dip. Chem.

Investigation of Industrial Processes Section

<i>Chemist</i>	Mrs. Rabieb Prachankadee, B.Sc., M.Sc.
<i>Chemist</i>	Choo-Sakr Vijierajote, Dip. Ed.. B.S. (Ind. Chem.)
<i>Chemist</i>	Mrs. Nidnoi Sucharitakul, B. Sc.
<i>Assistant Chemist</i>	Amara Prachankadee
<i>Assistant Chemist</i>	Sasi Boonyamanop, B.Sc.
<i>Assistant Chemist</i>	Miss Supis Dabbhavimala, B.Sc., Dip. Ed.
<i>Assistant Chemist</i>	Miss Chirada Chunanonda, Dip. Chem.

STAFF CHANGES AND MOVEMENTS

Appointments

1. Riddhi Subhanka, B.Sc., B. Chem. Eng., M.S. (Chem. Eng.)
May 19, 1947
Assistant Chemist
Division of Industrial Chemistry
2. Boonyiam Meesuk, M.S. (1st. Class Hons.), M.A., Dip. Chem. Eng.
November 24, 1947
Assistant Chemist
Division of Industrial Chemistry
3. Miss Sumalee Namankalakul, B.Sc.
October 4, 1948
Assistant Chemist
Stores Section
Office of the Secretary of the Department
4. Miss Supis Dabbhavimala, B.Sc., Dip. Ed.
October 1, 1948
Investigation of Industrial Processes
Section
Division of Industrial Research

Death

Samroeng Vimuktanandana, B.S. (Chem.)
March 2, 1948
Chemist
Water Analysis Section
Division of Chemistry

Officials who went to study abroad

Parl Na Pombejra, B.Sc. May 26, 1947
Chemist
Workshop Section
Division of Industrial Research
went to study at his own expenses
on the Technology of distillation at
Joseph E. Seagram & Son Inc. and
Chemical Engineering at Wisconsin
University, U.S.A.; approval by the
Civil Commission.

Special Duties

1. **Dr. Charng Ratanarat**

Chairman of the Committee for the Examination of Industrial Trainees, Tobacco Factory.
 Chairman of the Committee for Improvement of the Thai Paper Factory, Kanchanaburi.
2. **Yos Bunnag**

Member and Representative of the Department to review the Public Health Regulations in accordance with the Food Act of 1941.
 Member of the Committee for Investigation and Improvement of Alcoholic Liquor Production Methods, Bangyeekhan Distillery.
 Member of the Committee for Investigation of the Department Personnel and to review the Department Regulations.
 Member of the Committee for the Improvement of the Thai Rubber Factory.
 Special Lecturer at the Faculty of Pharmacy, University of Medical Science.
3. **Pue Rochanapurananda**

Member and Secretary of the Committee for Investigation of the Department Personnel and to review the Department Regulations.
 Member and representative of the Department of the Infested Rice Export Committee.
 Member and Secretary of the Committee for the Examination of Industrial Trainees, Tobacco Factory.
 Member of the Committee for Improvement of the Thai Paper Factory, Kanchanaburi.
 Science Lecturer at Mahamongkut-Rajavithayalai, Educational Institute.
 Editor of the Industrial Magazine.
 Editor of the Thai Science Bulletin.

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|----|-----------------------|---|
| 4. | Manoon Prachankadee | Special Lecturer in Ceramics in the Chemical Engineering Course, Faculty of Engineering, Chulalongkorn University. |
| 5. | Boonyiam Meesuk | Member of the Committee for Improvement of the Thai Paper Factory, Kanchanaburi. |
| 6. | Riddhi Subhanka | Member of the Committee for Investigation and Improvement of Alcoholic Liquor Production Methods, Bangyeekhan Distillery. |
| 7. | Choo-Sakr Vijierajote | Special Lecturer in Tanning in Chemical Engineering Course, Faculty of Engineering, Chulalongkorn University.
Lecturer in Animals Hides and Leather at the Military Quarter-Master School. |
| 8. | Chinda Bunyamit | Was loaned to the Government Purchasing Bureau until September 9, 1948. |

Official Tours in the Country

- | | | |
|----|--|---|
| 1. | Manoon Prachankadee | made a survey of raw materials for ceramics industry in Nakorn Naryok and Prachinburi during December 1-6, 1947. |
| 2. | Manoon Prachankadee
Vongse Naewbanij
Tekaryu Jinanavin
Sompule Suyasinto
Kchit Sankavasi
Nimit Verabandha | made a survey of raw materials for the ceramics industry and localities of springs in Lampang, Chiengrai, Chiengmai, Lamphun, Maehongson, Prae, Nan, during March 31-May 19, 1948. |
| 3. | Vongse Naewbanij | accompanied the Director-General of Mines Department for special duty on Metals and Ores to the Southern provinces during March 13-23, 1947. |
| 4. | Klow Dejdamong | made a survey of the Mayow Oil sources with Captain Prayura Phinsawaddi R.N. representative of the Royal Navy, in Prae, Lampang, Chiengrai, Lamphun and Chiengmai during April 27-May 14, 1947. |

GENERAL REVIEW

At present, the work of the Department can be divided into three general functions, namely :

- (1) routine analysis of samples of goods submitted by other Governmental agencies and the public,
- (2) promotion and improvement of national industrial works both privately owned and government owned, and
- (3) study and research in scientific fields, concerning raw materials and chemical processes.

In the first category, the amount of work achieved depended solely on the volume of samples submitted by various agencies, and this increased greatly as the country progressed industrially. In the promotion and improvement of industrial plants, the Department gave technical assistance and advice to various companies with good results and also set up a separate service for certification of locally manufactured products to encourage the public to use good locally made products. Regarding research on chemical processes, not much has been done, work in this field being largely hindered by lack of space and insufficient appropriations to carry on such work. However at the present stage, a broad study of the raw materials available within the country has been made and when we move to our new site at Phya Thai we hope that this work will be continued.

The number of samples submitted during this period totalled 5,860, being 2,464 in 1947 and 2,896 in 1948, showing an increase of about 1000 samples over the last period.

The Library made a good start in recovering from the effects of the War. The numbers of books received have increased greatly, chiefly through the aid and kindness of the Rockefeller Foundation via the United States Information Service, and the American Book Center for War Devastated Libraries Inc. via the Ministry of Education. The number of readers who took advantage of the Library also increased markedly.

In 1947 there were 17 graduates, and in 1948, 13 graduates from the school of Practical Chemistry. The School will admit a new group of students in 1949.

The majority of the work in the Division of Chemistry was of routine nature. During this period the Opium Dross Section devised a method of testing by which the Government's opium could be distinguished from other opium. Some of the work in the Forensic Chemistry Section was transferred to the Division of Pharmacy, Medical Science Department, in accordance with the agreement made between the Ministry of Industry and the Ministry of Public Health. The analysis of blood stains and semen stains and the examination of fire-arms and documents still remained with the Section, while the analysis of medicine and medicinal plants was transferred. The fuel Section determined the calorific values of 22 samples of wood.

In the Division of Industrial Chemistry, the Ceramics Section made an extensive analysis of raw materials used in ceramics such as kaolin, sand, quartz, limestone, dolomite, felspar, and soapstone. The Food Section carried out studies on the preservation of rice from bugs, a quick process in the preparation of fish sauce, and the preservation of fruits. The Alcoholic Beverage Section made a study on fermentation and analysed samples of whiskey made locally.

In the Division of Industrial Research, several interesting topics were investigated such as the hydrogenation of oils, the preparation of glue for affixing excise stamps on cellophane, the determination of Vitamin C in various fruits, the preparation of barium sulphate or use in hospitals and the preparation of ammonia solution for use in the Department.

Furthermore, the Department helped train many other officials from various department, in different branches of practical science, and also during this period showed many visitors around the Department.

THE LIBRARY

During this period the Library possessed books and publications as listed below :

Items	No. of Volumes	No. of Volumes
	1947	1948
1. Scientific books	2709	2820
2. Scientific publications	2500	2679
3. Scientific journals (bound volumes)	871	1044
4. Scientific journals (unbound volumes)	3205	2679
5. Scientific journals (newly received)	51	40

In addition to journals procured by direct subscription, many other journals were donated by various foreign organizations : in 1947, 283 journals by the Rockefeller Foundation through the U.S. Information service, and 66 journals by the U.S. Government through the Ministry of Education ; in 1948, 1 journal by the French Legation, and 609 journals by the American Book Center for War Devastated Libraries Inc. , through the Ministry of Education.

The Department published several publications for general distribution during this period namely : the Thai Science Bulletin, Department Report nos. 10, 11 and 12, and a pamphlet on "Lac". Regarding the Thai Science Bulletin, 193 copies were sent to various organizations in Europe, America, Australia and Asia, and 180 copies were distributed locally; altogether a total of 373 copies was circulated.

The Library appropriation for the year 1947 was 12,000 baht and for the year 1948, 11,500 baht. These were rather small sums from which after the subscriptions for the journals were paid, only a few new books could be purchased.

Persons not attached to the Department who made use of the Library during this period, totalled 676 persons, They were from the following various governmental and non-governmental organizations :

Faculty of Pharmacy, University of Medical Sciences,
 Division of Pharmacy, Department of Medical Sciences,
 Department of Industrial Promotion,
 Department of Agriculture,
 University of Agriculture,
 Department of Royal Highways,
 Department of Fishery,
 Government Distillery,
 Department of Public Health,
 Pharmaceutical Factory,
 Naval General Laboratory,
 Faculty of Veterinary, University of Medical Sciences,
 Thai Naval Signal Section
 Military Supplies Department,
 Department of Finance,

Military Arsenal Department,

Naval Docks Department,

San Saduag Co., Ltd.,

Thuai Thong Co., Ltd.,

Assia Co., Ltd.

The number of books loaned out during this period totalled 2,959 volumes.

THE CERTIFICATION OF LOCALLY MANUFACTURED PRODUCTS

During 1947-1948, 48 kinds of merchandise were sent in for approval, only 37 kinds were accepted for certification. The merchandise approved during 1947-1948 is shown below :

1947				1948			
Merchandise	Kinds	Certified	Not certified	Merchandise	Kinds	Certified	Not certified
Cosmetics	16	13	3	Cosmetics	12	12	-
Food	1	-	1	Food	8	6	2
Distilled Water	2	2	-	Distilled Water	2	1	1
Soap	3	3	3	Soap	1	1	-
				Liquid Rubber Cement	1	1	-
				Mosquito Incense	1	1	-
				Disinfectant	1	-	1

Of the merchandise approved, 22 kinds were sent in by alien companies and 15 kinds by Thai companies. From the preceding statistics, it was evident that the number of companies interested in sending their products for approval was far too few, and most of the products submitted were not essential items for everyday life.

Merchandise approved in 1947

1. Malisod Hair Curlset
2. Orchid Hair Curlset
3. Lavender Cream
4. Macherry Cream
5. Orchid Powder
6. Distilled Water of the Chemistry Union Laboratory
7. 1.77 Hair Tonic
8. Anna Cream
9. Anna Hair Tonic
10. 1.77 Baby Powder
11. Congka Hair Tonic
12. Congka Cream
13. Ramwong Powder
14. Ramwong Cream
15. Phyanag Distilled Water of the Thai Distilled Water Factory, Dhonburi

Merchandise approved in 1948

1. Liquid Cement of S. Dampitaksa
2. Malisod Hair Curlset
3. Orchid Hair Curlset
4. Lavender Cream
5. Macherry Cream
6. Orchid Powder
7. Distilled Water of the Chemistry Union Laboratory
8. D.N.T. Mosquito Incense of Nitespaj
9. Hair Tonic
10. Glutinous-rice Flour
11. Rice Flour, Dhonburi
12. Green Gram Flour
13. 1.77 Baby Powder
14. Arrowroot Flour, Dhonburi
15. "Todlod" Flour, Dhonburi
16. Pratuchai Fish-soy
17. Anita Cream
18. Congka Hair Tonic
19. Congka Cream
20. Ramwong Powder
21. Ramwong Cream
22. Chula Toilet Soap

THE SCHOOL OF PRACTICAL CHEMISTRY

After the temporary suspension of the school during the War, it was re-opened on November 1, 1945. There were no new admissions in 1946. The First Year students graduated to the Second Year Class and the Second Year students received a further three-months training in laboratory work. In September, 1947, 17 students graduated from the School.

In 1948, there was only one class held, namely the Second Year Class, and no new admissions were accepted. Thirteen students of this class graduated in March, 1948. Those who failed in the final examination remained in the Second Year Class, commencing on December 30, 1948.

An amendment to the school's regulations was effected in 1948, in order to improve the status of the Department's personnel. Department officials who are graduates of Mathayom 6, or the Pre-university examination or its equivalent, and have been in the service for not less than 5 years, or those who have completed the course of the school but failed in the final examination, have the right to take the final examination of the school whenever such an examination is held, and to receive its certificate, if successful.

DIVISION OF CHEMISTRY

The following is a record of some of the more interesting work, done by the Division of Chemistry.

Opium

In 1947 there were 368 samples of opium submitted for analysis, comprising 63 samples of raw opium, 214 samples of cooked opium, 41 samples of mixed cooked opium, 4 samples of opium dross, and 46 samples of suspected harmful habit-forming drugs.

In 1948, 402 samples of opium were submitted for analysis: 43 samples of raw opium, 190 samples of cooked opium, 92 samples of mixed cooked opium, 11 samples of opium dross, and 66 samples of suspected harmful habit-forming drugs. Most of the samples were sent in by the Excise Department. In addition this section devised a means to test whether opium, was official or not, the method of which cannot be revealed here.

The data of work done by this section is tabulated below :

Items	1947			1948		
	Number of Samples	Findings Positive	Findings Negative	Number of Samples	Findings Positive	Findings Negative
Fire-arms and Ammunition	18	15	3	23	16	7
Blood Stains	58	23	35	62	20	42
Poison	23	7	16	1	1	-
Narcotic	9	8	1	1	1	-
Explosive	1	1	-	1	1	-
Miscellaneous	1	-	-	2	-	-

Accounts of some of the more interesting cases are given below :

Poison

Five fatal cases of poisoning were examined by this section. In 2 cases arsenic was found, mercury was used in two other cases, and salt of nitrite in another.

In the first case, arsenic was found mixed with the lime eaten with betel-nut. The victim was a woman born in Songkla.

In the second case, arsenic was found in Krong Kraeng pastries peddled by a woman in Dhonburi. Of the thirty persons who ate these only one girl, aged 6, died.

In the third and fourth cases, mercury was found in old-fashioned pills used for treating yaws. One case took place in Nakhonsawan. On examination, a pill weighing 0.393 gm. was found to contain 0.088 gm. of mercury compound, or 22.36%. The other cases happened in Nakhonrajsima, a pill of 0.049 gm. contained 0.012 gm. of mercury compound, or 25.77%. The symptoms in both cases were similar : pain in stomach, swelling of mouth and gullet, burning of tongue and loss of teeth. It was believed that the poisoning in both of these cases was not intentional but rather out of ignorance.

In the fifth case, salt of nitrite was found in epsom salt. Epsom salt was bought from a local drug store in Suphanburi; after taking the medicine for laxative purpose, four persons died immediately. On analysis of the sample drug, 17.3% of sodium nitrite was found.

In one case, a man in Rajburi died about 11 hours after taking Khangphised whiskey of the Government Distillery. On examining the viscera of the deceased person, no general poison was found. A sample of the whiskey was also received for analysis but the finding was negative. The whiskey was also fed to rats for biological testing, but the rats did not die and did not show any abnormal signs, accordingly it was concluded that the victim died through other reasons.

In August of 1947, the Department received two samples of arrows suspected to carry a poisonous substance in the arrow-heads, from the investigation-officers of Srisaked. On account of the insufficiency of the amount of substance for chemical analysis, the Department asked the Division of Pharmacy to conduct biological testing. As a result, curare, a very strong plant poison, was found in both samples.

Drugs and Medicinal Plants

Originally the Department was also responsible for the analysis service of drugs and medicinal plants. But after the transfer of the Pharmacy Division to the Ministry of Public Health, it was considered appropriate to drop this service owing to lack of personnel and equipment. Consequently, this service was officially transferred to

the Department of Medical Science, Ministry of Public Health as of 1948. However, the examination and analysis of fire-arms, blood stains, semen stains, and documents still remained with the Department. This change was also reported to the Ministry of Interior in order that various provincial officers be notified.

Torches

In March, 1948, a case of fire was reported in the Chakrawad precinct. The police suspected that it was intentional. On examination by the Department's officials, it was found that the store-room contained about 10,000 bundles of torches tied together. These torches were made of fibrous materials soaked in Yang oil, an unsaturated hydrocarbon. The oil was similar to linseed, being also a drying oil. In a warm and poorly ventilated room, spontaneous combustion could occur, as easily as rags soaked with linseed oil. It was thus advised that in order to avoid fire, the store-room should be kept clean and well ventilated.

Milk

The following table shows the analysis of milk and milk food during this period.

Items	Number of Samples		Remarks
	1947	1948	
Sweetened Condensed Milk			
from Department of Customs	78 *	84	* under standard: 1 sample
from Private Companies			
<i>Foreign Milk</i>	7	2	
<i>Local Milk</i>	1	-	
from Department of Public Health	6 *	8 **	* under standard: 2 samples
Unsweetened Condensed Milk			** Local milk
from Department of			

Items	Number of Samples		Remarks
	1947	1948	
Customs	55	49	Foreign Milk
from Private Companies	1	1	
Fresh Milk	3	4	
Powdered Milk			under standard
from Department of Customs	48	44	
from Department of Public Health	1	-	
Milk Food			
from Department of Customs	1	-	
Cream		4	
Total	201	196	

It will be noticed that most local milk is not up to standard which is due primarily to the primitive and unsanitary conditions of the milking processes. If more care is taken in keeping the locality and containers clean, the quality could be improved somewhat.

Fuels

The analysis of fuels during this period is shown below.

Items	Number of Samples	
	1947	1948
Fuel oils	99	24
Lubricants	49	12
Solid fuels (Coal, Coke, Charcoal, Wood, Torch)	33	31
Shale	6	-
Total	187	67

The analysis of a sample of coal (BK. 498) submitted by the Department of Mines is shown below.

Location of the source is the border of Suratthani, Nakhonsri-thamaraj and Krabi.

Specific gravity @ 27°C.	1.5378
Calorific value (calories/gramme)	
A. As received	4321
B. Moisture free	5124
Moisture	15.7%
Fixed carbon	33.0%
Volatile matter	41.2%
Sulphur	6.3%
Ash	10.3%

Other samples of coal are :

Items	From Kantang, Trang Bl. 918	From Amphur Muang, Krabi Bl. 919	From Huey Yod Trang Bl. 920
Specific gravity @ 30°C.	1.1870	1.2922	1.3144
Calorific Value (calories/gramme)			
A. As received	4758	4724	4853
B. Moisture free	5758	5902	6000
% Moisture	16.82	19.79	19.12
% Fixed carbon	29.32	24.51	21.87
% Volatile matter	42.52	47.07	48.87
% Sulphur	5.35	3.11	2.16
% Ash	11.34	8.63	10.14

Calorific Value of Fire-Wood

The Fuel Section analysed 22 samples of fire-wood as shown below.

Lab. Nos.	Thai Names	Botanical Names	Moisture %	calories per gramme	
				Calculated from Samples (as received)	Calculated from Dried Samples
B.H. 118	Mai Sait	<i>Phoebe paniculata</i>	8.78	4877	5346
B.H. 119	Mai Katon	<i>Sandoricum indicum</i> , Carr.	9.65	4542	4974
B.H. 120	Mai Farang	<i>Psidium guayana</i> , Linn.	10.81	4293	4813
B.H. 121	Mai Tenglang	<i>Shorea conchinchinensis</i>	9.89	4931	5472
B.H. 122	Mai Khaung	<i>Hemalium tamariscum</i>	10.62	5413	4938
B.H. 123	Mai Poodsa	<i>Zizyphus jujuba</i> , Lamk.	11.01	4194	4718
B.H. 124	Mai Tengrang	<i>Shorea obtusa</i> , Wall.	11.37	4461	5054
B.H. 125	Mai Yang	<i>Dipterocarpus alatus</i> , Roxb.	9.86	4395	4810
B.H. 126	Mai Sak	<i>Tectona grandis</i> , Linn.	8.43	4658	5094
B.H. 127	Mai Khaung	<i>Maukea orientalis</i> , Linn.	10.72	4280	4754
B.H. 128	Mai Pradeo	<i>Pterocarpus macrocarpus</i> , Kuz.	9.05	4723	5193
B.H. 129	Mai Kabang	<i>Anisoptera curtisi</i> , Dyar.	11.02	4539	5101
B.H. 130	Mai Lanchi	<i>Nephelium litchi</i> , Camb.	12.02	4260	4842
B.H. 131	Mai katin (Pimai)	<i>Acacia siamensis</i>	10.76	4277	4792
B.H. 132	Mai Maprang	<i>Bacca burmanica</i> , Griff.	11.41	4426	4936
B.H. 133	Mai Saupau	<i>Chaetocarpus castaneopsis</i>	9.57	4418	4889
B.H. 134	Mai Maphai	<i>Baccaurea sapida</i> , Muhl. Arg.	10.56	4189	4674
B.H. 657	Mai Dhodhi	<i>Ficus religiosa</i> , Linn.	9.86	4553	5051
B.H. 658	Mai Magleoe (Maidam)	<i>Dyosphyres mollis</i> , Griff.	6.42	4871	5205
B.H. 659	Mai Sontale	<i>Casuarina eguisetifolia</i> , Blume.	8.30	4579	4987
B.H. 660	Mai Hangnokyong	<i>Poinciana regia</i> , Rafin.	8.92	4091	4492
B.H. 661	Mai Payoong	<i>Dabergia cochinchinensis</i> , Pierre.	8.17	4694	5112

Vegetable Oils

In 1947, the Division of Chemistry analysed 149 samples of vegetable oils and in 1948, 35 samples. Most of these samples were coconut oil; a few castor oil samples and one dehydrated castor oil were made locally. The analysis of the dehydrated castor oil (Lab. No. BK. 518) was as follows :

Iodine value (Wijs)	110.1
Acid value (mg.KOH/gm.)	12.8
Specific gravity at 25° C.	0.953

Metals

The analyses of metals during 1947 and 1948 were as follows :

Items	Number of Samples	
	1947	1948
Tin	285	84
Lead	12	20
Iron	13	15
Antimony, Copper, Zinc, Silver	31	13
Alloy	11	4
Alloy for making coins	22	20
Total	374	156

Comparing the number of samples with that of the previous period, it is seen that a much smaller number was submitted during this period, especially tin samples.

Water

The water analysis data were as follows :

Source	Number of Samples	
	1947	1948
City Water Works	176	226
Chao Phya River	24	36
Sea Water	—	529
Miscellaneous	23	33
Total	223	824

The following table contains the analyses of water from various provinces. They are expressed as parts per 100,000; hardness is expressed as parts of CaCO₃ per 100,000. Oxygen consumed was determined at a temperature of 100 °C., maintained for 10 minutes.

**Average Analyses of Provincial City Water
1947**

	Bangkok			Pitsanulok	Nakon Sawan	Nakon Rajsimma	Nakon Pathom	Lopburi	Ayutthya
	City water supply canal	No. 3 Filter House	Pipe water Dept. of Science						
pH value	6.9	6.9	6.9	7.1	7.1	7.2	7.5	7.5	7.0
Electrical Conductivity	126	131	136	979	140	305	413	490	140
Total Solids	18.9	11.4	11.7	151.9	12.2	24.4	33.8	38.6	15.2
Suspended Solids	6.1	nil	nil	79.2	nil	-	nil	nil	2.5
Dissolved Solids	12.8	11.4	11.7	81.7	12.2	24.2	33.8	38.6	12.7
Total Hardness	5.4	5.5	5.6	17.1	8.1	12.7	26.1	33.3	7.1
Temporary Hardness	4.5	3.7	3.9	8.9	6.9	12.2	25.0	32.7	5.8
Permanent Hardness	0.9	1.8	1.7	9.1	1.2	0.5	1.1	0.6	1.3
Chlorides, expressed as Chlorine	0.8	0.8	0.8	34.5	0.3	4.1	2.5	0.6	0.7
Chlorides, expressed as Sodium Chloride	1.3	1.3	1.3	56.9	0.5	6.8	4.1	1.0	1.2
Oxygen Consumed	0.50	0.25	0.24	0.29	0.12	0.33	0.04	0.07	0.21
Saline Ammonia	0.005	0.002	0.002	0.016	0.002	0.007	0.001	0.001	0.002
Aluminoid Ammonia	0.027	0.014	0.013	0.020	0.011	0.014	0.004	0.005	0.013
Nitrates, expressed as Nitrogen	0.028	0.019	0.017	0.034	0.018	0.023	0.014	0.015	0.012
Nitrites	nil	nil	nil	traces	nil	nil	nil	nil	nil
Loss on Ignition	3.5	2.2	2.1	1.9	1.2	2.5	0.8	1.0	1.9
Iron	0.02	nil	nil	10.9	traces	nil	nil	nil	0.02

**Average Analyses of Provincial City Water
1948**

	Bangkok				Nakon Sawan	Nakon Rajsimha	Nakon Pathom	Iopburi	Ayuthya	Smutsakon
	City water supply canal	No. 3 Filter House	Pipe water Dept. of Science							
pH value	7.1	7.0	7.0		7.1	7.2	7.5	7.4	7.0	7.4
Electrical Conductivity	160	158	169		134	456	303	438	148	393
Total Solids	21.5	13.4	14.2		15.0	36.2	33.8	37.4	14.9	30.2
Suspended Solids	15.1	nil	nil		—	0.3	nil	nil	1.3	nil
Dissolved Solids	15.4	13.4	14.2		12.4	35.9	33.8	37.4	13.6	30.4
Total Hardness	7.7	7.2	7.7		6.3	14.2	27.0	30.7	7.1	21.4
Temporary Hardness	7.4	6.3	6.5		6.2	13.4	26.1	30.3	7.0	21.4
Permanent Hardness	0.3	0.9	1.2		0.1	0.8	0.9	0.4	0.4	nil
Chlorides, expressed as Chlorine	1.3	1.3	1.4		0.2	8.5	2.3	0.6	0.8	0.6
Chlorides, expressed as Sodium Chloride	2.1	2.1	2.3		0.3	14.0	3.8	1.0	1.3	1.0
Oxygen Consumed	0.38	0.21	0.17		0.18	0.33	0.06	0.09	0.21	0.05
Saline Ammonia	0.007	0.004	0.003		0.004	0.004	0.002	0.002	0.004	0.005
Albuminoid Ammonia	0.021	0.010	0.008		0.015	0.021	0.005	0.006	0.011	0.007
Nitrates, expressed as Nitrogen	0.013	0.010	0.011		0.013	0.013	0.005	0.012	0.014	0.005
Nitrites	nil	nil	nil		nil	nil	nil	nil	nil	minute traces
Loss on Ignition	3.1	1.9	1.8		1.8	2.2	0.9	1.4	1.9	0.7
Iron	0.2	nil	minute traces		0.03	—	nil	nil	0.01	nil
Sodium Carbonate	nil	nil	nil		0.5	—	—	—	0.5	6.1

The results of the analyses show that, compared with water of other provinces, Bangkok City Water is the purest and most wholesome. Nakhon Sawan and Ayuthya water is slightly soft and turbid due to insufficient sedimentation and coagulation. Water from Lopburi, Nakhon Pathom and Samudsakon, is hard, good for drinking but not good for some industrial purposes. Those of Nakhon Ratchasima and Pitsanulok are slightly hard, containing salts of iron and some nitrates and chlorides, consequently they are corrosive to iron.

DIVISION OF INDUSTRIAL CHEMISTRY

During the War years, work was not allotted to different divisions but rather performed jointly owing to shortage of men and equipment. Now since the situation has eased up a little, each division can again function individually.

Ceramics

The Ceramics Section made surveys of many sources of raw materials for the production of ceramics, the analyses of which are shown in the following pages :

Chemical

Lab. No.	Items	Loss on Igni- tion	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Free Silica	K ₂ O	CO ₂
		%	%	%	%	%	%	%	%	%
BF. 7 A	Kaolin	4.28	68.42	23.10	1.95	0.90	0.28	-	-	-
B	..	3.75	68.82	22.50	1.90	1.20	0.51	-	-	-
C	..	3.07	75.51	17.65	2.05	0.80	0.42	-	-	-
D	..	3.02	76.62	14.70	2.20	2.30	0.51	-	-	-
BF. 8	..	9.20	60.02	25.85	2.70	1.10	0.58	26.00	-	-
BF. 9	Quartz	0.22	91.64	5.50	0.60	1.00	0.29	-	-	-
BF. 10	White sand	13.71	55.36	1.97	0.38	27.70	0.83	-	-	-
BF. 11	Quartz	0.39	93.67	2.90	1.20	1.20	0.45	-	-	-
BF. 12	Shell	23.13	6.23	1.30	0.30	67.05	1.66	-	-	-
BF. 13	Granite	1.13	68.25	22.25	2.80	3.10	1.95	-	-	-
BF. 14	Lime- stone	15.28	19.36	4.05	1.70	48.50	11.02	-	-	-
BF. 15	Dolo- mite	14.99	6.30	3.70	1.60	50.30	22.66	-	-	-
BF. 16A	Feldspar	0.34	66.30	21.90	0.70	1.20	0.90	-	8.30	-
B	..	1.21	66.84	22.05	0.80	1.30	1.08	-	6.40	-

Analysis

Na ₂ O + K ₂ O	Mn ₃ O ₄	FeO	Total chloride	Total sulphate	Volatile matter	Mois- ture	Locality	Province	Suitable for making
%	%	%	%	%	%	%			
-	-	-	-	-	-	-	Tambon Had-yao	Jolburi	Earthen ware
-	-	-	-	-	-	-	Had-So	"	"
-	-	-	-	-	-	-	Katum- prong	"	"
-	-	-	-	-	-	-	Satta- heep	"	"
-	-	-	-	-	-	-	Bangla- mung, Satta- heep	"	"
-	-	-	-	-	-	-	Kaobejr Satta- heep	"	Porce- lain
-	-	-	-	-	-	-	Sea Beach, Satta- heep	"	Earthen ware
-	-	-	-	-	-	-	Kao- Sammuk	"	"
-	-	-	-	-	-	-	"	"	Enamel
-	-	-	-	-	-	-	Ang- Sila	"	Stone- ware
-	-	-	-	-	-	-	Sichang	"	-
-	-	-	-	-	-	-	"	"	-
-	-	-	-	-	-	-	Kao- Prabart	"	Glaze
-	-	-	-	-	-	-	"	"	-

Chemical

Lab. No.	Items	Loss on Ignition	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Free Silica	K ₂ O	CO ₂
		%	%	%	%	%	%	%	%	%
BH. 911	Kaolin-like substance	13.42	46.84	35.80	0.07	1.10	1.99	-	-	-
BH. 912A	Kaolin	11.27	51.50	32.00	2.40	1.65	1.15	-	-	-
B	„	12.23	46.41	35.75	2.30	1.00	13.23	-	-	-
BH. 913	„	11.05	52.05	30.30	2.85	1.90	1.39	-	-	-
BH. 914	Quartzite	4.12	83.62	6.95	1.70	1.90	1.68	-	-	-
BG. 784	Kaolin	4.12	69.74	22.50	1.90	0.80	0.68	-	-	-
BG. 785	„	6.53	68.58	20.10	3.50	0.60	0.61	-	-	-
BG. 786	„	2.75	73.57	20.70	1.30	1.40	0.22	-	-	-
BJ. 973	Dolomite	-	0.82	0.25	1.30	32.70	18.65	-	-	46.04

Analysis

Na ₂ O + K ₂ O %	Mn ₂ O ₄ %	FeO %	Total chloride %	Total sulphate %	Volatile matter %	Mois- ture %	Locality	Province	Suitable for making
-	-	-	-	-	-	-	Kao Changok	Nakon Nayok	Refrac- tory
-	-	-	-	-	-	-	Tambon Nongyai	Prachin- buri	Earthen ware or Refrac- tory
-	-	-	-	-	-	-	"	"	"
-	-	-	-	-	-	-	Tambon Parkplee	"	"
-	-	-	-	-	-	-	Kao E-To	"	Earthen ware
-	-	-	-	-	-	-	Kao Phadang, Amphur Tamai	Chanda- buri	"
-	-	-	-	-	-	-	Tambon Panglad, Amphur Tamai	"	Earthen ware or Refrac- tory
-	-	-	-	-	-	-	Tambon Ban-na, Amphur Grang	Ra-yong	Porce- lain
-	-	-	-	-	-	-	Tambon Tabo- tonglang, Sichang	Jolburi	"

Chemical

Lab. No.	Items	Loss On Igni- tion %	SiO ₂ %	Al ₂ O ₃ %	Fe ₂ O ₃ %	CaO %	MgO %	Free Silica %	K ₂ O %	CO ₂ %
BF. 633	Quartz sand	0.40	94.61	3.50	0.50	0.40	0.51	-	-	-
BH. 620	Kaolin	4.28	68.42	23.10	1.95	0.90	0.28	-	-	-
BH. 621	Kaolin	4.12	69.74	22.50	1.90	0.80	0.68	16.00	-	-
BH.6 22	Kaolin	9.20	60.02	25.85	2.70	1.10	0.58	66.00	-	-
BH. 623	White marble	41.74	1.13	nil	traces	56.0	0.87	-	-	-
BH. 624	Feldspar mixed Quartz	0.82	66.29	19.22	0.77	1.01	-	-	11.75	-
BH. 625	Quartz- zite	0.78	93.26	4.25	1.42	0.65	-	-	-	-
BH. 626	Sili- ceous Sinter	20.83	5.39	nil	traces	32.4	0.83	-	-	-
BH. 627	Manga- nese	14.6	11.9	-	33.5	-	-	-	-	-

Analysis

Na ₂ O + K ₂ O %	Mn ₃ O ₄ %	FeO %	Total chloride %	Total sulphate %	Volatile matter %	Moisture %	Locality	Province	Suitable for making
-	-	-	-	-	-	-	Tambon Bo-phud, Amphur Samui	Suradi- Dhani	-
1.07	-	-	-	-	-	-	Tambon Had-So, Satta- heep	Jolburi	-
0.26	-	-	-	-	-	-	Tambon Ta-Mai, Satta- heep	"	-
0.55	-	-	-	-	-	-	Tambon Na Klua, Amphur Bangla- mung	"	-
-	-	-	-	-	-	-	Kao- Phun	Kanjana- buri	-
-	-	-	-	-	-	-	Tambon Bang- buaban	Chieng- mai	-
-	-	-	-	-	-	-	Sri- Raja	Jolburi	-
traces	-	-	-	-	-	-	Amphur Chaiya	Suradi- Dhani	-
-	29.6	-	-	-	-	-	Amphur Grang	Rayong	-

Chemical

Lab. No.	Items	Loss on Igni- tion	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Free Silica	K ₂ O	CO ₂
		%	%	%	%	%	%	%	%	%
BH. 628	Manga- nese	13.0	11.7	-	26.0	-	-	-	-	-
BH. 629	Quartz	0.22	91.64	5.50	0.60	1.00	0.29	-	nil	-
BH. 766	Feldspar	1.21	66.84	22.05	0.80	1.30	1.08	-	6.40	-
BI. 479	Garnet	nil	41.2	18.0	-	1.8	5.5	-	traces	-
BI. 480	Spinel	nil	2.8	56.2	-	nil	17.9	-	nil	-
BI. 481	Feldspar	0.82	63.58	25.8	traces	traces	nil	-	9.7	-
BI. 482	Calcite	42.4	traces	nil	traces	57.56	nil	-	-	-
BI. 483	Calcite	43.4	nil	nil	traces	57.5	nil	-	-	-
BI. 484	Ash- Firewood	-	-	-	-	-	-	-	25.63	27.6
BI. 777	Quartz sand	0.24	98.8	traces	traces	traces	traces	-	-	-
BI. 778	Corun- dum	0.58	3.75	48.58	2.02	6.44	2.40	-	-	-
BI. 779	Quartz	0.23	95.60	2.13	2.02	traces	traces	-	-	-

Analysis

Na ₂ O + K ₂ O %	Mn ₂ O ₄ %	FeO %	Total chloride %	Total sulphate %	Volatile matter %	Mois- ture %	Locality	Province	Suitable for mak- ing
-	33.4	-	-	-	-	-	Koh Cram	Rayong	-
-	-	-	-	-	-	-	Kaobejr, Satta- heep	Jolburi	-
-	-	-	-	-	-	-	-	Jolburi	-
-	-	33.3	-	-	-	-	Amphur Grang	Rayong	-
-	-	23.0	-	-	-	-	Amphur Bo-ploi	Kancha- naburi	-
-	-	-	-	-	-	-	Tambon Tadee	Nakorn Sridham- araja	-
-	-	-	-	-	-	-	Kao-Kao	Lopburi	-
-	-	-	-	-	-	-	Kao Tubquai	Lopburi	-
-	-	-	4.44	5.76	42.1	-	-	-	-
-	-	-	-	-	-	-	Amphur Muang	Chanda- buri	-
-	-	-	-	-	-	-	Tambon Bang- gaja, Amphur Muang	"	-
-	-	-	-	-	-	-	Tambon Nongbau, Amphur Muang	"	-

Chemical

Lab. No.	Items	Loss	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Free	K ₂ O	CO ₂
		on Igni- tion % ₀	% ₀	% ₀	% ₀	% ₀	% ₀	% ₀		
BJ. 268	Kaolin (fine)	9.42	50.62	35.10	0.90	2.10	1.01	-	-	-
BJ. 269	Kaolin (coarse)	8.72	51.27	34.80	1.00	2.30	0.94	-	-	-
BJ. 272	Kaolin (fine)	13.33	45.06	37.25	1.20	2.05	1.09	-	-	-
BJ. 273	Kaolin (coarse)	11.33	45.15	39.10	1.20	2.30	0.91	-	-	-
BJ. 270	Sand from Kaolin	7.10	59.58	28.70	1.00	2.00	0.80	-	-	-
BJ. 271	Sand from Kaolin	2.82	85.94	8.10	1.30	1.30	0.54	-	-	-
BJ. 274	White sand (under ground 5metres deep)	0.39	91.21	3.15	1.00	2.80	1.45	-	-	-

Analysis

Na ₂ O + K ₂ O %	Mn ₃ O ₄ %	FeO %	Total chlo- ride %	Total sul- phate %	Vola- tile mat- ter %	Mois- ture %	Locality	Province	Suitable for making
0.85	-	-	-	-	-	0.99	Amphur Nasan	Suradr- Dhani	-
0.97	-	-	-	-	-	5.85	„	„	-
nil	-	-	-	-	-	0.94	Amphur Sijol	Nakorn Sridhama- raj	-
nil	-	-	-	-	-	1.09	„	„	-
-	-	-	-	-	-	1.83	Amphur Nasan	Suradr- Dhani	-
-	-	-	-	-	-	0.27	Amphur Sijol	Nakorn Sridhama- raj	-
-	-	-	-	-	-	0.08	„	„	-

Rice

The Thai Rice Company Ltd. found that, on storage of rice after the milling process, the rice became infested after three or four months. Experiments with slaked lime as a preservative have been carried out. It was found that rice mixed with 5% of lime could be stored for over four years without any infestation. The Company submitted the samples used in their experiments to the Department to determine whether the rice, thus preserved, was harmful to the human body.

As a result of its investigation, the Food Section reported that if the lime particles were first separated from the rice grains by blowing air through it, followed by three or four washings of rice as is the usual practice before cooking, no harm would be incurred.

To study the problem further, the Section tested the rice preserved in the above manner on rats for a period of two months as follows. The treated unblown rice was washed twice and cooked without pouring out the water. This cooked rice in combination with ground peas together with lettuce, potato and cucumber was fed to the rats. After a period of two months, the rats fed on the above diet were found to be in just as good health as the other rats fed on ordinary rice.

Fish Sauce

The Food Section conducted an experiment to find a quick process for manufacture of fish sauce. In the usual method of manufacture, the enzyme hydrolysis or natural hydrolysis is employed which requires at least 8 months before completion. The Section employed acid hydrolysis using hydrochloric acid as a hydrolysing agent. After the hydrolysis of the fish meal was complete, the filtrate was neutralized by sodium carbonate; the process took about 15-20 hours to complete. The fish sauce thus obtained was comparable to commercial first grade sauce in flavour, but not in colour and odour.

The results of analysis of the prepared fish sauce is shown below :

Total solids	280	gm.	per	litre
Salt free ash	1.88	gm.	„	„
Total nitrogen	12.39	gm.	„	„

Ammoniacal nitrogen	1.19 gm. per litre
Organic nitrogen	11.2 gm. " "
Formaldehyde nitrogen	0.896 gm. " "
Phosphorus (P ₂ O ₅)	1.0 gm. " "
Sodium chloride	191.3 gm. " "
Calcium oxide	1.12 gm. " "

The prepared sauce was controlled so that it contained only 20% salt (as compared with commercial sauce which contains 27-29%), thus lowering the percentage of total solids and salt free ash.

Preservation of Food

Various kinds of Thai fruit were canned to determine their keeping quality. Fruits used in the experiments were Pomelo, Rambutan, Katorn, Lamood and Lamyai.

The peeled Pomelo was cooked and put into a preserving jar, filling it up to half its contents. Three spoonfuls of sugar were added and more Pomelo was put in until the jar was full. Air was expelled from the jar by boiling it in water for 5 minutes. The cover was put on but its spring fastener was left unclamped. It was then cooked in a pressure cooker for 30 minutes at 15 pounds pressure, after which it was taken out and tightly closed. 25%-50% syrup can be used in place of sugar if desired.

Rambutan, Katorn, Lamood and Lamyai were preserved by three different methods :

1. The peeled fruit was put into a jar, boiling hot syrup poured over it up to the brim, and the jar was then closed tightly,
2. The fruit was precooked for 5 minutes, put in to a jar, the air expelled and then processed in a pressure cooker after which the jar was closed tightly.
3. The peeled fruit was put into a jar, filled with hot syrup, air-expelled, and processed in the regular water bath used for expelling the air.

Results showed that the 1st method was best for preserving Rambutan, but the 3rd method was also good. The 2nd and 3rd methods were good for Katorn and the 2nd method was recommended for Lamood while the 3rd method was best for Lamyai.

The recommended time for expelling the air and sterilization was as follows :

	Expelling air Minutes	Sterilization Minutes
Rambutan	10	30
Lamood	10	30
Katorn	15	90-120
Lamyai	15	90-120

Fermentation

In their experiments on the culture of yeast, the Food Section produced its own yeast for making bread. *Aspergillus oryzae* and *mucor* or rice-bran were also produced for the saccharification of rice alcohol. Results obtained were promising.

Alcoholic Beverages

A great number of samples of alcoholic beverages were submitted by the Excise Department for analysis. These samples having been collected from various licensed manufacturers all over the country. Routine analysis comprised the determination of the percentage of alcohol, presence of poisonous substances and harmful habit forming drugs.

In many samples, the actual percentage of alcohol was lower than that labelled. But no poisonous substance was found in any of the samples. The quality of the samples was much inferior to the products of the Government Distillery.

The following is the analysis of the "Khang Phised" Blend made by the Government Distillery, which was rumoured to contain poisonous substance.

Sample No. BF. 177

Alcohol	29.10	%
Acidity (as acetic acid)	0.016	%
Sugar :		
Reducing sugar (as invert sugar)	traces	
Sucrose	0.8419	gm./100 cc.
Ester (as ethyl acetate)	0.029	gm./100 cc.
Fusel oil	0.03	gm./100 cc.

Solids	1.0068 gm./100 cc.
Ash	0.004 gm./100 cc.
Aldehyde	present
Furfural	absent
Caramel	present
Metallic poisons and alkaloids	absent

From this analysis, it was evident that the liquor in question contained no poisonous substances as rumoured.

Sea Water

Mr. Smak Buravas, a Member of the Government Industrial Investigation Committee, submitted samples of sea water and bittern for analysis, needed further research on sea water products. These samples were taken from the Salt Cooperatives at Tambon Khom Amphur Muang Smutr Sakorn.

Sea Water

	gm. per litre
Na	10.3
K	0.2
Ca	0.4
Mg	1.3
Cl'	19.0
SO ₄ '	2.7
CO ₃ '	nil
HCO ₃ '	0.1
Br'	nil
NaCl (calculated from total Na)	26.3
KCl (calculated from K)	0.4
CaCl ₂ (calculated from Ca)	1.1
MgCl ₂ (calculated from total Mg & Ca after deducting NaCl, KCl and CaCl ₂)	2.9

Total soluble matter, dried at 180°C.	35.0
Insoluble residue	5.2
Soluble Fe	nil
Insoluble Fe	0.6

Bittern

Concentration	28.5° Baumé
KCl	10 gm. per litre
MgCl ₂	88 gm. „ „
MgSO ₄	60 gm. „ „
NaCl	180 gm. „ „

DIVISION OF INDUSTRIAL RESEARCH

Some of the more interesting subjects of research performed by the Division of Industrial Research are as follows:—

Hydrogenation of Oils

Experiments on hydrogenation of oil were performed in order to study property changes, problems involved in adapting process on large scale manufacture, and the feasibility of making solid oils. The oils studied were coconut oil, lard, olive oil, peanut oil, cotton seed oil, soybean oil, castor oil, sesame oil, krabau oil (*hydnocarpus*) and fish liver oil. Some of the changes in properties were: higher melting point, decrease in odour, retardation of rancidity and lower iodine value. The best catalyst, so far found, was nickel formate.

Cellophane Glue

The Division prepared a solution of glue to be applied to excise stamps on cigarette-packages, as requested by the Thai Tobacco Monopoly. The result was very satisfactory, because stamps thus applied with the prepared glue could not be removed without destruction of the stamps.

Vitamin C in Thai Fruits

A joint experiment was performed by the Division with the Food Section of the Division of Industrial Chemistry, to determine the quantity of vitamin C in certain Thai fruits.

Vitampip C was calculated in milligrams of ascorbic acid per 100 cc. of fruit juice.

Vitamin C in Thai Fruits

Kind		March	April	May	June	July	August	September	October	November	December	January	February
Thai Names	Botanical Names												
Som-o (Pomelo)	Citrus maxima,	67											
Khowjeeb	Merrill	66											
Tongdee		58											
Khowyai													
Khowpuang				55		70			45	41		82	108
Khunnond				50		51		52		48		61	61
Khownamphung								54					60
Khowsoong						68	76						
Namtansai							91						
Kati							81						
Khowpol													
Khowhom									72			68	
Ngolon													53
Khowtia													53
Khow Nakonchaistri													59
Somkhang	Citrus siamensis,	53	76		69	77	63	52	47	51	51	57	60
(Bitter orange)	Osbeck.												
Som Khieuwan	Citrus nobilis,lour.	30	37		26	38	26	27	26	24	21	34	37
Som-sa	Citrus macroptera,	57	48		36	21		54	52	49	51		56
	Montrouz												
Som-men	Citrus nobilis, lour.								30				
(Calamansis)													

Preparation of Barium Sulphate

The Division prepared 153.6 kilograms of Barium sulphate, 60 kilograms for Siriraj Hospital, and 93.6 kilograms for the Battery and Paint Division of the Royal Thai Naval Dockyards.

Liquid Ammonia

In addition to preparing liquid ammonia for the use of the Department, the Division also prepared 112 litres of liquid ammonia for the Faculty of Science of the Chulalongkorn University.

SCIENTIFIC LECTURES

To further scientific study and knowledge, the Department continued the scientific lecture program originated by Dr. Toa Labhanukrom. 5 lectures were delivered :—

1. Life on the Planets by M.L. Anong Nila-Ubol.
2. Columbium, Vital Metal by Vongse Naewbanij.
3. Cellulose Industry by Boonyiam Meesuk.
4. New Elements by Riddhi Subhanka.
5. Atomic Fission by Riddhi Subhanka.

VISITORS AND TRAINEES

Prof. Alexander Wolsky, Principal Scientific Officer of the South-East Asia Regional Scientific Cooperation Office, UNESCO, whose office was in India, visited the Department on December 9, 1948. He said that his office would be glad to assist or cooperate with the Department in any way it could.

The Department helped train four different groups of officials from various Government agencies :

1. Two officers from the Signal Corps of the Military Inspector General Department, in the analysis of materials used in the manufacturer of flashlight batteries
2. Three officers from the Militar Supply Department in the analysis of food.
3. One official from the Government Distillery, in the analysis of sugar and molasses.
4. One official from the Tannery Organization, in the preparation of hide-glue.

ANALYSIS STATISTICS

(A) SOURCE CLASSIFICATION

From	Items	Number of Samples	
		1947	1948
Ministry of Defence	Drinking water, Industrial water	4	9
	Sea water	359	402
	Fuel oil	-	1
	Lubricants	-	7
	Charcoal and Coal	-	1
	Blood stains	3	-
	Documents	1	-
	Internal organ	1	-
	Metals	1	7
	Ores	-	4
	Chemicals	1	4
	Food	1	-
	Earth, Rocks	24	24
	Miscellaneous	5	
		400	459
Ministry of Agriculture	Drinking water, Industrial water	-	1
	Chemicals	-	5
	Food	-	3
			-

From	Items	Number of Samples	
		1947	1948
Ministry of Communication	Fuel oil	1	-
	Lubricants	38	5
	Charcoal and Coal	12	12
	Fuels	-	2
	Metals	38	23
	Ore	1	-
	Chemicals	8	7
	Gum	1	-
		99	49
Ministry of Finance	Fule oils	71	7
	Lubricants	3	-
	Morphine or Opium dross suspects	34	58
	Other objects under suspect	1	-
	Metals	16	36
	Ores	9	13
	Chemicals	2	11
	Opium	299	293
	Opium dross	1	9
	Vegetable oil	1	1
	Alcoholic beverages	29	16
Food	181	184	

Form	Items	Number of Samples	
		1947	1948
	Pharmaceuticals	2	5
	Earth, Rock	1	1
	Fabrics, Textiles	6	11
	Fertilizer	-	1
	Tobacco	1	-
	Dyes	2	-
	Paints	-	6
	Food colour	1	-
	Colours	11	-
	Miscellaneous	3	7
			674
Ministry of Economic Affairs	Other objects under suspect	-	4
	Chemicals	-	2
	Tannin	-	1
		-	7
Ministry of Interior	Drinking water, Industrial water	127	162
	Mineral water	-	2
	Blood stains	55	109
	Fire-arms & Ammunition	27	31
	Morphine or Opium dross suspects	2	13

From	Items	Number of Samples		
		1947	1948	
	Poison suspects	24	-	
	Internal organ	1	-	
	Other objects under suspect	44	42	
	Chemicals	1	3	
	Vegetable oils	-	9	
	Gum, Para rubber	-	2	
	Paint	-	2	
			281	375
	Ministry of Justice	Document	-	1
			-	1
Ministry of Public Health	Drinking water, Industrial water	29	58	
	Blood stains	17	3	
	Morphine or Opium dross suspects	16	2	
	Other objects under suspect	35	1	
	Poison suspects	-	3	
	Chemicals	10	-	
	Non-alcoholic beverages	-	6	
	Food	8	153	
	Pharmaceutical	-	1	
	Food colours	8	6	
			123	233

From	Items	Number of Samples	
		1947	1948
Ministry of Industry	Drinking water, Industrial water	-	1
	Mineral water	6	-
	Charcoal and Coal	-	5
	Fuels	-	3
	Other objects under suspect	1	-
	Metal	1	-
	Ores	104	25
	Chemicals	20	47
	Alcoholic beverages	91	218
	Non-alcoholic beverages	4	-
	Food	2	7
	Earth, Rocks	29	29
	Shellac, Seed lac	1	-
	Soaps	3	-
	Tannin	-	2
	Merchandise for certification	22	26
Miscellaneous	14	4	
		298	367
Banks and Government Organizations	Charcoal and Coal	1	-
	Fuel	22	-
	Metal	-	1
	Gold	-	1

From	Items	Number of Samples	
		1947	1948
Bangkok Municipality	Ores	3	-
	Chemical	1	-
	Food	-	3
	Ink	-	1
	Miscellaneous	2	-
		29	6
	Drinking water, Industrial water	54	56
	Poison suspects	1	-
	Internal organ	1	-
	Chemicals	10	2
	66	58	
Semi-official Companies	Charcoal and Coal	-	1
	Metals	3	-
	Ores	24	1
	Food	-	2
	Earth, Rocks	-	11
	Miscellaneous	2	5
	29	20	
Public (Firms and Individuals)	Drinking water, Industrial water	3	6
	Sea water	-	10
	Fuel oil	2	7

From	Items	Number of Samples	
		1947	1948
	Lubricants	11	1
	Charcoal and Coal	3	8
	Poison suspects	-	1
	Metals	293	87
	Valuable metals	2	-
	Ores	100	44
	Chemicals	26	31
	Opium	1	-
	Edible oils, Fats	124	32
	Vegetable oils	33	18
	Alcoholic beverages	2	-
	Non-alcoholic beverages	1	11
	Food	27	38
	Animal feed	3	2
	Pharmaceuticals	16	6
	Earth, Rocks	5	12
	Textile, Fabrics	1	4
	Damaged merchandise	10	8
	Shellac, Seed lac	250	137
	Fertilizers	-	5
	Gum, Para rubber	3	11
	Tobacco	1	-
	Food colour	-	1
	Soaps	-	6
	Tannin	2	2
	Miscellaneous	20	5
		939	493
	Total	2,938	2,736

(B) KIND CLASISFICATION

Items	Number of Samples	
	1947	1948
Merchandise for certification	22	26
Water		
Drinking water, Industrial water	217	293
Mineral water	6	2
Sea water	359	412
Fuels		
Fuel oils	96	15
Lubricants	52	13
Charcoals and Coals	16	19
Miscellaneous	-	13
Other objects under suspect		
Blood stains	75	112
Fire-arms and Ammunition	27	31
Morphine or Opium dross suspects	53	73
Poison suspects	24	4
Semen stains	-	-
Document	1	1
Internal organ	3	-
Miscellaneous	81	47
Metal	352	154
Valuable metals	2	-
Gold	-	1
Ores	241	87
Chemicals	79	112
Opiums	300	293
Opium dross	1	9

Items	Number of Samples	
	1947	1948
Edible oils, Fats	124	32
Vegetable oils	34	28
Alcoholic beverages	122	234
Non-alcoholic beverages	5	17
Food	219	390
Animal feed	3	2
Pharmaceutical	18	12
Earth, Rocks	59	77
Textiles, Fabrics	7	15
Damaged merchandise	10	8
Shellac, Seed lac	251	137
Fertilizers	-	6
Gum, Para rubber	4	13
Tobacco	2	-
Dyes	2	-
Paints	-	8
Food colours	9	7
Colours	11	-
Soaps	3	6
Ink	-	1
Tannin	2	5
Miscellaneous	46	21
	2,938	2,736