MINISTRY OF INDUSTRY

BANGKOK, THAILAND

DEPARTMENT OF SCIENCE

10th. REPORT

FROM 1938 TO 1940

INTRODUCTION

The Department of Science Bi-Annual Reports were issued regularly since the Department had been originally instituted as the Government Laboratory. Nine volumes had already appeared. It was unfortunate that Dr. Toa Labanukrom, then the Director-General should have died on August 27, 1941, during the preparation of the 10th report. The compilation was thus left unfinished. Not long after Dr. Prachuab Bunnag took over the directorship, the War in the East broke out, and because of such an uncertain state of affairs the publication of the particular report had to be again suspended.

I am well aware of the fact that the collection of materials from official records and papers many years back is a task which could not be easily undertaken. However, to bring the report up-to-date has always been my intention since my appointment to the post on December 5, 1944.

With the official introduction of January instead of the usual April as the first month of the calendar year as from January 1941 onwards, it is probably oppropriate to include in this volume the account of B.E. 2483 (1940) nine months work.

I might as well point out that the period soon after the appearance of the 9th report also marked the changes in ministerial administration. In 1937 the Department of Science was under the Ministry of Economic Affairs. The latter was however in 1942 divided up into the Ministry of Commerce and the Ministry of Industry. The Department of Science has ever since come under the Ministry of Industry. Recently, under different ministries, there also appeared two more Science Departments, the similarity of the names of which is confusing to an outsider – the Military Science Department under the Ministry of Defence and the

Medical Science Department under the Ministry of Public Health. Therefore it should be understood that it is only the Department of Science, Ministry of Industry, that develops from the original Government Laboratory.

The interesting account of the progress of the work carried out at the Department during 1938–1940 is summarized under the title "General Review". And since whatever covered by this report was entirely under Dr. Toa Labanukrom's directorship, I therefore take this opportunity to include an appreciation.

Dr. Charng Ratanarat
Director - General.

Department of Science,
Ministry of Industry,
January 1947.

Toa Labanukrom, Dr. phil. nat. (magna cum laude)
An Appreciation

Dr. Toa Labanukrom, Assistant Minister of Economic Affairs and Director-General of the Department of Science, died on August 27, 1941, after a sudden illness. When he last attended the Cabinet Meeting on August 23, he was still in good health. This sudden death caused a great grief among his relatives as well as his colleagues.

Dr. Toa Labanukrom was born on the 3rd of October 1898. He went to Debsirindr School and Rajavithayalai School for his early education. In 1910 he won Prince Songkla's Scholarship for studying in Europe. From 1910—1917 he attended a school at Falkenberg, Mark, Germany. When Thailand was at war with Germany in 1917 he was taken prisoner and was sent to the prisoner-of-war camp in Berlin. Later on he was transferred to a camp in Celle along with other Thais and remained there until the war was over. He left Germany for Paris in December 1918 and volunteered to serve in the Thai Expeditionary Force which had been fighting in France. Being very fluent in German and French he was an indispensable interpreter and was very soon promoted to the rank of Sergeant Major. A year later he returned to Thailand. In recognition for his war-time services he was awarded the Order of the Golden Medal of the White Elephant, The Rama Medal and the European War Medal.

Soon after his release from the military service in 1919, Dr. Toa Labanukrom went back to Europe to continue his study again under the same Scholarship. He attended Berne University and Genève University specializing in Chemistry. In 1927 the Doctorate Degree—Dr. phil. nat. (magna cum laude), was conferred

upon him for his thesis on "The Influence of Chemical Composition on the Structure of Crystals". Later for two years more at Munich University he took up a course in Pharmacy and the following two years were spent in studying Botany at the University of Paris. After his extensive academic work he went on observation tour visiting various universities and scientific institutes in the United States and Japan and returned to Thailand in 1930. At home he first started as a second grade Assistant Chemist in the Government Laboratory then under the Ministry of Commerce and Communication.

Dr. Toa Labanukrom was an active member of the People's Party who staged the 1932 Coup d' Etat. He was then appointed one of the Second Category Members of the House of Representatives, and was appointed a Minister in Phya Manopakorn Nitithada's Cabinet. He left the Government in April 1933 but continued to be a Member of Parliament. In 1938 he again joined the Cabinet and remained Assistant Minister of Economic Affairs until his death.

Having come from a noble family and having been a highly educated person, he showed no personal greed nor a lust for political power. No matter which way the political wind was blowing his opinions had always been discretely and independently expressed. He was truly patriotic but never a fanatic.

Although he seemed to acquire his reputation in politics, his keen interest in science had never waned. In his scientific career, he was promoted to be a first grade Assistant Chemist in December 1932 and Chemist in June 1934. When the Government Laboratory was promoted to the status of the Department of Science in 1935, he was appointed its first Director-General.

Under his directorship, the Department of Science became a very active organization after a quiet period of 20 years as the Government Laboratory. The scope of the work was greatly

expanded and the number of officials was increased. Freshness and variety was created by the inclusion of a number of specialists in various fields from abroad as well as those graduated from our own university. His marked personality was a stimulus that encouraged his staff in their work. The science library as well as various divisions in the Department were better equipped, and the School of Practical Chemistry was founded. To keep workers well informed about the progress of science, highly instructive scientific lectures were arranged regularly. He was tireless for scientific collaboration and was a keen advocate of the application of science for our existing industry.

At the time of his death, Dr. Toa Labanukrom held many important positions :—

1. Director-General of the Department of Science.
2. Assistant Minister of the Ministry of Economic Affairs.
3. A member of the Scientific Section, the Royal Institute of Thailand.
4. Technical Adviser to the Department of Land and Mines.
5. Head of the School of Pharmacy, Chulalongkorn University.
6. Chairman of the Committee for Considering State Owned Industries.
7. Chairman of the Committee for the Improvement of Alcoholic Beverages.
8. Chairman of the Board of Directors of the Pharmaceutical Works.

His life was short but his work could be considered extensive. Only few of us have had as much colour in our careers or been more liked. Thailand had lost a very competent and able son.

To show the nation's gratitude, His Majesty the King was graciously pleased to command that his remains be placed in an octagonal urn - a very great honour according to the Thai custom - and the cremation was arranged by the Government as a state function.

STAFF

Director-General

Toa Labanukrom, Dr. phil. nat. (magna cum laude)

OFFICE OF THE SECRETARY OF THE DEPARTMENT

Assistant-Director. Phra Krasapna Bibhag.

Correspondence Section

Head of Section. Singto Ratanakasikara.
Assistant. Ong Thadasih.

Science Library Section

Librarian. Pue Rochanapurananda, B.S. (Chem.), Dip. Ind. Chem.

Accounts Section

Head of Section. Siri Juvidya, B.S.C.
Assistant. Sanga Ruenvongsa.

Stores Section

Head of Section. Siri Suvanapathama.

SCHOOL OF PRACTICAL CHEMISTRY

Director. Toa Labanukrom, Dr. phil nat. (magna cum laude)
Assistant Director. Pue Rochanapurananda, B.S. (Chem.), Dip. Ind. Chem.
Instructor. Miss Proesiri Bhekanandhana, B.A.

DIVISION OF CHEMISTRY

Senior Chemist. Luang Vichien Dhatukarn, L. ès. Sc., I.C. (Poitiers).

Forensic Chemistry Section

Medical Officer. Siri Tuyanonta, M.B., Dip. Pharm.
Chemist. Kliaw Bunnag, B.S. (Pharm.), Dip Pharm.
Medical Officer. Sub-Lieut. Thon Jarusorn, M.B.

Metallurgy Section

Chemist. Vongse Naewbanij, A.A.
Assistant Chemist. Banbota Svawasu, B.S.Ch.
Assistant Chemist. Kriang Tankulratana, Dip. Pharm.

Opium Dross Control Section

Assistant Chemist. Ua Rasmithat, Dip. Pharm.

Water Analysis Section

Chemist. Samroeng Vimuktananda, B.S. (Chem).
Assistant Chemist. Miss Somnuk Vongsaratana, Dip. Pharm.

Fuel Section

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

General Analysis Section

Assistant Chemist. Miss Bun Lom Khachentharachai, B.Sc.
Assistant Chemist. Pravati Isarankura Na Ayudhya, Dip. Ed.
Assistant Chemist. Miss Snith Mansilpa, B.Sc.
Assistant Chemist. Chalad Virayodhin.

DIVISION OF INDUSTRIAL CHEMISTRY

Senior Chemist. Aree Suphol, B.Sc.

Physics Section

Assistant Chemist. M.L. Anong Xumsai, B.Sc.
Assistant Chemist. Laukayura Lauhabandhu, Dip. Ed.

Ceramics Section

Chemist. Chalaem Phumiratana, Sc. B. Chem.
Assistant Chemist. Bunsup Bunya-uphaphat, Dip. Ed.

Textiles Section

Chemist. Miss Skul Nivasanandana, B. Sc.

Foods Section

Chemist. Yos Bunnag, M.Sc., A.R.C.S., D.I.C.
Chemist. Thongkham Milindalek, Dip. Pharm.
Chemist. Prathip Prathipasen, B.S.S.T.
Assistant Chemist. Sommatra Malayamal, Dip. Pharm.

Fermentation Section

Assistant Chemist. M.L. Chawipongse Rongsong, B.S.E.
Assistant Chemist. Chul Kanchanalaksana, Dip. Pharm.
Assistant Chemist. Kapan Lanhabhandhu, Dip. Pharm.

Minerals and Ores Section

Chemist. Vacant.

Work Shop Section

Assistant Mechanic. Boonsom Saisanit.

DIVISION OF AGRICULTURAL SCIENCE

Senior Chemist. Sangar Sharasuvarna, C.D.A. (Hons.).
Chemist. Magdaleno Cero, B.S. (Agr.).

Agricultural Chemistry Section

Assistant Chemist. Mrs. Prapan Panpat, B. Sc.
Assistant Chemist. Miss Chamnien Vimuktananda, Dip. Pharm.

Soil Analysis Section

Chemist. Suang Jarnprakorn.
Assistant Chemist. Miss Supha Ponchandara, Dip. Pharm.

Soil Bacteriology Section

Chemist. Thongchai Punyasingha B.S. (Agri.).
Chemist. Chom Raktakanit. B.S. (Agri.).

Fertilizers and Insecticides Section

Assistant Chemist. Lek Laksanahut, B.S. (Chem.).
Assistant Chemist. Miss Charoon Phalachivin, Dip. Pharm.

DIVISION OF PHARMACY

Senior Chemist. Prachuab Bunnag, Dr. Phil. Chem.
Senior Pharmacist. Arno Viehover, Ph.C., F.C., Ph.D., Pharm. D.
Senior Pharmacist. Rudolf Shaller, Appr. Apotheker.

Plant Chemistry Section

Pharmacist. Thongdee Suvanakas, B.S. (Pharm.).
Pharmacist. Tidtor Bunnag, B.S. (Pharm.), Dip. Pharm.

Pharmaceutical Chemistry Section

Pharmacist. Lieut. Chamnong Prasomthong, Dip. Pharm.
Pharmacist. Tor Thaewyu.
Medical Officer. Miss Chitra Chuangsuvanich, M.B.
Assistant Pharmacist. Prem Banichpol, B.Sc.
Assistant Pharmacist. Virabul Phongphiphat, Dip. Pharm.
Assistant Pharmacist. Somphon Nimihut, Dip. Pharm.
Assistant Pharmacist. Chamnong Pugglanandana.

Pharmacognosy Section

Pharmacist Chiad Aphaiwongse. Dip. Pharm.
Chemist. Miss Chomchai Semarabun, B.Sc.
Assistant Pharmacist. Sub-Lieut. Vichien Muang Noi Charoen, Dip. Pharm.

Biochemistry Section

Medical Officer. Kamthorn Suvanakich. M.B.
Medical Officer. Komol Pengsrithong, M.B.
Assistant Pharmacist. Puan Charoenbanij, Dip. Pharm.

Bacteriology Section

Medical Officer. Mrs. Praphai Vatanaphut, M.B.

Note; The staff arrangement was in accordance with the Royal Decree pertaining to the organization of the Ministry of Economic Affairs, No. 12, B.E. 2483.

APPOINTMENT

Sub-Lieut. Komol Pengsrithong, *May 14, 1938*: as
Medical Officer, Biochemistry Section,
Division of Pharmacy.

Mrs. Prapan Pampat, *May 14, 1938*: as
Assistant Chemist, Agricultural Chemistry Section,
Division of Agricultural Science.

Lek Laksanahut, *July 22, 1938*: as
Assistant Chemist, Agricultural Chemistry Section,
Division of Agricultural Science.

M.L. Chaweepongse Rongsong, *August 28, 1938*: as
Assistant Chemist, General Research Section,
Division of Industrial Chemistry.

Banbota Savawasu *December 19, 1938*: as
Assistant Chemist, Metallurgy Section,
Division of Chemistry.

Singto Ratanakasikarn, *April 1, 1939*: as
Head of Correspondence Section,
Office of the Secretary, (transferred from the Ministry
of Education).

Miss Bunlom Khachentharachai *April 17, 1939*: as
Assistant Chemist, Inorganic Chemistry Section,
Division of Chemistry.

Miss Chamnien Vimuktananda, *April 17, 1939*: as
Assistant Chemist, Ceramics Section,
Division of Industrial Chemistry.

Virabul Phongphiphat, *April 17, 1939*: as
Assistant Pharmacist, Pharmaceutical Chemistry Section,
Division of Pharmacy.

Tidtor Bunnag, *April 17, 1939*: as
Pharmacist, Pharmaceutical Preparation Section,
Division of Pharmacy.

Chul Kanchanalaksana, *April 24, 1939*: as
Assistant Pharmacist, General Research Section,
Division of Industrial Chemistry.

Miss Somchai Semarabun, *June 20, 1939*: as
Chemist, Pharmacognosy Section,
Division of Pharmacy.

Mrs. Praphai Vatanaphut, *August 2, 1939*: as
Medical Officer, Biochemistry Section,
Division of Pharmacy.

Laukayura Lauhabandhu, *October 27, 1939*: as
Assistant Chemist, Physics Section,
Division of Industrial Chemistry. (transferred from the Ministry of Education).

Prathip Prathipasen, *January 1, 1940*: as
Chemist, Forest Products Research Section,
Division of Industrial Chemistry, (transferred from the Department of Agriculture and Fishery).

Sub-Lieut. Thon Jarusorn, *February 1, 1940*: as
Medical Officer, Biochemistry Section,
Division of Pharmacy,
(transferred from the Ministry of Defence).

Chom Raktakanit *February 15, 1940*: as
Chemist, Soil Bacteriology Section,
Division of Agricultural Science, (transferred from the Department of Agriculture and Fishery).

Miss Sommuk Vongratana *May 1, 1940*: as
Assistant Pharmacist, Organic Chemistry Section,
Division of Chemistry.

Miss Snith Mansilpa, *May 1, 1940*: as
Assistant Chemist, Water Analysis Section,
Division of Chemistry.

Sommatra Malayamal, *May 1, 1940*: as
Assistant Pharmacist, Medicinal Product Section,
Division of Industrial Chemistry.

Kriang Tankulratana, *May 1, 1940*: as
Assistant Pharmacist, Plant Chemistry Section,
Division of Pharmacy.

Miss Charoon Phalachivin, *May 1, 1940*: as
Assistant Pharmacist, Plant Chemistry Section,
Division of Pharmacy.

Miss Somphon Nimihut, *May 1, 1940*: as
Assistant Pharmacist, Pharmaceutical Chemistry Section,
Division of Pharmacy.

Miss Supha Phenchandra, *May 1, 1940*: as
Assistant Pharmacist, Pharmacognosy Section,
Division of Pharmacy.

Kapan Lauhabandhu, *May 6, 1940*: as
Assistant Pharmacist, Biochemistry Section,
Division of Pharmacy.

Prem Banichpol, *June 1, 1940*: as
Assistant Chemist, Pharmaceutical Chemistry Section,
Division of Pharmacy.

M.L. Anong Nil-Ubol, *June 3, 1940*: as
Assistant Chemist, Textiles Analysis Section,
Division of Industrial Chemistry.

Miss Proesiri Bhekanandhana, *July 13, 1940*: as
Instructor, School of Practical Chemistry.

Rudolf Shaller, *July 15, 1940*: as
Senior Pharmacist,
Division of Pharmacy.

Miss Chitra Chuangsuvanich, *August 1, 1940*: as
Medical Officer, Pharmceutical Chemistry Section,
Division of Pharmacy.

Officials Who Left the Department of Science

1. Khun Chamras Rasayana, Head of the Correspondence Section, Office of the Secretary, on February 1, 1939.
2. Udom Kraisorakul, Chemist, Opium Dross Control Section, Division of Chemistry, on May 1, 1939.
3. Phong Manidith, Accounts Section, Office of the Secretary, transferred to the Department of Custom on June 1, 1940.
4. Mom J. Dubois Chitrabongse, Chemist, Metallurgy Section, on August 1, 1940.
5. Miss Aroon Israbhakdi, Chemist, Textiles Analysis Section, Division of Industrial Chemistry, transferred to the Department of Public Welfare on October 1, 1940.

Observation Tour in Various Fields Abroad

Thongchai Punyasingha : U.S.A.
August 2, 1938— November 14, 1939.
Soil Bacteriology.

Luang Vichien Dhatukarn : Federated States of Malaya.
March 11-14, 1939.

Vongse Naewbanij : England. June 17, 1939–February 24, 1940,
Metallurgy.

Dr. Prachuab Bunnag : Japan and Java.
March 23, 1939–June 29, 1940,
Alcohol Manufacture.

Banbota Savawasu : Indo-China, Japan, Java, Philipines,
Formosa, and Manchuria,
March 30, 1940 – June 30, 1940,
Salt Production.

Aree Suphol : Singapore, August 28, 1940-September 10, 1940.
Purchase of Alcohol Distillation
Equipment.

Official Tour in the Country

1. Luang Vichien Dhatukarn and Kliaw Bunnag gave Assistance in the condensed milk production of the Military Quarter-master Department at Supmuang, Nakornrajsima, from January 25, 1939 to January 31, 1939.
2. Dr. Toa Labanukrom representing the Prime-Minister, presided over the opening of the Merchandise Exhibitions at Nakornbhanom with Pue Rochanapurananda as secretary. Besides going to the Exhibitions they also went to Ubol, Sakolnakorn, Udorn, Nongkai, Korngaen, Mahasarakam, Roi-et and Nakornrajsima on a general inspection tour from January 21, 1939 to February 4, 1939.
3. Dr. Prachuab Bunnag made a survey of asbestos in Nan and Uttraradit from March 12, 1939 to April 1, 1939.
4. Phra Krasapna Bibhag, Chiad Apaiwongse, Vongse Naewbanij made a study of gold mining in Toh-Moh and mining in the southern provinces from April 5, 1939 to April 29, 1939.
5. Chalaem Bhumiratana went to inspect the pottery industry in Chiengmai and Lampang from August 2, 1939 to August 12, 1939.
6. Dr. Arnold Viehover made a survey of sources of various medicinal plants in Cholburi from October 28, 1939 to October 30, 1939.
7. Chalaem Bhumiratana made a survey of sources of Hin Fan Ma or Feldspar at Hua Hin from October 29, 1939 to October 31, 1939.
8. Ua Rasmidhata observed the tapping of opium in Chiengmai from December 31, 1939 to January 13, 1940.
9. Dr. Toa Labanukrom and his party made a survey of medicinal plants, minerals, local industries, and agriculture in Chiengmai, Lampun, Taak, Sukothai from March 17, to March 30, 1939.

10. Tongkham Milintalek and Chalaem Bhumiratana observed the making of vermicelli and umbrellas in Chiengmai from June 19, 1940 to July 10, 1940.

11. Dr. Arnold Viehover, R. Schaller, Magdaleno Cero, Virabul Phongsphiphat and Sa-Ngiam Phongsboonrod inspected various places in Chiengmai in order to have medicinal plants planted for official use in the Pharmacy Division from October 2, 1940 to October 8, 1940.

12. Pravat Isarankura Na Ayudhya and officials in the Department of Mines made a survey of asbestos in Uttradit from March 3, 1941 to March 19, 1941.

Special Duty

Kliaw Bunnag :	1938.	Special Lecturer in Analytical Pharmacy, School of Pharmacy, Chulalongkorn University.
	1939.	Special Lecturer in Standardization, School of Chulalongkorn University.
Thongdee Suvanakas :	1938.	Special Lecturer in Industrial Chemistry, School of Pharmacy. Chulalongkorn University.
	1939.	Special Lecturer in Pharmacy, Chulalongkorn University.
Dr. Kamthorn Suvanakich :	1938-40	Special Lecturer in Public Health, Faculty of Arts and Science. Chulalongkorn University.
Tidtor Bunnag :	1939.	Special Lecturer in Pharmaceutical Chemistry, Chulalongkorn University.
Dr. Arnold Viehover :	1939.	Special Lecturer in Pharmacy, Chulalongkorn University.

Chiad Aphaiwongse :	1939.	Special Lecturer and Assistant Head of the School of Pharmacy, Chulalongkorn University.
Magdaleno Cero :	1939.	Member of the Agriculture and Fishery Joint Committee in making soil survey for planting Tobacco at Chiengrai.
	1940.	Special Lecturer, the University of Agriculture.
Dr. Toa Labanukrom :	1940.	Director of the National Air Raid Precaution Committee.
Dr. Prachuab Bunnag :	1940.	Member of the National Air Raid Precaution Committee.
Luang Vichien Dhatukarn :	1940.	Member of the National Air Raid Precaution Committee.
Banbota Sudhikam :	1940 :	Special Analytical Chemist, Department of Fuels.
Sub-Lieut. Thon Jarusorn :	1940.	Special Training in Biochemistry, Faculty of Medicine, Chulalongkorn University.
	1940.	Special Course in Surgery, Ministry of Defence.
Sub-Lieut. Komol Pengsrithong :	1940.	Special Course in Surgery, Ministry of Defence.

GENERAL REVIEW

On the whole, it could be seen that the Department during the period covered by this report, made a considerable progress. The work of various divisions had been re-organized. The Library Section was added to the Office of the Secretary. The Organic Chemistry Section and the Inorganic Chemistry Section were removed from the Division of Chemistry, since the work done by these two sections were carried out by other sections. A Forensic Chemistry Section was set up under the Division of Chemistry. Under the Division of Industrial Chemistry, the Medicinal Products, the Forest Products Research and the General Research Sections were abolished and the Physics, Food, Fermentation, Minerals and Ores and the Workshop Sections were set up. The Textile Section came under the Fibre Section. Under the Division of Pharmacy, the Pharmaceutics Section was abolished since it had grown out to form a separate Pharmaceutical Establishment and a new Bacteriology Section was added.

The analytical work done during this period :

		1938	*1939*	*1940*
Total number of samples analysed		9092	6291	5897
Routine samples	Opium Dross	2619	1437	994
	Bronzes	2162	541	252
General samples		4311	4313	4651

It should be noted that during 1940, only nine-months work was taken into account.

The average increase of work could be compared with the previous periods :

	1932-33	*1934-35*	*1936-37*
General samples	2193	3413	6880
Average per year	1096	1706	3440

Although more officials had been appointed during this period, still they were found insufficient to handle a much greater increase in the volume of work. Owing to such expansion, the working space had become inadequate. A plan for new buildings of the Department on a new site at Phya Thai was proposed. The new site comprising an area of 47 rais (75,200 square meters), was rented from the Crown Property Office. The Pharmaceutical Factory building was established first, and the main building later. During the period covered by this report, the Pharmaceutical Building was finished but only the foundation of the main Science Building was laid down. The details of the construction will be found in this report.

During this period there were in all 68 officials, including 30 new members. Five officials left the Department and six went abroad on official duty.

Besides performing their allotted work, many officials were requested to render assistance to other Departments, such as the Department of Agriculture and Fishery, and the Department of Fuels; some were requested to be special lecturers at the Chulalongkorn University and members of various committees.

There had been two new striking activities namely (1) the periodical lectures given by officials with the purpose of keeping members well informed of recent scientific developments: and (2) the certification of locally produced merchandise with the purpose of making known to the public the reliability of local products.

The Forest Products Research and the General Research Sections, formerly were under the Division of Industrial Chemistry, and after being transferred to the Division of Pharmacy, these two sections had been concentrating on medicinal plants.

THE LIBRARY

Formerly the Library was part of the Correspondence and Library Section. Owing to the fact that the library had its own significance, it was thus considered best to form a new section under the Office of the Secretary. This was accomplished and announced in the Royal Decree concerning the Organization of the Ministry of Economic Affairs, No. 12, issued in 1940.

To begin with the new Library Section was under staffed, so various officials were requested to help temporarily under the direction of the Director-General.

Under this new set up, the library work was entirely re-organized according to the universal practice. New scientific books, publications and journals were purchased.

Items	Number of Volumes at the end of 1937	Number of Volumes at the end of 1940	Increase		Remarks
			Volumes	per-cent	
1. Scientific books	1314	1794	480	30	Total number
2. Scientific publications	355	655	300	84	of bound
3. Scientific journals	48	73	25	52	volumes at
4. Other publications	98	179	81	83	the end of
5. Other journals	18	34	16	89	1940 was
	(kinds)	(kinds)	(kinds)		499

During this period the Library published 8 pamphlets on various scientific subjects for distribution to the public.

THE SCIENCE MAGAZINE

"Science" a quarterly magazine, originated in 1936 for the purpose of popularizing and encouraging the study of Science among the public had been warmly received by the Thai throughout the country.

Staff of "Science" Magazine for the Year 1938:

Editor:	Dr. Toa Labanukrom
Assistant Editor:	Pue Rochanapurananda
	Kliaw Bunnag
Manager:	Pravat Isarankura Na Ayudhya
Advertising Manager:	Sroung Charuprakara
	Ua Rasmidatta
	Bunsup Bunya-nphaphat
	Siri Suvanpathama
Treasurer:	Siri Chuvidya

Publication Committee

Phra Krasapna Bibhag	Dr. Prachuab Bunnag
Luang Vichien Dhatukarn	Sangar Sharasuvarna
Kamthon Suvarnakich	Lt. Chamnong Prasomthong
Thongdee Suvanakas	Miss Aroon Israbhakdi

Staff of "Science" Magazine for the Year 1939:

Editor:	Phra Krasapna Bibhag
Manager:	Singto Ratanakasikara
Advertising Manager:	Sroung Charuprakara
Treasurer:	Siri Chuvidya

Publication Committee

Sangar Sharasuvarna	Aree Suphol
Kamthon Suvarnakich	Pue Rochanapurananda
Kliaw Bunnag	Lt. Chamnong Prasomthong

Staff of "Science" Magazine for the Year 1940 :

Editor : Phra Krasapna Bibhag
Manager : Singto Ratanakasikara
Advertising Manager : Sroung Charuprakara
Treasurer : Siri Chuvidya

Publication Committee

Sangar Sharasuvarna — Aree Supol
Kamthon Suvarnakich — Kliaw Bunnag
Lt. Chamnong Prasomthong — Miss Sakul Nivasanandana
Prathip Prathipasen — Bunsup Bunya-uphaphat
Pravat Isarankura Na Ayudhya — Lek Laksanahut

THAI SCIENCE BULLETIN

Besides the "Science" magazine, the Department also published the "Thai Science Bulletin" in English, to report the results of Scientific investigation and research carried out in Thailand. It is published in English for the purpose of distribution among foreign scientific institutions and organizations. At first, the publication was not regular, depending on available materials, but later it was quarterly issued.

During 1938-1940, four issues appeared. The Department sent out the "Bulletin" to 28 countries and had been receiving in return 35 regular publications.

The Editor of the "Thai Science Bulletin" was Pue Rochanapurananda.

SCIENTIFIC LECTURES

The programme of "Scientific Lectures" was introduced by Dr. Toa Labamukrom. The scientific and technical officials were asked to participate in giving lectures. The subjects either chosen by the lecturer himself on his own field or by his Chief of Division, were submitted to the Director-General for approval. External experts were also invited to give lectures. At the start of

the programme, lectures were given during the office hours in the afternoon but later on changed to after the office hours. The change was affected to benefit the public who were interested in science. Moreover, slide-projection as an aid in lecturing could be done easily at night. After the lecture, there was an open discussion which proved to be very advantageous in exchanging ideas.

The objects of this programme were two-fold, firstly to train officials in giving lectures, and secondly to benefit other officials in subjects outside their own fields of work.

From 1938-1940, there were 26 lectures on the following subjects :

1. The Analysis of Wolframite Ores.
2. Different Kinds of Gas Masks.
3. The pH of Soils.
4. The Polarization of Light and Some of Its Application.
5. The Methods of Analysis of Limited Quantities of Arsenic, Lead, Iron, Sulphate and Chloride in Drugs.
6. Bioassay.
7. The Papaya Sap.
8. The Analysis of Narcotics.
9. Textiles.
10. The Determination of Alcohol in Beer Manufacture.
11. Soaps.
12. The Analysis of Blood Stains.
13. Ceramics.
14. The Body Resistance and the Preparation of Anti Human Serum.
15. The Preparation of Drug-Tablets.
16. Experiments on Alcohol and Liquors.
17. Bacteria.
18. The Analysis of Fats and Butter.

19. Soil Micro-organisms.
20. The Analysis of Opium-Alkaloids.
21. Red-Palm Oil.
22. Fabrication of Non-ferrous Materials.
23. Microscopes.
24. The Alcohol Fermentation.
25. Thai Resources of Heart-stimulants.
26. Industrial Promotion in Thailand.

THE CERTIFICATION OF LOCALLY MANUFACTURED PRODUCTS

Not long after the War broke out in Europe in 1939, the importation of manufactured goods into Thailand was greatly reduced. The prices of those articles which could occasionally come into the country rised tremendously. To meet the public demand, varieties of merchandise were locally made. There was however a keen competition among producers and the public choice seemed to depend mainly upon effective advertisements which did not necessarily comply with the quality of the goods. In order to direct the public towards more reasonable and genuine products and to encourage faithful manufacturers at the same time, the Department initiated the certification of those which were up to the standard. The approval was given only when the results of chemical analyses or certain physical tests were comparable to those of reliable imported goods of the same type.

During 1939-1940, 62 kinds of merchandise were sent in for approval, only 20 of them were up to the standard. The fact that only 62 kinds of goods were sent in, did not mean that only 62 varieties were produced in the country. In fact there were a great deal more, but whatever was already accepted by the public the manufacturers did not trouble to send in for official approval.

The merchandise approved during 1939-1940:

1. Ramasun-Mekhala Printed Cloth of Silpathai Factory.
2. Distilled Water of Bangkok Distilled-Water Factory.
3. Savitri Printed Cloth of Praneet-Industrial Factory.
4. Dr. See Toothpaste of Dr. See-Factory.
5. Disinfectant of Hatayich Dispensary.
6. Snipe Brand Kesini Sauce of B.T. Works.
7. Bayan Liquid Powder of Phenprabha Factory.
8. Bayan Tooth Powder of Phenprabha Factory.
9. Bayan Hair Dressing Cream of Phenprabha Factory.
10. Swan Sauce of Bangkok Thai-Chemical Company.
11. Chula Toilet Soap of the Elephant Brand Soap Co., Ltd.
12. Cat Brand Chalk of Sriayuthaya Factory.
13. Turkey Brand Sauce of M.L. Ngiab.
14. Machinery Brand Glue of Praneet Industrial Factory.
15. Raden Curlset Hair Dressing Cream of Raden Toiletries Co.
16. 1.77 Baby Powder of the 1.77 Factory.
17. 1.77 Hair Cream of the 1.77 Factory.
18. 1.77 Hair Tonic of the 1.77 Factory.
19. Raden Tooth Powder of Raden Toiletries Co.
20. Bear Brand Lux Hair Cream of Lux & Son Factory.

THE CONSTITUTIONAL FAIR EXHIBITIONS

The Department of Science took part in the Constitutional Fair Exhibitions for the years, 1938, 1939 and 1940.

In 1938 the Department took part as a section of the Division of Economics, led by the late Dr. Toa Labanukrom. The object of this exhibition was to advocate the usefulness of soybean and certain foods and to display the work in Pharmacy and Agriculture.

The soybean advertisement was a continuation of the previous show. In addition, the soybean-milk was prepared and sold to the public on the spot.

As for the significance of food in Nutrition, facts concerning essential nutrients were stressed. A comparison was made between Thai foods and some imported food products. Besides, a publication in Thai on "Food and Soybean" was also published for distribution to the public.

On the Pharmaceutical Paael, it was shown how some local medicinal plants could be used in making modern medicine, and what were their important properties. The preparation of finished drugs from local medicinal plants was exhibited.

Samples of soil from various provinces with analytical results were shown in the Agricultural section. The soil samples were placed in glass containers, in such a way that, different layers of soil could be easily seen as a cross-section of the natural stage of formation.

In one section, a temporary office of the "Science" magazine was put up to take new subscriptions and to sell back numbers of the magazine.

In 1939, the Department of Science again took part in the Exhibition in conjunction with the Department of Economics. Phra Krasapna Bibhag, Assistant Director, was made the chairman. The exhibition was arranged in 6 sections, namely, Pharmacy and Food, the Division of Chemistry, the Division of Agriculture, the Division of Industrial Chemistry, the advertisement of the "Science" magazine, and the distribution of guide-books of the show put up by the Department of Science.

In the Pharmacy section, the show was divided into four sub-sections:

(1) Medicine and drugs used in protection and as remedies against certain poisonous gases,

(2) Medicine prepared locally,

(3) The differences between the medicine prepared by the older and modern methods,

(4) The plan of the future Pharmaceutical Building.

The "Food Show" was divided into 4 sub-sections:

1) General food, to show the public the nutritive values of common foods and the body requirements,

2) Milk, to illustrate to the public that pasteurized milk was more beneficial than the non-pasteurized. Samples of non-pasteurized milk with micro-organisms usually found in them were shown,

3) Vitamins: guinea-pigs showing a sign of vitamin-deficiency were displayed,

4) Preservation of foods: various methods of food preservation were demonstrated for the benefit of housewives such as candies fruits, fruit-jam, pickled vegetables, and preserved meat and fish.

The exhibition of the Division of Chemistry was divided into five sub-sections:

1) Data and statistics of analytical results of various commodities,

2) The analysis of opium and opium dross,

3) Poisonous foods,

4) The preparation of soybean sauce: steps were shown from the beginning to the end product,

5) The distillation of some essential oils, such as Ylang Oil, Carnation Oil and that from kaffir leine skin.

The show of the Division of Agriculture was divided into 5 sub-sections:

1) Maps of soil survey,

2) The advantages and certain qualities of some fertilizers,

3) The elimination of plant-enemy in the soil,

4) The effect of light on plant-growth,

5) Essential plant nutrients: this was illustrated by planting rice in solutions.

The show of the Division of Industrial Chemistry was divided into 3 sub-sections:

1) Ceramics,

2) The preparation of alcoholic liquor from rice,

3) The Exhibition of some scientific apparatus made by the Workshop of the Division.

The advertisement of the "Scienc" magazine was arranged as in the previous year.

In 1940, the Department again co-operated with theDivision of Economics in the Annual Constitutional Exhibitions as in 1938 and 1939. Phra Krasapna Bibhag was the chairman. The show was similar to the one in 1939. Minor variations were as follows:

The Division of Chemistry: the oven-drying of coconut kernel; and preparation of essential oils and dyes from local plants.

The Division of Industrial Chemistry: samples of earthenwares made with local materials were displayed; the preservation of foods and the the production of yeast for fermentation.

The Division of Pharmacy: map of Thailand showing the sources of medicinal plants, medicine prepared and tested at the Department, and the diagram of the preparation of drugs from some medicinal plants.

The Division of Agriculture: the growth of micro-organisms, the development of soybean and some globular rooted plants, and the development of pea-bacteria.

The major deviation from the previous year was the exhibition put up by the School of Practical Chemistry. In this section, it was shown how various things could be made for home-use by simple methods. Samples of table salt, syrup, ink, paper-glue, starch-glue, mosquito-repellant, face powder, tooth paste, hair oil, and shoe-polish were displayed. Besides, students demonstrated the preparations of some of the above mentioned articles.

It could be said that the public was quite interested in the exhibition and realised the contributions made by the Department of Science.

THE CONSTRUCTION OF NEW BUILDINGS

Even a new building for the Division of Pharmacy had been established as described in the 9th report, the working space was found inadequate owing to the fact that additional divisions and sections had been set up within the Department in later years. The Crown Property Office had already leased a piece of land of 47 rais at Phya Thai to the Department for its programme of expansion. The construction of the Pharmaceutical Establishment– a one storied building occupying an area of 900 sq. meters, was completed. The main building of the Department will be built later. It is expected that the new Department would be a three storied building of the size 160×20 meters with two wings of 60×20 meters each in addition. Already the foundation of the building had been laid with the cost of 112, 543 baht. It is sincerely hoped that the construction could proceed according to plan.

THE SCHOOL OF PRACTICAL CHEMISTRY

To meet our requirement of assistant-chemists, the School of Practical Chemistry, attached to the Department of Science, was formed in 1937.

In 1938, the School admitted the second group of 15 students. In 1939, only 17 students were selected from 67 candidates for the course. In 1940, there were 43 candidates but 11 students were admitted.

The Ministry of Education revised the High School curriculum in 1940 and it was found that with this new change High School graduates were inadequately prepared for the School of Practical Chemistry. The Department found it necessary to set up a one-year preparation course for those who desired to enter the School of Practical Chemistry. There were 147 applicants, but only 21 were admitted.

Nine of the first group of students who entered the School in 1937 graduated in 1939, and twelve of the second group obtained their certificates on December 1, 1940.

In the meantime, the School had raised its standard and many more hours were added to the practical work. Besides their regular work, the students were taken out on tour, visiting many factories and industrial plants, such as, the Paper Mill, the Textile Mill, the Oil Extraction Factory, the Liquid Fuel Refinery, etc.

All of the graduates in 1939, were employed at the Department and they proved to be quite satisfactory.

In 1940, as already described the School of Practical Chemistry participated in the Annual Constitutional Exhibitions, under the Division of Economics.

From the figures of the applicants in the last few years, it could be noted that the School was now quite popular and well recognized. There were other Governmental Agencies who desired to take on some of the graduates, but so far they could not be spared. However, it is hoped that in the years to come the School would probably produce enough assistant-chemists to meet the requirements of other institutions as well.

DIVISION OF CHEMISTRY

The routine analysis of opium, water and certain fuels had been the major concern of this Division. Special assignments were usually handed on to the General Analysis and Forensic Chemistry sections.

The following table shows the number of samples of opium dross, bronzes and water analysed during the period covered by this report.

	Opium Dross	Bronzes	Water
B.E. 2481	2,619	2,162	1,192
B.E. 2482	1,437	541	1,527
B.E. 2483 (9 months)	994	252	1,767

TABLE SALT

In 1938, the Excise Department took control of salt production all over this country. In co-operation with the Excise Department, the Department of Science gave technical assistance in analysing brine, sea-salt and land-salt from which salt was extracted.

The following table shows analyses of salts from various provinces:

Lab. No.	Source	Insoluble matters in water %	$CaSO_4$ %	$CaCl_2$ %	$MgCl_2$ %	NaCl %	Other salts %
AF. 337	Chaiyaphum	0.28	—	0.78	0.09	97.88	1.97
AF. 338	Burirum	0.41	2.32	1.21	1.05	93.99	1.92
AF. 341	Nakornrajasima	0.28	—	2.03	0.41	96.40	0.88
AF. 343	Mahasarakham	0.48	0.77	0.46	0.05	97.76	0.48
AF. 345	Ubol (black)	0.60	0.73	0.38	0.03	97.78	0.48
AF. 345	Ubol (white)	0.16	0.24	0.11	0.02	98.85	0.62
AF. 347	Udorn	0.37	1.67	0.36	0.05	97.07	0.48
AF. 349	Khon-kaen	0.19	0.75	1.16	0.16	96.79	0.95

Computations are based on moisture free basis.

The results of analyses of land salt from various provinces:--

Lab. No.	Source	Chlorides expressed as NaCl % (Moisture free basis)
AF. 393	Burirum	3.44
AF. 340	Chaiyaphum	3.23
AF. 342	Nakornrajasima	4.85
AF. 344	Mahasarakham	4.12
AF. 346	Ubol	3.86
AF. 348	Udorn	6.58
AF. 350	Khon-kaen	0.33
AF. 694	Loei	6.49
AF. 696	Roi-et	6.18
AF. 707	Surin	0.16
AF. 711	Srisaket	7.02

In connection with salt production the Co-operative Department also took part by setting up Salt Co-operative Settlements in 1939 at Smut Sakorn. Samples of salt from Khun Samut Manirat were sent to the Department of Science for analysis. In the native method of salt production, sea-water was let into the first field to stand in the sun. When all sediments had settled the brine was drained into another field for further evaporation. The concentrated brine was let into the third field and the salt crystallized out. The whole procedure was carried out without any scientific aids; only experience was the sole guide.

Average Analytical Results of Smut Sakorn Table-Salt :

	Calculated from Sample as received %	Calculated on moisture free basis %
Moisture	10.01	—
Water insoluble matters	0.01	0.01
NaCl	85.96	95.61
$CaSO_4$	1.22	1.36
$MgSO_4$	0.30	0.33
$MgCl_2$	1.68	1.87
Other salts	0.73	0.82

SOYBEAN MILK

In order to promote the consumption of soybean milk the Department of Science produced this soybean product for distribution among hospitals and other institutions. It was easy and inexpensive to produce free from germs normally found in animals milk. Two hundred and fifty students of the University of Morals and Political Sciences were put on the soybean milk diet of 45 litres for two months. It was found that their general health improved considerably. Dr. Montri Mongkolsamai of the Siriraj Hospital reported that the soybean milk was not recommended for infants because it contained insufficient amount of fat. But this deficiency could be supplemented by coconut milk. Soybean milk was quite suitable for older children.

Results of analyses of soybean milk of dilution 1:5 (soybean 1 part, water 5 parts) and soybean milk of dilution 1:10 (soybean 1 part, water 10 parts) could be tabulated below:—

	Dilution 1:5	Dilution 1:10
Protein	3.60 %	2.22 %
Fat	1.44 %	0.74 %
Mineral salts	3.07 %	0.35 %
Carbohydrate	1.71 %	0.64 %
Calorific value per 100 g.	349 cal.	186 cal.

The composition of soybean milk varied with the type and age of the soybean and the temperature of water extraction.

TUNG SEEDS AND TUNG OIL

In 1937, the Forest Department sent tung seeds from Pattani for analysis as mentioned in the 9th report; since then more tung seeds were received for further investigation. The seeds from Pattani is known as *L tsea grandis*

The whole seed:

Moisture	8.4 %
Oil	37.5 % (moisture free)

Oil extracted with Petroleum Ether:

Specific gravity,	30°C.	0.986
Solidifying point		30°C.
Melting point		41°C.
Iodine value		—
Saponification value		210.0
Unsaponifiable matter		6.2
Refractive index	60°C.	1.461
Reichert-Michel value		2.7

COTTON SEED-OIL

The Thai Weaving Factory sent samples of cotton-seed oil which had been extracted and purified by them to this Department for analysis.

Specific gravity	25°C.	0.9492
	29.5°C	0.9475
Refractive index	20°C.	1.473
	40°C.	1.467
Rotation	25°C.	0.09
Acid value (as oleic acid)		0.50%
Iodine value		103.15
Saponification value		195.7

The cotton-seed oil was of standard purity and was edible.

In the 9th report it was mentioned that the Committee for the promotion of soybean products had recommended the setting up of a factory for the extraction and purification of soybean and other oils to the Council of Ministers; consequently the sub-committee for the planning of the Factory with the Director-General of this Department as chairman was then set up. When the construction was completed the factory was placed under the supervision of the Thai Weaving Factory, since the cotton-seed was their important by-product. The extraction and purification of cotton-seed oil could be carried out at all times and the soybean oil was produced only when soybean was found surplus in the market.

ASBESTOS

During his trip to Uttradit to prospect for asbestos Dr. Prachuab Bunnag brought back specimens of asbestos for analysis. They were Tremolite, $CaMg_3(SiO_4)_3$. Its composition was as follows :-

SiO_2	57.29 %
Al_2O_3	2.16 %
Fe_2O_3	4.54 %
CaO	13.02 %
MgO	19.36 %
Loss on ignition	3.12 %

DESICCATED COCONUT

The Division of Chemistry had coconut-flesh flaked and dried with a view to study the methods of its preservation since it would save the cost of transportation and storage.

It was found that the flakes remained wholesome after having been kept sealed in a tin for a period of one year. The milk squeezed from these moistened flakes was indistinguishable from that obtained from a fresh one.

Method of making dried flakes: The white flesh of the coconut was first cleaned and then put in a flaking machine. The flakes were then spread uniformly over a tray and then dried in a steam oven at 70—80°C, for 4—6 hours. Then they were packed in tins and hermetically sealed.

Making coconut milk: The preserved flakes were soaked with water and squeezed to obtain the coconut milk.

It was found that the dried flakes weighed only 8.28 % of the whole nut. Flakes from 22 nuts could be packed in a standard kerosene tin. The whole package weighed only 6 Kg.

To the Ministry of Defence, the Department had recommended that this dried product should be used for soldiers in the field.

FORENSIC CHEMISTRY

The work in this section included analysis of poisons, blood stains, seminal stains, questioned documents, firearms, explosives and unlawful imitations.

POISONING CASES

The total number of specimens of suspected poisoning cases and the identification of poisons responsible could be tabulated as follows:

		Number of Specimens.		
		1938	*1939*	*1940*
	Total	127	54	28
Identified as:—	Arsenic oxide	27	6	3
	Chloral hydrate	—	—	1
	Codeine	—	—	1
	Copper compounds	—	2	—
	Corrosive substance	—	—	1
	Cyanide	—	2	1
	Cyanogenetic glucoside	1	—	—
	Hydrochloric acid	—	1	—
	Hypnotica (unknown)	1	—	—
	Lead carbonate	—	1	—
	Mercury	—	1	—
	Oil of Wintergreen	1	—	—
	Opium	1	—	—
	Phenol	1	—	—
	Potassium hydroxide	—	1	—
	Strychnine	—	2	—
	Sulphur	—	1	—
	Veronal	1	—	—

THE POISONOUS FRUIT

The fruit, *Paranephelium macrophyllum*, grows wild in Yala. The fact that it is poisonous became known when warders and inmates of the Yala prison were rendered unconscious after having taken the fruits. The chemical analysis showed the presence of a cyanogenetic glucoside from which hydrocyanic acid was liberated on boiling.

CHLORAL HYDRATE

The case of murder by poisoning occurred at Bangkwang Prison. The defendant tried to complicate a hated warder by poisoning fellow prisoners who were under the charge of the warder. This resulted in the death of a prisoner who had taken more contaminated food than others. The remaining food and stomach content of the deceased showed that chloral hydrate was used. The amount of chloral hydrate in the deceased stomach totalled 2.35 g. which was in excess of the usualdose of 0.3-1.2 g. as a soporific The poison actually taken must have been of a greater quantity since most of which had come out with the vomit. The defendant dissolved chloral hydrate in milk.

MEDICINAL PILLS CONTAINING ARSENIC

This case was not an intentional poisoning. Many similar cases of poisoning were due to the ignorance of the makers of this sort of native pills. The victim lived in Ubol and was suffering from gonorrhea. He bought some pills from an old fashioned practitioner who advised him to take 2 pills daily, morning and evening. The sufferer took two pills and felt burning pain in his mouth and gullet. He went to the local medical officer and received the necessary treatment. The rest of the pills were sent here for analysis. It was found that each contained 12 mg. of white arsenic. A dose of 10 pills or 220 mg. would have been fatal.

BLOOD STAINS

During the period covered by the report the Department had analysed blood stains:—

In 1938, 75 specimens in 26 criminal cases. Findings were positive in 29 specimens from 13 cases.

In 1939, 41 specimens in 23 criminal cases. Findings were positive in 32 specimens from 17 cases.

In 1940, 54 specimens in 21 criminal cases. Findings were positive in 19 specimens from 10 cases.

Usually these blood stains were found on clothings, weapons or surrounding objects. But in one case they were found on the defendant's body who had to come to the laboratory in person. The stains proved to be human blood but the defendant also had some wounds so it could not be proved whether the stains were his own blood or some one else. This difficulty arose from the fact that our work concerning blood tests had not progressed enough to distinguish one type of human blood from another. It is hoped that we would be able to do so in the near future.

SEMINAL STAINS

During the period covered by this report 4 specimens from 3 cases of raping were sent for identification of seminal fluid. The findings were positive in 2 cases.

DOCUMENTS

The analysis of documents usually concerned the age of ink used in suspected writings. Alterations of document may also be detected. There were cases of fraudulent tampering of documents. One case concerned the cleaning of used revenue stamps and sold or re-used them. The police authority wished to know if the stamps had been cancelled and then cleaned with a chemical eradicator. We found that the stamps had been used and then erased with a solution of hypochlorite. An enlarged photograph of the stamp showed tracings on paper fibres due to the first cancellation with pen and ink.

Another interesting case concerned counterfeit rubber coupons. The police authority sent both suspected and genuine coupons for comparison. By subjecting the coupons to exact measurements, weighing, microscopic examination of fibres, and weighing of incinerated coupons, we could be certain that they were printed on different kinds of paper.

FIRE-ARMS

The usual work concerning fire-arms is to ascertain whether it had been fired after the last cleaning.

In 1938 there were 14 specimens of which 8 were positive.

In 1939 there were 29 specimens of which 19 were positive.

In 1940 there were 12 specimens of which 6 were positive.

Most of the specimens were foreign made fire-arms such as, automatics and revolvers. Only two specimens were crude home made cap-guns.

GUNPOWDER & EXPLOSIVES

There were 10 specimens suspected to be explosives. Findings were positive in 4 specimens, one of which was gelatin dymanite.

COUNTERFEIT COIN ALLOYS

During this period the police authority sent for analysis alloys suspected in counterfeits. There were 23 specimens from 5 cases. Specimens from 4 cases were alloys totally different from that used at the Mint. In one case the specimens were in the form of unperforated coins but the alloy used was indentical with the legal one.

HARMFUL HABIT-FORMING DRUGS

During this period the Division of Chemistry had analysed 104 specimens which were suspected to contain harmful habit-forming drugs, sent by the Departments of Police, Public Health and Customs. These specimens were drugs advertised as cough-cures or opium bane in powder, pills and liquid forms. The findings were positive in 60 specimens. Morphine was found in

51 specimens. These did not include those sent by the Excise Department which appears under the heading illicit opium.

The results of analysis in connection with the harmful-habit-forming drugs are as follows :—

Samples

From	Opium	Morphine	Codeine	Cocain	Papaverine
Police Department	—	22	—	—	—
Department of Public Health	1	28	4	—	—
Department of Customs	—	1	2	1	1

ILLICIT OPIUM

The Division of Chemistry had received from the Excise Department 170 specimens suspected to be illicit opium. The results of analysis showed that 60 specimens contained opium and 4 specimens contained morphine.

PURE MORPHINE

The Division of Chemistry prepared 2165.8 g. of pure morphine for the Department of Public Health.

THAI OPIUM

Formerly the Excise Department imported raw opium from foreign countries, when this was interrupted by the outbreak of war, opium was purchased from the Northern Provinces of Thailand. Specimens were sent to the Department for analysis. The results are tabulated below :

From	Sample No.	Moisture %	Morphine %
Chiengmai	AD. 591	31.0	11.0
,,	AD. 592	25.9	7.4
,,	AD. 593	23.3	8.1
,,	AD. 594	19.9	12.7
,,	AD. 595	20.7	10.3
,,	AD. 596	25.1	9.0
,,	AD. 597	22.8	11.4
,,	AD. 598	28.1	10.4
,,	AD. 599	18.2	11.3
,,	AD. 612	22.2	8.7
,,	AD. 613	21.9	5.7
,,	AD. 614	14.8	6.3
,,	AD. 811	21.9	8.8
,,	AD. 812	18.6	11.1
,,	AD. 813	32.5	5.2
,,	AD. 814	21.1	10.8
,,	AD. 815	22.7	10.0
,,	AD. 816	21.6	10.0
,,	AD. 817	24.8	8.5
,,	AD. 818	24.9	10.6
,,	AD. 819	22.6	9.8
Chiengrai	AD. 600	21.8	9.5
,,	AD. 601	22.3	9.3
,,	AD. 602	20.8	9.1
,,	AD. 603	22.4	10.1
,,	AD. 604	25.5	10.5
,,	AD. 605	23.1	10.1
,,	AD. 606	23.5	10.6
,,	AD. 607	23.8	10.2
,,	AD. 608	27.8	9.6
,,	AD. 609	13.3	9.2
,,	AD. 610	14.1	9.3
,,	AD. 611	10.7	6.4
,,	AD. 733	29.8	10.2
,,	AD. 724	28.0	10.6
,,	AD. 725	30.0	11.1

From	Sample No.	Moisture %	Morphine %
Nan	AD. 726	21.5	11.0
,,	AD. 727	17.6	10.1
,,	AD. 728	20.7	8.5
,,	AD. 729	39.5	6.5
,,	AD. 730	43.9	6.9
,,	AD. 731	39.4	7.5
,,	AD. 799	52.1	3.4
,,	AD. 800	53.5	2.2

The moisture content of imported raw opium was about 10%. The analyses had shown that the morphine content of Thai opium compared favourably with those imported. The figures appeared lower in percentage owing to high moisture content; this might be due to the lack of experience of our collectors.

In giving technical assistance to the Excise Department, Ua Rasmidats joined the group of officials in charge of the transaction at Chiengmai in 1939.

WATER

During the period covered by this report the Water Section had analysed specimens of water from the Chao Phya river, the sea, and rivers of other provinces as detailed below:—

Source	No. of Samples		
	1938	*1939*	*1940*
City Water Work	154	188	167
The Chao Phya river	752	754	568
Sea water	214	369	802
Miscellaneous localities	112	211	204
Total	1232	1522	1743

The followings are results of analysis of city water-supply and municipal water-supply of various provinces. They are expressed as parts per 100,000. Hardness is expressed as parts of carbonate per 100,000. Oxygen consumed is analysed by keeping the temperature at 100°C. for 10 minutes.

Bangkok City Water
1938

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.3	210	17.6	—	17.6	11.5	10.1	1.4	1.9	3.1	0.11	0.001	0.006	0.016	—	1.6	—
May	7.3	225	18.0	—	18.0	11.0	9.8	1.2	2.3	3.8	0.12	0.001	0.006	0.025	—	1.7	—
June	7.1	170	16.1	—	16.1	10.0	6.7	3.3	1.5	2.5	0.14	0.001	0.005	0.020	—	2.1	0.01
July	7.2	122	11.7	—	11.7	6.5	4.4	2.1	0.8	1.3	0.16	0.002	0.008	0.020	—	2.0	—
August	7.1	102	9.7	—	9.7	6.0	4.0	2.0	0.5	0.8	0.17	0.002	0.006	0.020	—	1.1	—
September	7.2	135	12.0	—	12.0	7.0	3.8	3.2	0.7	1.2	0.14	0.002	0.008	0.015	—	1.9	—
October	7.2	151	13.2	—	13.2	8.0	2.4	5.6	1.6	2.6	0.12	0.002	0.007	0.010	—	1.8	—
November	7.2	115	10.0	—	10.0	6.0	5.9	0.1	0.5	0.8	0.17	0.002	0.009	0.015	—	2.4	—
December	7.2	125	11.1	—	11.1	7.5	6.7	0.8	0.4	0.7	0.21	0.001	0.011	0.015	—	2.1	—
January	7.2	160	14.4	—	14.4	18.5	8.0	0.5	0.9	1.5	0.28	0.003	0.012	0.020	—	3.1	—
February	7.2	180	15.9	—	15.9	10.0	8.8	1.2	1.2	2.0	0.12	0.001	0.006	0.015	—	1.7	—
March	7.3	190	16.2	—	16.2	10.0	9.5	0.5	1.5	2.5	0.11	0.001	0.006	0.016	—	2.0	—
	7.2	157	13.8	—	13.8	8.5	6.7	1.8	1.2	1.9	0.15	0.002	0.008	0.017	—	2.0	—

Bangkok City Water
1939

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.2	205	17.7	—	17.7	11.0	9.9	1.1	1.8	3.0	0.10	0.001	0.006	0.020	—	1.9	—
May	7.5	210	20.1	—	20.1	10.0	8.5	1.5	2.0	3.3	0.14	0.001	0.005	0.017	—	3.5	—
June	7.2	215	19.5	—	19.5	11.0	8.6	2.4	2.0	3.3	0.11	0.001	0.005	0.025	—	2.2	—
July	7.1	126	11.9	—	11.9	5.5	4.7	0.8	1.0	1.6	0.16	0.001	0.007	0.025	—	2.2	—
August	7.1	107	10.1	—	10.1	6.0	5.1	0.9	0.6	1.0	0.14	0.001	0.005	0.015	—	1.5	—
September	7.1	118	11.5	—	11.5	6.5	5.0	1.5	0.6	1.0	0.12	0.001	0.005	0.015	—	1.6	—
October	7.1	170	14.7	—	14.7	9.0	3.3	5.7	1.0	1.6	0.16	0.001	0.007	0.015	—	2.0	—
November	7.1	130	12.5	—	12.5	7.0	6.2	0.8	0.6	1.0	0.29	0.001	0.010	0.015	—	2.9	—
December	7.1	120	11.6	—	11.6	7.5	6.0	1.5	0.6	1.0	0.27	0.001	0.012	0.015	—	2.5	—
January	7.2	150	13.4	—	13.4	9.0	7.5	0.5	0.9	1.5	0.18	0.001	0.008	0.015	—	1.7	—
February	7.2	174	15.4	—	15.4	10.0	8.9	1.1	1.3	2.1	0.11	0.001	0.006	0.020	—	1.5	—
March	7.2	183	16.2	—	16.2	11.0	9.0	2.0	1.5	2.5	0.12	0.001	0.008	0.015	—	1.9	—
	7.2	159	14.6	—	14.6	8.6	6.9	1.7	1.2	1.9	0.16	0.001	0.007	0.018	—	2.1	—

Bangkok City Water
1940

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.2	208	17.8	—	17.8	12.0	9.5	2.5	2.0	3.3	0.17	0.002	0.009	0.015	—	2.0	—
May	7.2	225	18.9	—	18.9	12.0	9.7	2.3	2.4	4.0	0.20	0.001	0.009	0.015	—	1.1	—
June	7.2	220	19.5	—	19.5	12.0	9.8	2.2	2.1	3.6	0.14	0.001	0.010	0.020	—	1.5	—
July	7.2	141	12.4	—	12.4	7.0	6.0	1.0	0.9	1.5	0.23	0.002	0.010	0.012	—	2.4	—
August	7.2	131	11.3	—	11.3	7.0	5.4	1.6	0.8	1.3	0.20	0.002	0.008	0.016	—	1.6	—
September	7.1	109	10.7	—	10.7	6.0	4.9	1.1	0.5	0.8	0.16	0.001	0.005	0.015	—	1.4	—
October	7.2	129	12.5	—	12.5	7.0	3.5	3.5	0.7	1.1	0.15	0.001	0.005	0.001	—	1.7	—
November	7.1	118	10.0	—	10.0	6.5	2.6	3.9	0.9	1.5	0.13	0.001	0.005	0.017	—	1.0	—
December	7.1	119	11.9	—	11.9	7.0	3.5	3.5	1.0	1.6	0.21	0.002	0.020	0.018	—	1.8	—
	7.2	156	13.9	—	13.9	8.5	6.1	2.4	1.3	2.1	0.18	0.001	0.009	0.014	—	1.6	—

Bangkhwang City Water
1938

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.3	245	22.3	—	22.3	13.8	6.0	7.8	3.1	5.1	0.13	0.001	0.005	0.020	—	2.2	—
May	7.2	245	21.5	—	21.5	12.0	6.4	5.6	2.7	4.4	0.11	0.001	0.007	0.028	—	1.9	—
June	7.1	178	17.7	—	17.7	9.0	3.4	5.6	1.5	2.5	0.10	0.002	0.005	0.020	—	2.0	—
July	7.1	123	12.2	—	12.2	6.0	1.3	4.7	0.7	1.2	0.15	0.002	0.008	0.020	—	1.8	—
August	7.1	110	10.2	—	10.2	7.0	3.0	4.0	0.6	1.0	0.16	0.002	0.007	0.020	—	1.7	—
September	7.1	112	10.9	—	10.9	6.0	3.0	3.0	0.5	0.8	0.14	0.002	0.006	0.015	—	2.0	—
October	7.2	97	9.2	—	9.2	7.0	3.1	3.9	0.5	0.8	0.16	0.002	0.009	0.015	—	1.2	—
November	7.2	98	9.4	—	9.4	6.0	4.6	1.4	0.4	0.7	0.24	0.002	0.011	0.015	—	2.5	—
December	7.2	110	9.8	—	9.8	6.0	4.7	1.3	0.5	0.8	0.12	0.002	0.012	0.015	—	1.7	—
January	7.2	158	14.1	—	14.1	9.0	5.4	3.6	0.9	1.5	0.12	0.001	0.006	0.018	—	1.9	—
February	7.2	178	16.4	—	16.4	10.0	6.0	4.0	1.4	2.3	0.12	0.001	0.006	0.020	—	1.3	—
March	7.2	195	16.4	—	16.4	9.0	7.0	2.0	1.7	2.8	0.11	0.001	0.005	0.025	—	1.8	—
	7.2	154	14.2	—	14.2	8.4	4.5	3.9	1.2	2.0	0.14	0.002	0.007	0.019	—	1.8	—

Bangkhwang City Water
1939

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.1	215	18.6	—	18.6	11.0	7.8	3.2	2.3	3.8	0.11	0.001	0.007	0.023	—	1.9	—
May																	
June	7.1	220	19.9	—	19.9	11.0	8.1	2.9	2.2	3.6	0.19	0.001	0.008	0.030	—	3.0	—
July	7.0	130	11.8	—	11.8	6.0	2.8	3.2	1.1	1.8	0.14	0.001	0.006	0.020	—	2.4	—
August	7.1	103	10.1	—	10.1	6.0	3.3	2.7	0.6	1.0	0.11	0.002	0.006	0.020	—	1.4	—
September	7.1	97	9.7	—	9.7	6.0	3.1	2.9	0.5	0.8	0.12	0.001	0.007	0.015	—	1.4	—
October	7.1	103	10.8	—	10.8	7.5	3.5	4.0	0.6	1.0	0.18	0.001	0.008	0.015	—	2.0	—
November	7.1	104	10.5	—	10.5	7.0	4.6	2.4	0.5	0.8	0.24	0.002	0.010	0.015	—	2.2	—
	7.1	139	13.1	—	13.1	7.8	4.8	3.0	1.1	1.8	0.16	0.001	0.007	0.020	—	2.0	—

Bangkhwang City Water
1940

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.1	225	20.3	—	20.3	12.5	6.5	6.0	2.4	4.0	0.17	0.002	0.008	0.018	—	2.0	—
May	7.1	250	22.2	—	22.2	13.0	7.0	6.0	3.3	5.4	0.12	0.001	0.008	0.020	—	1.3	—
June	7.1	260	25.1	—	25.1	13.0	5.3	7.7	2.5	4.1	0.14	0.002	0.008	0.030	—	2.2	—
July	7.0	126	10.6	—	10.6	5.5	3.0	2.5	0.8	1.3	0.16	0.001	0.010	0.016	—	2.2	—
August																	
September	7.0	96	10.1	—	10.1	6.0	2.1	3.9	0.5	0.8	0.11	0.001	0.009	0.015	—	2.0	—
October	7.1	96	9.7	—	9.7	6.0	2.5	3.5	0.5	0.8	0.14	0.001	0.009	0.006	—	1.8	—
	7.1	176	16.3	—	16.3	9.3	4.4	4.9	1.7	2.7	0.14	0.001	0.009	0.018	—	1.9	—

Sri-Ayuthaya City Water
1938

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April																	
May																	
June																	
July																	
August	7.2	110	10.7	—	10.7	5.0	0.7	4.3	0.5	0.8	0.14	0.002	0.008	0.018	—	2.2	—
September	7.1	106	10.0	—	10.0	6.0	3.5	2.5	0.5	0.8	0.11	0.002	0.008	0.020	—	2.1	—
October	7.1	107	10.0	—	10.0	6.9	3.4	2.6	0.5	0.8	0.13	0.002	0.007	0.013	—	2.1	—
November	7.2	91	8.5	—	8.5	6.0	5.1	0.9	0.4	0.7	0.21	0.002	0.008	0.015	—	1.4	—
December	7.2	122	10.4	—	10.4	7.0	6.1	0.9	0.5	0.8	0.19	0.004	0.010	0.015	—	2.0	—
January	7.2	143	12.9	—	12.9	6.5	6.5	0.0	0.7	1.2	0.12	0.003	0.008	0.015	—	2.1	—
February	7.2	160	14.5	—	13.9	9.0	8.8	0.2	1.1	1.8	0.13	0.001	0.008	0.020	—	1.3	—
March	7.2	170	14.9	—	14.9	11.0	9.6	1.4	1.2	2.0	0.11	0.001	0.008	0.013	—	1.4	—
	7.2	126	11.5	—	11.4	7.1	5.5	1.6	0.7	1.1	0.14	0.002	0.008	0.015	—	1.8	—

Sri-Ayuthaya City Water
1939

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.2	180	15.7	—	15.7	10.0	9.6	0.4	1.5	2.5	0.12	0.002	0.007	0.015	—	1.7	—
May	7.2	210	18.4	—	18.4	1.10	10.7	0.3	1.9	3.1	0.18	0.001	0.009	0.020	—	2.5	—
June	7.2	140	12.8	—	12.5	7.0	6.8	0.2	1.1	1.8	0.18	0.002	0.008	0.023	—	2.4	—
July	7.0	124	11.2	—	11.2	6.0	1.8	4.2	1.1	1.8	0.11	0.001	0.005	0.015	—	1.9	—
August	7.0	95	9.3	—	9.3	6.0	2.2	3.8	0.6	1.0	0.10	0.001	0.004	0.023	—	1.2	—
September	7.2	96	9.4	—	9.4	7.0	2.4	4.6	0.5	0.8	0.09	0.001	0.004	0.015	—	1.2	—
October																	
November																	
December	7.1	118	11.4	—	11.4	8.0	4 6	3.4	0.6	1.0	0.11	0.001	0.006	0.025	—	1.3	—
January	7.2	141	12.9	—	12.9	9.0	8.6	0.4	0.7	1.2	0.11	0.001	0 005	0.020	traces	1.2	—
February	7.2	152	13.5	—	13.5	10.0	8.8	1.2	1.0	1.6	0.14	0.001	0.010	0 015	—	1.5	—
March	7.2	168	14.8	—	14.8	11.0	8.4	1.6	1.2	2.0	0.13	0.002	0.012	0.015	traces	1.6	—
	7.2	142	12.9	—	12.9	8.5	6.4	2.1	1.0	1.7	0.13	0.001	0.007	0.019	—	1.7	—

Sri-Ayuthaya City Water
1940

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.2	200	17.8	—	17.8	13.0	8.1	4.9	1.6	2.6	0.17	0.001	0.008	0.015	—	2.0	—
May	7.2	220	19.2	—	19.2	13.0	11.3	1.7	2 1	3.5	0.18	0.002	0.008	0.015	—	2.2	—
June	7.2	160	14.5	—	14 5	10.0	7.5	2.5	1.1	1.8	0.16	0.001	0.008	0.030	—	2.0	—
July	7.1	114	10.9	—	10.9	6.0	4.0	2.0	0.6	1.0	0.18	0.001	0.007	0.024	—	2.3	—
August	7.1	108	10.5	—	10.5	7.0	5.1	1.9	0.7	1.2	0.13	0.001	0.008	0.022	—	1.5	—
September	7.0	100	9.7	—	9.7	6.5	2.3	4.2	0.4	0.7	0.09	0.002	0.005	0.015	—	1.2	—
October	7.0	122	13 8	1.7	12.1	7.0	1.1	5.9	0.4	0.7	0.19	0.001	0.012	0.023	—	1.7	—
November	7.1	120	11.7	—	11.7	8.0	3.4	4.6	0.4	0.7	0.14	0.001	0.014	0.020	—	1.4	—
December	7.2	150	14.2	—	14.5	10.0	6.9	3.1	0.6	1.0	0.13	0.001	0.011	0.015	—	1.2	—
	7.1	162	15.3	0.2	15.1	10.1	6.2	3.9	1.0	1.6	0.16	0.001	0.010	0.022	—	1.9	—

Nakhonrajasima City Water
1938

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.5	520	40.7	—	40.7	20.7	19.2	1.5	10.5	17.3	0.34	0.003	0.015	0.005	—	3.4	0.03
May	7.4	420	33.4	—	33.4	17.0	17.0	—	7.6	12.5	0.45	0.005	0.020	0.023	—	2.7	0.01
June	7.1	170	16.4	—	16.4	8.0	2.7	5.3	2.7	4.4	0.18	0.002	0.009	0.015	—	2.4	—
July	7.2	255	23.7	—	23.7	10.0	4.3	5.7	5.7	9.4	0.28	0.002	0.012	0.025	—	2.9	0.03
August	7.3	125	11.75	—	11.75	3.0	2.1	0.9	1.1	1.8	0.25	0.005	0.015	0.021	—	1.6	—
September	7.3	450	39.5	—	39.5	13.0	8.8	4.2	13.3	21.9	0.33	0.005	0.014	0.025	—	3.2	—
October	7.1	110	9.3	—	9.3	6.0	3.6	2.4	0.5	0.8	0.17	0.002	0.008	0.015	—	2.2	—
November	7.2	128	12.7	—	12.7	7.0	5.2	1.8	1.4	2.3	0.28	0.003	0.012	0.018	—	3.0	—
December	7.3	250	22.0	—	22.0	13.0	11.0	2.0	3.7	6.1	0.19	0.005	0.011	0.013	—	1.8	—
January	7.3	310	25.9	—	25.9	17.5	16.7	0.8	3.2	5.3	0.19	0.002	0.008	0.005	—	1.5	—
February	7.5	350	28.8	—	28.8	21.0	19.4	1.6	2.8	4.6	0.33	0.001	0.009	0.018	—	2.5	—
March	7.4	420	35.9	—	35.9	21.0	20.1	0.9	6.9	11.4	0.32	0.004	0.013	0.015	—	2.4	—
	7.3	292	25.0	—	25.0	13.1	10.8	2.3	5.0	8.2	0.27	0.003	0.012	0.017	—	2.5	0.006

Nakhonrajasima City Water
1939

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.4	385	31.9	—	31.9	18.0	17.9	0.1	6.1	10.1	0.42	0.003	0.017	0.020	—	2.6	—
May	7.3	302	26.1	—	26.1	14.0	12.7	1.3	4.8	7.9	0.46	0.002	0.017	0.020	—	3.1	—
June	7.2	390	32.2	—	32.2	13.0	12.8	0.2	9.0	14.8	0.42	0.004	0.019	0.025	traces	3.0	0.01
July	7.1	190	18.2	0.3	17.9	9.0	4.3	4.7	3.4	5.6	0.32	0.001	0.014	0.020	—	2.8	0.01
August	7.2	285	23.3	—	23.3	10.0	7.7	2.3	6.0	9.9	0.42	0.003	0.018	0.023	—	2.8	—
September	7.1	170	15.9	—	15.9	9.0	5.9	3.1	2.2	3.6	0.28	0.003	0.014	0.015	—	2.2	—
October	7.2	130	12.5	—	12.5	8.0	6.9	1.1	1.1	1.8	0.26	0.002	0.013	0.020	—	2.0	—
November	7.2	225	19.8	—	19.8	11.0	9.2	1.8	3.7	6.1	0.31	0.002	0.013	0.018	—	2.5	—
December	7.2	148	13.8	—	13.8	8.0	7.6	0.4	1.6	2.6	0.32	0.002	0.012	0.015	—	2.5	—
January	7.2	241	20.8	—	20.8	12.0	11.8	0.2	3.8	6.3	0.24	0.002	0.009	0.015	—	1.8	—
February	7.3	315	27.8	—	27.8	19.0	18.0	1.0	3.7	6.1	0.28	0.002	0.014	0.018	—	2.3	—
March	7.3	350	29.9	0.3	29.6	16.0	14.9	1.1	6.8	11.2	0.43	0.004	0.020	0.020	—	2.3	—
	7.2	261	22.7	0.1	22.6	12.2	10.8	1.4	4.4	7.2	0.35	0.003	0.015	0.019	—	2.5	—

Nakhonrajasima City Water
1940

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.3	450	38.2	—	38.2	19.0	18.2	0.8	9.1	15.0	0.41	0.003	0.020	0.025	nil	3.0	—
May	7.1	585	47.1	—	47.1	18.5	18.5	nil	14.0	23.1	0.42	0.003	0.027	0.020	traces	3.0	—
June	7.2	280	24.8	—	24.8	11.0	8.9	2.1	6.3	10.4	0.31	0.002	0.017	0.020	nil	2.9	—
July	7.2	340	30.1	—	30.1	13.0	9.6	3.4	8.9	14.7	0.37	0.002	0.013	0.017	traces	2.1	—
August	7.2	410	37.0	—	37.0	13.5	9.9	3.6	12.1	19.9	0.43	0.001	0.018	0.023	nil	2.0	—
September	7.2	360	31.1	—	31.1	12.5	9.8	2.7	9.5	15.7	0.46	0.005	0.024	0.009	traces	1.9	—
October	7.1	136	12.8	—	12.8	8.5	6.8	1.7	1.0	1.6	0.28	0.003	0.022	0.006	nil	1.4	—
November	7.2	330	27.7	—	27.7	12.0	10.8	1.2	7.6	12.5	0.39	0.004	0.027	0.011	traces	2.5	0.01
December	7.2	585	50.8	—	50.8	17.0	13.2	3.8	17.8	29.3	0.41	0.002	0.020	0.025	traces	2.4	—
	7.2	386	33.3	—	33.3	13.9	11.8	2.1	9.6	15.8	0.39	0.003	0.021	0.017	traces	2.4	—

Lopburi City Water
1939

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April																	
May																	
June																	
July	7.5	470	39.7	—	39.7	31.0	31.0	—	0.9	1.5	0.04	0.001	0.006	0.018	—	2.0	—
August																	
September																	
October																	
November																	
December	7.6	450	40.2	—	40.2	34.0	34.0	—	0.6	1.0	0.07	0.001	0.005	0.035	—	1.2	—
January	7.6	465	41.0	—	41.0	35.0	35.0	—	0.7	1.2	0.05	0.001	0.004	0.022	—	1.4	—
February	7.6	460	41.2	1.4	39.8	34.0	34.0	—	0.7	1.2	0.05	0.001	0.007	0.020	—	1.3	—
March	7.4	320	28.0	—	28.0	25.0	24.6	3.8	0.8	1.3	0.05	0.001	0.002	0.015	—	1.1	—
	7.5	433	38.0	0.3	37.7	31.8	31.7	—	0.7	1.2	0.05	0.001	0.005	0.022	—	1.4	—

Lopburi City Water
1940

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.4	380	34.4	0.4	34.0	25.0	25.0	—	1.8	1.3	0.09	0.001	0.005	0.017	traces	1 5	—
May	7.5	450	35.2	—	35.2	28.5	28.5	—	0.6	1 0	0.10	nil	0.004	0.015	traces	2.2	—
June	7.5	405	37.5	0.5	37.0	29.0	29.0	—	0.8	1.3	0.08	0.003	0.005	0.012	—	1 5	—
July	7.5	430	37.3	—	37.3	25.5	25.5	—	0.8	1.3	0.06	0.001	0.007	0.018	—	1.2	—
August	7.5	400	33.9	—	33.9	22.5	25.5	—	0.9	1.5	0 09	0.001	0.005	0.015	—	1.2	—
September	7.5	380	33.4	—	33.4	27.5	27.5	—	0.8	1.3	0.06	0.001	0.004	0.017	—	1.1	—
October	7.5	445	38.1	—	38.1	28.0	28.0	—	0.9	1.5	0 05	0.001	0.007	0 010	—	1.1	—
November	7.5	455	37.1	—	37.1	30.0	30.0	—	0.8	1.3	0.14	0.001	0.005	0 018	—	1 7	—
December	7.6	470	40.8	—	40.8	35.0	35.0	—	0.6	1.0	0.06	0.001	0.008	0.012	—	1.2	—
	7.5	424	36.4	0.1	36.3	28.2	28.2	—	0.8	1.3	0.08	0.001	0.006	0.015	—	1.4	—

Nakhonsawan City Water
1939

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April																	
May																	
June																	
July																	
August																	
September	7.1	96	10 4	—	10.4	6.5	4.2	2.3	0.9	1.5	0.13	0.001	0.005	0.015	—	1.5	—
October	7.1	110	10.5	—	10.5	7.0	4.3	2.7	0.8	1.3	0.12	0.001	0.007	0.018	—	1.4	—
November	7 2	122	11.9	—	11.9	8.0	6.7	1.3	0.5	0.8	0.10	0.001	0.006	0.015	—	1.0	—
December	7.1	118	11.5	—	11.5	7.0	6.0	1.0	0.4	0.7	0.14	0.002	0.007	0.015	—	1.1	—
January	7.2	123	11 5	—	11.5	9.0	7.8	1.2	0.4	0.7	0.10	0.002	0.007	0.015	—	1 0	—
February	7.2	132	12.7	—	12.7	10.0	8.2	1.8	0.5	0.8	0.09	0.003	0.010	0.015	—	1.2	—
March	7.2	134	12 7	—	12.7	10.0	8.6	1.4	0.5	0.8	0.13	0.001	0.016	0.010	—	1.4	—
	7.2	119	11.6	—	11.6	8.2	6.5	1.7	0.6	1.0	0.12	0.002	0.007	0.015	—	1.2	—

Nakhonsawan City Water
1940

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.2	163	14.1	—	14.1	11.0	10.4	0.6	0.5	0.8	0.14	0.001	0.007	0.015	—	1.6	—
May	7.2	169	15.1	—	15.1	12.0	10.8	1.2	0 5	0.8	0.16	0.002	0.012	0.015	—	2.0	—
June	7.2	136	12.5	—	12.5	10.5	8.2	2.3	0.5	0.8	0.15	0.002	0.010	0.015	—	0.7	—
July	7.2	106	10.4	—	10.4	8.0	5.2	2.8	0.4	0.7	0.19	0.002	0.008	0.009	—	1.1	—
August	7.2	101	9.9	—	9.9	8.0	6.1	1.9	0.3	0.5	0.12	0.004	0.022	0.006	—	1.0	—
September	7.1	108	9.5	—	9.5	6.0	3.3	2.7	0.4	0.7	0.10	0.001	0.004	0.015	—	1.2	—
October	7.1	110	10.5	—	10.5	6.5	3.9	2.6	0.3	0.5	0.13	0.002	0.010	0.015	—	1.5	—
November	7.1	113	10.6	—	10.6	8.0	5.5	2.5	0.4	0.7	0.09	0.001	0.006	0.015		0.9	—
December	7.2	121	11.8	—	11.8	9.5	7.5	2.0	0.3	0.5	0.11	0.001	0.006	0.014	—	1.0	—
	7.2	125	11.6	—	11.6	8.8	6.8	2.0	0.4	0.7	0.13	0.002	0.009	0.013	—	1.3	—

Pitsanulok City Water
1939

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April																	
May																	
June																	
July	7.2	920	88.4	2.9	85.5	18.0	8.6	9.4	38.5	63.4	0.14	0.079	0.008	0.030	—	2.6	0.20
August	7.2	910	88.9	5.1	83.8	18.0	8.9	9.1	38.0	62.6	0.15	0.078	0.007	0.030	—	2.2	0.27
September	7.2	910	88.7	5.2	83.5	18.0	8.8	9.2	38.0	62.6	0.09	0.087	0.004	0.030	—	1.8	0.16
October	7.2	910	89.2	5.1	84.1	18.0	8.5	9.5	39.0	64.3	0.13	0.067	0.004	0.030	traces	1.4	0.10
November	7.2	910	90.6	5.4	85.2	18.0	8.4	9.6	39.0	64.3	0.10	0.073	0.006	0.030	—	1.3	0.05
December	7.2	900	86.3	3.2	83.1	18.0	9.1	8.9	38.0	62.6	0.09	0.028	0.004	0.025	—	1.3	0.03
January	7.2	900	86.5	3.2	83.3	19.0	8.7	10.3	38.0	62.6	0.10	0.089	0.006	0.020	—	1.3	0.18
February	7.2	900	85.3	1.9	83.4	18.0	8.8	9.2	38.5	63.4	0.09	0.002	0.007	0.025	—	1.3	0.05
March	7.2	900	85.6	2.2	83.4	18.0	8.8	9.2	38.5	63.4	0.11	0.082	0.009	0.030	—	1.3	0.15
	7.2	907	87.7	3.8	83.9	18.1	8.7	9.4	38.4	63.3	0.09	0.065	0.006	0.028	—	1.6	0.13

Pitsanulok City Water
1940

	pH value	Electrical conductivity	Total solids	Undissolved solids	Dissolved solids	Total hardness	Temporary hardness	Permanent hardness	Chloride as chlorine	Chloride as NaCl	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrate nitrogen	Nitrites	Loss on ignition	Iron
April	7.2	900	85.1	2.0	83.1	18.0	8.5	9.5	37.5	61.4	0.14	0.068	0.008	0.030	—	1.6	0.08
May	7.2	890	84.7	2.7	82.0	18.0	8.7	9.3	37.2	61.3	0.14	0.040	0.005	0.025	traces	1.8	0.15
June	7.2	900	90.8	5.9	84.9	17.5	8.6	8.9	36.7	60.5	0.19	0.001	0.020	0.026	traces	2.0	0.33
July	7.2	900	87.8	3.1	84.7	18.0	8.9	9.1	37.0	60.9	0.19	0.011	0.004	0.005	—	2.2	0.18
August	7.2	900	89.4	5.2	84.2	19.0	8.7	10.3	37.7	62.1	0.36	0.030	0.010	0.020	traces	2.0	0.70
September	7.2	900	95.3	1.4	81.9	17.5	8.9	8.6	36.0	59.3	0.55	0.050	0.038	0.020	traces	1.2	0.89
October	7.2	900	86.7	2.6	84.1	19.0	8.7	10.3	36.0	59.3	0.23	0.012	0.004	0.031	traces	1.2	0.89
November	7.0	900	81.4	1.5	79.9	18.0	9.5	8.5	36.5	60.2	0.15	0.040	0.007	0.022	—	1.2	0.1
December	7.2	895	84.7	2.2	82.5	19.0	8.6	10.4	36.8	60.6	0.14	0.005	0.009	0.036	—	0.9	0.29
	7.2	898	87.3	4.3	83.0	18.2	8.8	9.4	36.8	60.6	0.23	0.029	0.012	0.024	traces	1.8	0.36

Training of Officials from Other Departments

The Thai Weaving Factory of the Quarter Master General Department sent 4 officials for training in the technique of vegetable oil analysis at the Division of Chemistry in January 1938.

The Ordnance Department sent one officer for training in the technique of milk analysis at the Division of Chemistry from 20th July to 30th November 1939.

DIVISION OF INDUSTRIAL CHEMISTRY

During the period covered by this report there were many changes in the Division, viz: abolition of the Pharmaceutical section, the Forest Product Research section and the General Research section; installation of the sections of Physics, Foods, Fermentation, Minerals and Ores, and Workshop; transferring the work on Fabric Analysis to the Fibre section. The work on hydnocarpus oil and esters extraction was handed over to the Pharmaceutical Works.

Physics Section

This section started with the accumulation of Physical apparatus to meet the growing need in certain chemical and physical analyses. It was initiated after Aree Supol returned from Europe in 1936.

Ceramics Section

The work in this section had made some progress. However making of ceramics from native raw materials could be done only on a small scale owing to shortage of suitable appliances.

The primary purpose of this section was to promote the productions of earthen-ware rather than porcelain, since the raw materials were not good enough. The quality could be improved however but at an exhorbitant running cost, thus the Department only aimed at making earthen-wares such as sinks, lavatory supplies, etc.

An excavation of the ruins at Wat Phra Meru, Nakorn Pathom, was made by the Fine Arts Department in 1938. By casual observation the building of the ruins was of Khmer Style, that was in certain cases the laying of stones with the use of resins as cementing materials. It was noticed in this case that the gaps between stones contained a certain binding material which could be leached out by water and would again harden in the sun. The binding material was analysed at the Department and found to consist of a kind of local rocks called Hin Kai Pla, well ground, mixed with sand and certain resins. It is thus quite interesting to note that though the builders followed Khmer's Arts of stones binding in general, they also introduced the use of well ground rock in the cementing material.

Fibres Section

That a large quantity of woven goods were sent here for analysis necessitated the setting up of a Textiles Section. The name of the section was changed from Textiles to Fibres so as to include all fibres used in industry.

Foods Section

For a long time the Department has been interested in food analysis. Thailand has abundant foodstuffs but most of the peoples are not well aware of their food-value in nutrition. The Foods Section began analysis of common foods such as vegetables, fruits, fish pastes and fish sauces, and the last two were standardized for future control. Results of analyses of certain native fruits and vegetables are tabulatad below.

This section also carried out routine analysis of food produced by the Military Supplies Department. The daily allowance for Thai soldiers consists of 100 g. protein, 350 g. carbohydrate and 150 g. fat per head.

Varieties	Moisture %	Protein %	Fat %	Carbo-hydrate %	Mineral Salt %	Roughage %
Mango (Nangklangwan)	79.33	0.50	0.16	19.15	0.34	0.52
,, (Thongdam)	77.74	0.62	0.62	20.48	0.42	0.55
,, (Phimsen)	80.05	1.07	0.16	17.57	0.22	5.48
Jack Fruit	70.33	1.30	0.40	26.08	0.89	0.99
Banana (Homchan)	73.06	1.42	0.27	24.45	0.26	0.47
,, (Namwa)	69.89	1.05	0.28	26.81	0.47	1.50
,, (Klai)	65.64	1.21	0.64	31.65	0.62	0.24
,, (Hagmug)	71.33	1.55	0.39	24.41	0.72	1.60
,, (Nam)	68.63	1.10	0.22	29.09	0.69	0.27
Phagbia	91.71	1.74	0.35	3.17	1.65	1.38
Phagboong	93.81	2.13	0.48	2.42	0.49	0.67
Beansprout	90.54	3.36	0.18	4.80	0.50	0.62
Lettuce	94.86	0.97	0.33	2.38	1.13	0.33
Chinese lettuce	94.08	1.83	0.33	1.96	1.11	0.69
Cabbage	92.09	0.89	0.34	5.58	0.60	0.50
Kached	88.39	2.99	0 42	4.94	1.26	2.00
Phangphuay	89.12	1.10	0.36	7.11	1.24	1.07
Papaya	87.95	0.76	0.43	7.55	1.35	1.96
Kana	92.09	2.70	0,51	2.20	0.94	1,56
Kood fern	92.97	1.72	0.36	3.02	0.58	1.35
Squash	87.50	0.80	0.38	9.92	0.55	0.85
Lily stem	96.11	0.34	0.13	2.42	0.27	0.75
Kasang	96.44	0.56	0.22	1.41	0.73	0.64
Phugkhom	84.31	3.01	0.53	7.20	2.31	2.64
,, with thorns	81.36	1.80	0.41	9.01	2.10	5.32
Lily root	82.53	1.69	0.13	14.07	0.64	0.94
Soybean	11.08	34.04	18.64	26.72	4.82	4.66
Mung bean	12.19	14.62	2.22	66.61	2.20	2.15

Fermentation Section

This section was recently formed and the intial work concerned native non-distilled liquors. Normally this liquor is brewed for local consumption and the quality was not standardized. This Department, in co-operation with the Excise Department, made an effort to standardize this liquor and plan a large scale production.

Minerals and Ores Section

The work in connection with minerals and ores was new and little work had been done.

Workshop Section

The workshop has grown considerably since the last report and has to be raised to the status of a Section as a result of increased personnel. More equipments were purchased in order to cope with growing number of daily repairs and constructions.

DIVISION OF AGRICULTURAL SCIENCE

During this period the Division of Agricultural Science had made satisfactory progress and had been in close co-operation with the Department of Agriculture and Fishery.

METEOROLOGICAL STATION

The Division of Agriculture had set up certain meteorological instruments in front of the Department's main building in order to record the rain fall, sunshine, temperature of the ground and etc. Records of ground temperatures had been scanty though it should be of great importance in studying plant growth, and soil bacteria.

WATER

Samples of water from Irrigation Canals and the Agricultural Experiment Station at Thanjaburi were sent for analysis. They were found to be mostly neutral with an approximate pH of 7. Two of these samples, however, showed a lower pH of 6.94 and 6.33. The water from the fields and shallow wells, on the other hand, showed an acid pH of 3.73 to 5.00. This condition perhaps may be due to the break down of the cellulose materials in the soil giving off methane, hydrogen and carbon dioxide. The calcium salts and lime in the ground are not sufficient to neutralize them, this may account for the acidity of the water. Such a condition should be remedied, otherwise the soil would not be suitable for planting crops.

The Agricultural Science Division received two samples from a tin mine in Trang to find out whether it would be harmful to plants in the surrounding area. The results of analysis showed that they contained no harmful chemicals. The chloride contents in the two samples were 3.6 and 10.7 parts in 100,000 parts, which were regarded as not unusual. The pH values of the two samples were 5.48 and 5.15 respectively. A qualitative analysis showed no trace of tin. Besides the Agricultural Division also received the soil samples on the particular location for further investigation. It was found that there were no harmful chemicals in the soil, the poor plant growth may be due primarily to the physical condition of the soil itself. The soil consisted of 62 percent clay. Since samples were not taken before the irruption took place it was difficult to determine the extent of clay brought by the water. It was also doubtful whether the clay carried with the water would hinder rice growing.

Farmers often blamed the tin mines for what happened and asked for compensation for their losses of rice crops. From analytical results, it was found that less than 800 grains of

solids were present in a gallon of water, and it was allowed according to the Mining Law. This problem is yet to be investigated in details so as to give satisfactions to both parties.

In 1939 the Head of the Research Section, Rice Division. Department of Agriculture and Fishery, went on inspection at Chainat Province and examined the upper river water which is the source of water flowing downward supplying rice fields in the Central and Western Parts. Samples were sent to the Department for the determination of pH and electrical conductivity. In certain samples other constituents were determined as well.

The list of the samples is as follows :–

AC. 131 taken from the entrance of the canal to Boraphed Swamp (the clear water of the swamp meets the muddy water of Khwae Yai or Nan)

AC. 132 water from Khwae Yai (Khwae Yai is the junction of Yom and Nan tributaries) taken from behind the Paknam Pho Railroad Station.

AC. 133 taken from the entrance of Khwae Yai, Phaknam Pho (the muddy turbulent water mixing with the water of two tributaries, namely Ping and Khwae Yai tributaries)

AC. 134 muddy water of Ping Tributary (only Ping water)

AC. 135 taken from the middle of Boraped Swamp (clear because it is not turbulent)

AC. 136 taken from in front the Court House of Nakhonswan Province (the mixed water of two tributaries)

AC. 137 taken from in front of the rice mill Amphur Krogphra (water from the Chao Phya River where it is diverted into Makhamthaw Canal)

AC. 138 taken at Ban Namsong, first village, (muddy water)

AC. 139 taken from in front of Amphur Phayuhakhiri (muddy water)

AC. 140 taken from in front of Wat Yai, Tambon Thaniphan in Chainat Province.

AC. 141 taken from behind Thepho Island, Chainat Province.

AC. 142 taken from behind Sinsathan Island, Chainat Province.

AC. 143 taken from in front of Amphur Manorom.

AC. 144 taken from behind Manorom Island.

AC. 145 taken from behind Talat Island, Amphur Manorom (near the entrance to Makhamthaw Canal)

AC. 146 taken from in front of Wat Thammamoon, Chainat Province.

AC. 147 taken from behind Wat Thammamoon, Chainat Province.

AC. 148 taken from the entrance to Wat Makhamthaw, Chainat Province, leading to Suphanburi Province.

AC. 149 taken from the middle of the Makhamthaw Water Gate, Chainat Province (muddy shallow water)

AC. 150 taken from the outside of Makhamthaw Water Gate, Chainat Province (entering the Irrigation Boundary)

AC. 151 taken from in front of Wat Singh (Wat Plalai Municipal School, Chainat Province.

AC. 152 taken from in front of Wat Nongkhae, Chainat Province, leading into Suphanburi Province.

AC. 153 taken from Tambon Huey Ngoo, Seventh Village, Amphur Hankha, Chainat Province.

AC. 154 taken from in front of Wat Khogmu, Chainat Province.

AC. 155 taken from in front of Huey Ngoo Municipal School, Amphur Hankha, Chainat Province.

AC. 156 taken from in front of Wat Wongduan, Tambon Huey Ngoo, Amphur Bansian, Chainat Province.

AC. 157 taken from in front of Wat Bangkhwai, Amphur Bansian, Chainat Province.

AC. 158 taken from in front of Amphur Hankha, Chainat Province.

AC. 159 taken from Tambon Bansian, Fourteenth Village, Amphur Bansian, Chainat Province.

AC. 160 taken from Makhamthaw Canal, in front of Wat Doembang, Tambon Doembang, Amphur Doembang, Suphanburi Province.

AC. 161 taken from in front of Wat Thachang, Tambon Bangphra, Amphur Doembang, Suphanburi Province.

AC. 162 taken near Doembang Amphur Building, Suphanburi Province.

AC. 163 taken fron in front of Banthung Water Gate, Suphanburi Province.

AC. 164 taken from near Samchug Amphur Building, Suphanburi Province.

AC. 165 taken from the center of the Wat Phraw Water Gate, Suphanburi Province.

AC. 166 taken from near Amphur Muang Building, Suphanburi Province.

AC. 167 taken from in front of Amphur Bangplama Building, Suphanburi Province.

AC. 168 taken from the center of Banghyihon Water Gate, Suphanburi Province.

AC. 169 taken from in front of the Municipal School, Tambon Wat Chaoched, Amphur Sena, Ayuthaya Province (in Chaoched Canal. The water was black and smelly because it was stagnant for a long time)

AC. 170 taken from the center of Chaoched Water Gate, Ayuthaya Province.

AC. 171 taken from the middle of river, Tambon Lanthe, Ayuthaya Province (where Sikug tributary meets Chao Phya River. The muddy water looks almost clear, but it is dirty).

Laboratory Number	Conductivity	pH value
AC. 131	110	6.80
AC. 132	150	7.24
AC. 133	155	7.34
AC. 134	150	7.34
AC. 135	108	7.14
AC. 136	160	7.04
AC. 137	155	7.04
AC. 138	155	7.22
AC. 139	155	7.05
AC. 140	160	7.31
AC. 141	150	6.97
AC. 142	155	7.05
AC. 143	155	7.22
AC. 144	155	6.97
AC. 145	150	7.05
AC. 146	153	6.88
AC. 147	153	6.80
AC. 148	155	7.14
AC. 149	165	7.31
AC. 150	150	6.54
AC. 151	150	7.05
AC. 152	150	6.86
AC. 153	150	6.78
AC. 154	150	6.86
AC. 155	150	7.46
AC. 156	150	6.98
AC. 157	150	7.32
AC. 158	150	6.98
AC. 159	150	6.90
AC. 160	145	6.90
AC. 161	145	6.98
AC. 162	145	6.83
AC. 163	143	6.98
AC. 164	145	7.17
AC. 165	140	7.24
AC. 166	140	6.81

Laboratory Number	Conductivity	pH value
AC. 167	135	6.98
AC. 168	120	6.81
AC. 169	120	7.15
AC. 170	130	6.56
AC. 171	140	7.15

The results of analyses of some samples are as follows:

Lab. No.	Conductivity	pH value	Organic carbon parts / 100,000	N parts / 100,000	C/N	K_2O parts / 100,000	SO_4 parts / 100,000	Al_2O_3 + Fe_2O_3 parts/ 100,000	MgO parts/ 100,000
AC. 134	150	7.34	1.04	0.58	1.79	1.12	0.82	1.80	3.73
AC. 136	160	7.04	1.22	0.73	1.67	0.54	0.58	2.40	2.53
AC. 169	120	7.15	1.92	0.50	3.84	0.58	0.41	1.60	7.02

ANIMAL FEEDS

The Division of Animals Husbandry, Department of Agriculture and Fishery, sent some samples of animal feeds for analysis, the results of which are as follows:—

Lab. No.	Item	Moisture %	Ash %	Protein %	Ether extract %	Crude fibre %	Carbo-hydrate %
AB.874	Cotton Seed Residue	11.67	6.30	44.80	11.37	3.75	22.11
AB.957	Sasame Residue	9.86	20.34	36.93	9.40	5.07	18.40
AC.404	Ground Pork	8.91	2.17	59.50	26.77	0.60	2.05
AC.405	Dry Cow Blood	11.72	3.39	81.55	1.03	—	2.31
AC.599	Kapok Seed Residue	12.57	5.35	24.94	8.73	20.39	28.02
AC.600	Coconut Residue	11.69	5.31	22.63	19.33	6.79	34.25
AD.621	Soybean Residue	11.89	6.29	48.08	4.27	6.31	23.15
AD.624	Ground Fish	16.88	20.27	46.20	9.44	1.78	5.42
AD.625	Peanut Residue	12.74	3.99	45.76	13.42	3.14	20.95
AL.406	Khae Leaves and Branches	11.89	8.15	16.62	2.26	4.31	56.77
AL.407	Soybean Leaves and Branches	8.27	5.61	6.46	1.09	6.46	47.97
AL.408	Marichus Grass	9.14	7.52	12.99	2.78	27.84	39.73

THE FISH SAUCE

The Division of Agriculture made a study on "Fish Sauce", for (a) its food value, (b) the chemical changes of the protein breakdown and (c) the relationship between manufacturing methods and quality. The fish sauce could be regarded as a salt solution containing proteins and protein decomposition products resulting from hydrolysis in a concentrated salt solution. The high concentration of salt prevents the putrefaction of the sauce by micro-organisms. J. Guillerm (Le nuoc Mam et l' Industries Saumuriere en Indochine, April 1928.) claimed that the toxicity of a putrified sauce was due to the presence of some toxic alkaloids. The study of the fish-sauce has been in its beginning stage. Certain analytical results are shown below:—

	Y. 495	Y. 496	W. 670	Y. 140	X. 737	Y. 144
Total nitrogen	9.94	15.60	23.91	22.68	10.50	9.94
Organic nitrogen	5.52	13.08	21.61	17.98	8.48	7.34
Formaldehyde nitrogen	2.35	2.80	11.42	2.46	1.12	1.79
Ammoniacal nitrogen	4.42	2.60	2.30	4.70	2.02	2.60
Amino acid nitrogen	—	0.20	9.12	—	—	—
Sodium chloride	292.50	222.30	277.88	264.42	292.50	289.58
Salt free ash	0.28	0.78	6.68	3.62	3.44	2.36
Total solids	328.66	321.39	437.46	393.00	381.11	355.96
Phosphoric acid (P_2O_5)	0.18	0.66	1.12	0.86	2.22	0.22
Calcium (CaO)	0.25	0.24	0.97	5.18	1.12	0.35
Silica (SiO_2)	0.50	0.33	0.42	0.40	2.14	0.25

Remark: The figures are in grams per litre.

SOILS

According to the Soil Survey Programme, soil samples from various parts of the country were sent for analysis. The work were tedious since 29 determinations had to be made on each sample. Since the number of analysts were also limited, it would take some times to fulfil the programme. Moreover the Department had taken the responsibility in studying exchange-bases of soil samples sent by the Department of Agriculture.

FERTILIZERS

The Department of Agriculture and Fishery experimented with the production of a fertilizer from soybean. It was supposed to be a better fertilizer than manure from stables or some fertilizers sold in the local market. They sent fermented and organo-fertilizers for analysis.

	Fermented	Organo
Moisture	9.23 %	6.68 %
Carbon	14.18 %	14.34 %
Nitrogen	1.18 %	0.94 %
Potash	3.16 %	2.29 %
Phosphate	2.66 %	7.91 %

The same department also sent fermented fertilizers made from rice straw which might be used instead of stable manure if found suitable. The result of the analysis :—

	Fermented	Manure
Moisture	9.36 %	7.97 %
Ashes	31.04 %	29.69 %
Carbon	13.83 %	15.12 %
Nitrogen	1.04 %	1.15 %
Phosphate	0.52 %	0.59 %
Potash	0.56 %	1.20 %

INSECTICIDES

The use of the derris root extract as an insecticide became very popular. It is better than those containing arsenic which is harmful to human-beings. Two species of derris are in use, namely, *Derris elliptica* and *Derris malaccensis*.

The Agricultural Experimenting Station at Hadyai cultivated many species of derris obtained from Malaya.

From the results of analysis the *Elliptica* was found to yield more rotenone than the *Malaccensis* :—

Lab. No.		% Rotenone (moisture free)	% Ether extract (moisture free)
AA. 375	*Malaccensis*	1.59	20.35
U. 263	*Elliptica*	9.68	30.10

It was found that the optimum age giving maximum amount of rotenone was 24 months. It must be borne in mind that if allowed to age longer the roots would become thickened and less rotenone would be obtained. From the tabulated results we can conclude that the plant should be utilized before it is fully 24 months old or else the amount of rotenone would decrease.

Lab. No.	Age	% Ether extract (moisture free)	% Rotenone (moisture free)
T. 679	22 months	28.57	10.66
T. 678	23 ,,	29.22	10.00
T. 416	24 ,,	21.84	—
U. 263	25 ,,	29.98	9.64
U. 264	26 ,,	29.15	9.15
U. 265	27 ,,	25.59	8.22
V. 691	28 ,,	24.82	6.32
V. 692	29 ,,	22.94	8.42
V. 693	30 ,,	35.51	8.44
V. 694	31 ,,	28.65	9.29
V. 695	32 ,,	27.98	7.89
Y. 554	33 ,,	14.43	4.85
Y. 555	34 ,,	28.14	7.74
Y. 556	35 ,,	30.71	8.68
Y. 557	36 ,,	27.92	7.87
Y. 558	37 ,,	30.10	9.06
Y. 559	38 ,,	26.81	8.27
Y. 560	39 ,,	24.00	7.16
Y. 561	40 ,,	15.44	4.29

However the conclusion should not be regarded as final. The question of optimum age should be further studied.

DIVISION OF PHARMACY

The Division of Pharmacy became quite active soon after the appointment of Dr. Prachuab Bunnag as Head of the Division in 1938. The major concerns had been analysis of food and drugs, standardization of native drugs and preparations of certain biological compounds. During this period the control of importation of biological products was handed over by the Department of Science to the Department of Public Health.

ANTI-HUMAN SERUM

The outbreak of World War II in Europe prevented the supply of the anti-human serum from Copenhagen. In 1939 the serum was prepared at the Division using rabbits as experimental animals. The prepared serum could be used satisfactorily in the Forensic Section.

INSULIN

The alcohol-extraction method for the laboratory-preparation of insulin from animals pancreas appeared to be most economical. The coarsely ground pancreas was extracted with acidified alcohol; the extract obtained was evaporated *in vacuo* and precipitated by ammonium sulphate. The insulin was further purified by precipitation at its isoelectric point. The pancreas from cattles gave a better yield than that from pigs.

VITAMIN B_1

For sometimes the Department of Science had been preparing vitamin B_1 extracts but the potency had never been determined. By rat-growth procedure the standard vitamin B_1 extract produced by the Department was found to contain 16 I.U. vitamin B_1 per ml. By the same procedure the vitamin B_1 content of a kind of unpolished rice was found to be 20 times higher than that in the highly polished rice of the same variety.

The Division also made an investigation as to the feasibility of replacing the imported corn-starch, pure casein, and Baker's Yeast normally used in the diets of our experimental animals by rice-starch, soybean proteins and local yeast respectively.

THAI PHARMACOPOEIA

It had been proposed to compile a Thai Pharmacopoeia, and Dr. Arno Viehoever was made Chairman of the Committee.

ANIMALS FOR DRUGS TESTING

A study had been made in using *Daphnia magma*, *Palaemonetes* and a kind of gold fish, *Jobiella pellucida*, as experimental animals for testing pharmacological actions of drugs. The choice of these animals was made owing to the fact that the transparency of the body walls would permit visual observation of the reaction of various organs towards drugs administered. The work had been reported in details in the Thai Science Bulletin, (1940). Vol. 2 Nos. 3 and 4.

PHARMACEUTICAL WORKS:

The construction of the 36,635 ticals Pharmaceutical Works began in 1939 and was completed in 1940. The purpose is to produce certain ingredients used in drugs from our medicinal plants and other available raw materials. The administration of the Factory does not come under the Department of Science directly but is controlled by a separate Board of Committees presided by the Director General of the Department of Science. The Ministry of Finance had already granted 500,000 ticals as its circulating capital. The Division of Pharmacy took the responsibility of testing the finished products and the raw materials used. The factory had already produced tincture of asafetida, tincture of orange, compound tincture of benzoin, tincture of capsicum, tincture compound of cardamon, tincture of nux vomica, camphorated tincture of opium, compound tincture of rhubarb,

tincture of ginger, liquorice extract, aromatic spirit of ammonia, aspirin tablets, amidopyrin tablets, tablets of ipecacuanha and opium, potassium chlorate tablets, quinine sulphate tablets, soda-mint tablets, vitamin B_1 tablets, morphine hydrochloride, quinine hydrochloride, and strychnine sulphate.

MEDICINAL PLANTS

The Division aimed at making a comphrehensive study of the Thai medicinal plants. The work was in its beginning stage.

STRYCHNOS PLANT

Plants of the *strychnos* family are known in different localities as Salaengchai, Kacheeree, Kot-Kut-Kling and Matung. Those found in Chiengrai and Prae are of the same species, *Strychnos nux blanda*, Hill. The seed is oblong; greyish and not bitter in taste; it contains no strychnine. The species in Nakorn Rajsima, *Strychnos nux vomica*, is somewhat roundish, flattened yellowish-brown in colour and contains 1.49% strychnine. Brucine has also been identified among the crude alkaloids.

KRAPIAD OR NON-TAI-YAK

The plant of the genus *Stemona* is known locally as non-tai-yak and krapiad. Only two species exist in Thailand — *S. tuberosa*, Lour. and *S. collinsae*, Kerr.; the latter seems to have comparatively thinner roots and smaller leaves.

In China the alcoholic extract of the roots of *S. tuberosa* had been used effectively as a cough cure, carminative and anthelmintic. It was claimed that the roots could be used in the treatment of phthisis and thoracic pains. In Thailand it has been used internally as an anthelmintic and also as an insecticide against human lice and insect pests of pepper plants.

Suziki (1940) reported the presence of alkaloids stemonidine ($C_{19}H_{31}O_5N$) and tuberostemonine ($C_{22}H_{33}O_4N$) in the Japanese *Stemona tuberosa*. The latter alkaloid was identical with that isolated by Schild (1936) from *Stemona sessilifolia*.

The *Stemona collinsea* found in Cholburi gave an alkaloid, insoluble in water, readily soluble in acetone, alcohol, ethylene trichloride. The hydrochloride was found soluble in water and was quite effective at great dilutions against mosquito-larvae both *Culex* and *Anopheles*.

PHRA CHAN KRUNG SEAK (The Half-Moon Plant), *Lobelia chinensis*, Lour.

Lobeline had been reported present in *Lobelia inflata* and *L. sessilifolia*. Since the Half-Moon Plant, *Lobelia chinensis*, had been used effectively as an asthma cure in China for a long time, it is quite probable that the plant may contain the same active principle. Garrett identified the species at Doi Anka, Northern Thailand as *Lobelia pyramidalis*: the local Karens used this plant in rendering the arrow-heads poisonous. It was proposed to make a preliminary investigation into the active principle of *Lobelia chinensis* at the Division of Pharmacy.

HARNG CHORAKAY (Crocodile's Tail Plant), *Aloe vera*, L.

The plant grows abundantly in Thailand. It had been used in making laxative preparations. The effect could be compared with that obtained from the famous *Curacao aloe*. It should be noted that Chopra and Ghosh, Arch. Pharm. (1938) p. 348-350, from their study of the *Aloe* plant in Bengal, reported the absence of aloin; and the presence of traces of aloe-emodin was insufficient to give a laxative action at an ordinary dose.

DEE-NGOO or Bitter Korm, *Picrasma javanica*, Blum.:

The plant grows wild in Northern Thailand generally at an elevation of 150-1400 meters. Some people used its bitter bark in the treatment of malaria. It was found that the bark of *Picrasma* contains no quinine. The crude product obtained from the bark is very soluble in water and bitter in taste. It was neither an alkaloid nor a glucoside, but it showed the properties of a quassin-like compound.

CHAH-RU-SI, *Ehretia microphylla*, Lam. :

Ehretia microphylla is regarded as a medicinal plant in the Philippines. In India the roots were used in the treatment of syphilis and as an antidote for vegetable poisoning. The leaves were used instead of tea in the Dutch East Indies and the Philippines. A saponin, the glucoside known as ehretin. was found distributed in every part of the plant mainly the root except in its edible fruit. The dry root contained 0.6 % ehretin. The phyllobaphane-type tannin and the quercetin-type dye were present in the leaves and barks; but the glucoside ehretin, giving a blue dye, previously reported present in *E. buxifolia* and *E. tenuifolia* or *E. tinifolia* and a chlorogenic acid found in the leaves of *E. buxifolia* were absent in the Thai species, *E. microphylla*, Lam.

The seed contained 51.7 % non-drying oil specific gravity (30°C.) 0.82, refractive index (30°C.) 1.47 and iodine number (Hanus) 102.8.

MANGLUK SEED, *Ocimum basilicum*, Linn.

When soaked in water the outer coating of the mangluk seed forms a jelly-like substance. The jelly part was found to contain 1 % by weight hemicellulose and starch.

ANALYSIS STATISTICS

From	Items	Number of Samples		
		1938	*1939*	*1940*
Ministry of Finance				
Department of Customs	Fuel oils	579	463	330
	Lubricants	273	6	1
	Butter and Milk	131	160	140
	Milk Foods and Powder	38	11	16
	Chinese Liquors	20	31	20
	Harmful Habit forming drugs	18	5	10
	Imports for alcoholic determination	7	3	13
	Wood naphtha	19	6	22
	Woven articles	131	173	154
	Edible goods	6	2	—
	Essences	8	4	10
	Metals	34	6	18
	Vinegar	22	13	—
	Fats and oils	22	51	44
	Paper	3	13	5
	Insecticides	54	25	19
	Mineral oils	7	20	—
	Drugs	42	44	20
	Miscellaneous	19	9	8
		1433	1045	830
Department of Revenue	Opium	9	17	10
	Raw Opium	79	53	49
	Opium Dross	2	9	12
	Morphine	—	—	1
	Opium, Opium Dross or Morphine suspects	71	63	39
	Salt	—	—	66
	Metals	10	4	9
	Miscellaneous	2	3	14
		173	149	200

From	Items	Number of Samples		
		1938	*1939*	*1940*
Department of Finance	Gold	—	6	24
	Silver	—	—	3
	Nickel	133	—	—
	Copper	—	25	—
	Tin	20	252	—
	Zinc	8	9	—
	Iron	4	—	—
	Other Metals	—	34	—
	Acids	—	34	—
		165	360	27
Store Department	Ink	10	2	6
	Carbon Paper	2	11	1
	Miscellaneous	—	3	—
		12	15	7
Ministry of Agriculture				
Department of Lands and Mines	Wolfram ores	37	42	104
	Tin ores	9	8	73
	Other ores	2	—	15
	Rock earth sand	1	—	1
	Miscellaneous	—	3	2
		49	53	195
Department of Agriculture and Fishery	Water	12	19	14
	Earth	—	—	287
	Fertilizer	—	—	4
	Salts	13	—	—
	Derris roots	13	11	—
	Animal foods	—	10	12
	Plants	—	4	—
	Miscellaneous	4	3	6
		42	47	322

From	Items	Number of Samples		
		1938	*1939*	*1940*
Forestry Department	Plants and Seeds	1	8	4
	Vegetable products	1	3	—
	Woods	—	7	—
	Acids	—	—	2
		2	18	6
Irrigation Department	Mineral oils	1	3	—
		1	3	—
Ministry of Interior				
The Committee of Commissioners of Changvad and Amphur	Poison suspects	31	17	13
	Materials for examination under the harmful habit forming drug Law	3	1	—
	Opium, opium dross of morphine suspects	12	1	2
	Blood stains	5	10	8
	Fire arms explosive	2	7	1
	Fish sauces	46	—	—
	Rocks and Earth	—	6	—
	Miscellaneous	1	3	10
		100	45	34
Penitentiary Department	Drugs	—	—	1
	Miscellaneous	—	—	4
		—	—	5

From	Items	Number of Samples		
		1938	*1939*	*1940*
Police Department	Blood stains	26	42	47
	Fire arms and explosives	21	24	13
	Material for examination under the harmful habit forming drug Law	7	20	9
	Poison suspects	55	12	29
	Semen stains	1	1	1
	Counterfeits forgeries	5	27	25
	Drugs and Chemicals	—	3	9
	Miscellaneous	8	10	6
		153	139	139
Department of Public Health	City water	112	127	86
	Other water	44	85	59
	Foods	—	—	13
	Materials for examination under the harmful habit forming drug Law	20	12	4
	Poison suspects	4	2	4
	Chemicals	3	—	3
	Drugs	—	2	—
	Miscellaneous	2	4	6
		185	232	175
Public Works Department	Water	45	78	87
	Germicides	—	1	—
	Alum	2	1	1
	Miscellaneous	7	5	1
		54	85	89
Bangkok Water Works	City water	—	15	32
	Alum	2	1	3
	Lime	8	9	—
	Chlorinated lime	—	—	1
		10	25	36

From	Items	Number of Samples		
		1938	*1939*	*1940*
Ministry of Economic Affairs				
Department of Commerce	Rice and bran	—	—	4
	Foods	—	—	14
	Cosmetics	—	4	2
	Woven goods	—	1	38
	Paper	—	—	1
	Oils	—	11	—
	Miscellaneous	—	14	15
		—	30	74
Post and Telegraph Department	Metals	10	3	—
	Acids	—	1	—
	Rocks and earth	2	—	—
	Miscellaneous	—	—	1
		12	4	1
Department of State Railways	Metals	19	17	14
	Oils	3	—	5
	Chemicals	17	5	1
	Water	—	1	7
	Wood	—	11	2
	Miscellaneous	—	7	—
		39	34	29
Department of Science	River water	716	620	551
	Rice and Bran	105	107	83
	Foods	—	19	9
	Drugs and Chemicals	9	22	24
	Chemicals	—	6	9
	Ores	—	—	1
	Clay etc.	—	—	6
	Miscellaneous	—	41	33
		830	815	716

From	Items	Number of Samples		
		1938	*1939*	*1940*
Ministry of Justice				
Law Courts	Confiscated foods	4	—	—
	Liquors	—	—	3
	Documents	—	4	—
		4	4	3
Ministry of Defence				
Army Medical Department	Poison suspects	2	—	—
		2	—	—
Inspector General Department	Grass	—	3	3
	Soil	—	38	10
		—	41	13
Royal Survey Department	Chemicals	49	32	26
	Ores and Minerals	2	19	10
	Salts	—	7	4
	Lubricants	—	—	4
	Miscellaneous	—	7	—
		51	65	44
Military Supplies Department	Foods	7	2	—
	Animals foods	4	1	—
	Drugs and Chemicals	1	2	—
	Metals	3	—	3
	Miscellaneous	3	—	—
		18	5	3
Military Arsenal Department	Tin ores	27	27	—
	Other ores	5	—	—
	Miscellaneous	1	1	—
		33	28	—

From	Items	Number of Samples		
		1938	*1939*	*1940*
Fuel Department	Fuel oils	5	6	8
	Distilled water	—	—	1
	Miscellaneous	4	3	—
		9	9	9
Quarter Master General Department	Foods	5	1	—
	Oils	12	2	—
		17	3	—
Naval Science Laboratory	Fuel oils	1	1	—
	Metal	—	—	1
		1	1	1
Hydrographic Service Department	Water	214	358	778
	Soil	—	19	45
		214	377	823
Military Store Department	Woven goods	1	—	—
	Disinfectant	—	—	1
		1	—	1
Thai Textile Works	Cotton seed meal	—	—	4
		—	—	4
Naval Medical Department	Water	—	1	—
	Drug	—	1	—
		—	2	—
Royal Air Force & Aeronautical Work Shop	Metals	3	8	3
	Fuels	—	1	1
	Miscellaneous	—	—	1
		3	9	5

From	Items	Number of Samples		
		1938	*1939*	*1940*
Public (Firms and Individuals)	Damaged merchandise	81	12	4
	Water	59	46	87
	Drugs and Chemicals	24	29	38
	Ores	16	13	66
	Metals	1	6	6
	Fabrics	16	4	3
	Foods and Beverages	16	28	14
	Rice and Bran	13	5	1
	Fuel oils	2	2	2
	Lubricants	4	3	2
	Miscellaneous	40	145	40
		272	293	263

N. B. The year 1940 covered only 9 months work i.e, from April to December.