MINISTRY OF ECONOMIC AFFAIRS

BANGKOK, THAILAND.

DEPARTMENT OF SCIENCE

9th REPORT

FROM APRIL 1st 1936 TO MARCH 31st 1938.

BANGKOK, SEPTEMBER 1940.

Price Baht 1.00.

Ministry of Economic Affairs,

September, B. E. 2483.

To His Excellency Major-General Luang Pibul Songgram,
President of the Council of Ministers.

Sir,

I have the honour to lay before Your Excellency the Ninth Report of the Director-General of the Department of Science on the work of this Department for the years B. E. 2479 and 2480.

I have the honour to be, Sir,

Your obedient servant,

BORIBHANDH YUDHAKITCH

Minister of Economic Affairs.

Department of Science,
Ministry of Economic Affairs.

September, B. E. 2483.

To His Excellency Colonel Phra Boribhand Yudhakitch,
Minister of Economic Affairs.

Your Excellency,

I have the honour to lay before Your Excellency the Ninth Report of my Department covering the work carried on in the years B. E. 2479 and 2480.

I have the honour to be, Sir,

Your obedient servant,

TOA LABANUKROM

Director-General.

STAFF.

Director-General—Dr. Toa Labanukrom, PH. D. (Berne).

OFFICE OF THE SECRETARY OF THE DEPARTMENT.

Chief of Division—Senior Chemist, Phra Krasapna Bibhag.

CORRESPONDENCE AND LIBRARY SECTION.

Head of Section—Khun Chamras Rasayana.
Assistant—Nai Ong Thadasih.

ACCOUNTS SECTION.

Head of Section—Nai Siri Chuvidya, B. S. C. (F. E. U.)
Assistant—Nai Phong Manidisth.

STORES SECTION.

Assistant Chemist—Nai Siri Suwanapadama.

DIVISION OF CHEMISTRY.

Chief of Division—Senior Chemist, Luang Vichien Dhatukarn, L. ès Sc., I. C. (Poitiers).
Principal Chemist—Mr. C. J. House, B. Sc. (Lond.) A. R. C. S., F. I. C.

INORGANIC CHEMISTRY SECTION.

Assistant Chemist—Nangsoa Aroon Israbhakdi, B.S. (Chem.) (Silliman).
Assistant Chemist—Nai Ua Rasmidatta, Dip. Phar. (Ch. U.)

ORGANIC CHEMISTRY SECTION.

Assistant Chemist—Nangsoa Skul Nivasanandana, B. Sc. (Ch. U.)

METALLURGY SECTION.

Chemist—Nai Banbota Suddhikam, B. S. (Chem.) (Silliman)
Assistant Chemist—Nai Vongse Naewbanij, A. A. (Sto. Thomas).

Opium Dross Control Section.

Chemist—Nai Udom Kraisorakul.
Assistant Chemist—Nai Tong Kham Milintalek, Dip. Phar. (Ch. U.)

Water Analysis Section.

Chemist—Khun San Kosiyabastr.
Chemist—Nai Samroeng Vimuktananda, B. S. (Chem.) (Silliman).
Assistant Chemist—Nai Pravat Isarankura Na Ayudhya, Dip. Ed. (Ch. U.)

Fuel Section.

Assistant Chemist—vacant.

General Analysis Section.

Chemist—Mom. J. Dubois Chitrabongse.

DIVISION OF INDUSTRIAL CHEMISTRY.

Chief of Division—Senior Chemist, Dr. Prachuap Bunnag, Ph. D. (Berne).

Medicinal Products Section.

Chemist—Nai Kliau Bunnag, B. S. (Phar.) (U. P.), Dip. Phar. (Ch. U.)
Assistant Chemist—Nai Robert Saisanit.

Research into Forest Products Section.

Chemist—Nai Taw Thaewyoo.

General Research Section.

Chemist—Nai Pue Rochanapurananda, B. S. (Chem.) (U. P.)

Ceramics Section.

Chemist—Nai Chalaem Bhumiratana, Ch. B. Chem. (Sto. Thomas).

Textiles Section.

Assistant Chemist—vacant.

DIVISION OF AGRICULTURAL SCIENCE.

Chief of Division—Senior Chemist, Nai Sangar Sharasuvarna, C. D. A. (Hons.) (Seale-Hayne).

Chemist—Mr. M. M. Cero, B. S. Agr. (U. P.)

Agricultural Chemistry Section.

Chemist—Nai Thongchai Punyasingha, B. S. Agr. (U. P.)

Soil Analysis Section.

Chemist—Nai Sroung Charuprakara.

Fertilizers and Insecticides Section.

Chemist—Nai Aree Supol, B. Sc. (Calcutta).
Assistant Chemist—Nai Bunsuep Alobho, Dip. Sc. (Ch. U.).

Soil Bacteriology Section.

Chemist—vacant.

DIVISION OF PHARMACY.

Chief of Division—vacant.

Phyto Chemistry Section.

Pharmacist—Nai Thong Dee Suvanakas, B. S. (Phar.) (G.W.U.).

Pharmaceutical Chemistry Section.

Pharmacist—Lt. Chamnong Prasomthong, Dip. Phar. (Ch. U.).

Pharmacognosy Section.

Assistant Pharmacist—Sub. Lt. Vichien Muang Noi Charoen, Dip. Phar. (Ch. U.).

Biochemistry Section.

Medical Officer—Nai Kimkang Suvarnakich, M. B. (Ch. U.).
Assistant Pharmacist—Nai Puan Charoenbanij, Dip. Phar. (Ch. U.).

PHARMACEUTICS SECTION.

Medical Officer—Nai Siri Tewayananda, M.B., Dip. Phar. (Ch. U.).

NOTE.

Officials who joined the Department of Science:

1. Nai Pravat Isarankura Na Ayudhya was transferred from the Ministry of Education as Assistant Chemist, Water Analysis Section on the 1st June 1936.
2. Nai Banbota Suddhikam joined the Staff as Chemist, Metallurgy Section on the 1st August 1936.
3. Dr. Prachuab Bunnag was transferred back from the Ministry of Defence on the 1st December 1936.
4. Nai Siri Tewayananda joined the Staff as Medical Officer, Pharmaceutical Section on the 24th April 1937.
5. Nangsao Skul Nivasanandana joined the Staff as Assistant Chemist, Organic Chemistry Section on the 3rd June 1937.
6. Nangsao Aroon Israbhakdi joined the Staff as Assistant Chemist, Inorganic Chemistry Section on the 7th June 1937.
7. Nai Thong Dee Suvanakas joined the Staff as Pharmacist, Phyto Chemistry Section on the 10th August 1937.
8. Nai Kimkang Suvarnakich was transferred from the Department of Public Health as Medical Officer, Biochemistry Section on the 1st January 1938.
9. Lt. Chamnong Prasomthong was transferred from the Ministry of Defence as Pharmacist, Pharmaceutical Chemistry Section on the 1st January 1938.
10. Sub. Lt. Vichien Muang Noi Charoen joined the Staff as Assistant Pharmacist, Pharmacognosy Section on the 1st January 1938.

Officials who went abroad:

1. The Director-General was absent from March 28th 1936 to June 11th 1936 on account of an official trip to Japan and Manchuria.

2. Nai Chalaem Bhumiratana left Thailand with the Director General on the 28th March 1936 and studied ceramics in Japan. He returned on the 19th August 1936 after an absence of nearly five months.

3. Nai Aree Supol left Thailand on the 11th April 1936. He visited England, France and Germany to study the technique recently developed in spectrum analysis and other physico-chemical methods used in chemistry laboratories. He returned on the 7th December 1936 after an absence of eight months.

4. Nai Tongkam Milintaleka left Thailand on the 20th April 1937 for Manila P. I. to study pharmaceutical chemistry. He returned on the 18th May 1938 after an absence of thirteen months.

5. Nai Kliau Bunnag left Thailand for England and Germany on the 24th April 1937 to study pharmaceutical chemistry and bioassay. He returned on the 7th March 1938 after an absence of ten months.

6. Nai Banbota Suddhikam left Thailand for Japan on the 12th October 1937. He studied petroleum refinery and analysis. He did not return until December 15th 1938.

Officials retired:

1. Khun San Kosiyabastr retired from Service on the 19th August 1936.

2. Lt. Van Lohpinit, retired on the 1st August 1937.

GENERAL REVIEW.

During the period covered by this report there has been a phenomenal increase in the entire activity of the Department as evidenced by the volume of the analytical work done, the new tasks undertaken, the extension of the laboratory accommodations, as well as in the additional members of the staff acquired, and the new equipments secured.

The analytical work done during this period as well as in the two previous periods are tabulated below:

		B. E. 2475 & 2476	*B. E. 2477 & 2478*	*B. E. 2479 & 2480*
Total number of Samples analysed		13,872	35,628	32,956
Routine Samples	Opium dross	10,327	31,889	24,213
	Bronzes	—	326	1,863
General Samples		2,169	3,413	6,880
Increase of General Samples over previous period		—	1,244	3,467
Increase of Samples in Percent.			57.35%	101.6%

The total number of samples analysed compares favourably with that of the previous period. After deducting the opium dross and bronze samples, the examination of which is purely a matter of routine, the number of general samples analysed was 6,880 as compared with 3,413 for the previous period. This represents an increase of 101.6% and this figure—6,880—is 3.17 times the total number of general samples (2,169) of the period B. E. 2475-2476.

It will be seen that the volume of analytical work done has increased more than three fold during these four years.

The fees received during this period as well as in the two previous periods are tabulated below:

		B. E. 2475 & 2476	*B. E. 2477 & 2478*	*B. E. 2479 & 2480*
Sales of Preparations	Baht	11,142.95	19,649.37	33,502.73
Analytical fees	„	2,999.20	4,614.90	4,718.00
Examination fees		—	—	120.00
Total Receipt	„	14,142.15	24,264.27	38,340.73
Increase of total receipt over the previous period		—	10,122.12	14,076.46
Increase in Percent.			71.57%	58.02%

The sales of preparations during this period amounted to Baht 33,502.73, which represents an increase of Baht 13,853.36 or 70.5% over that of the previous period (Baht 19,649.37) and is 3.0 times that of the period B. E. 2475-2476. Similarly the total receipt of this period, Baht 38,340.73, represents an increase of Baht 14,076.46 or 58.02% of the total receipt of the previous period (Baht 24,264.27) and is 2.7 times that of the period B. E. 2475-2476.

In addition to the enormous increase in all branches of works that formerly embraced the entire activity of the Department, quite a number of new work was started to enable the Department to widen its scope of usefulness to the Government as well as the general public.

The Division of Pharmacy was established, and a two storied building constructed to the east of the main building to accommodate this new Division.

The Ceramics Section was started and made a part of the Division of Industrial Chemistry formerly known as the Division of Technology.

The balance room of the main building was equipped with an air conditioning system, with automatically controlled temperature and humidity, for the storage of delicate instruments which would soon deteriorate and become ultimately useless in the tropics, as well as to facilitate the weighing of substances which absorb moisture too rapidly from a humid atmosphere.

A quarterly Science Magazine in Thai Language was published to popularize the knowledge of science, and to encourage its application in industry as well as in every day life.

A School of Practical Chemistry was founded, with a view to produce reliable assistants properly trained in theoretical and practical chemistry, in order to supply the long felt want and constantly growing need for such functionaries. The instructions are imparted by members of the staff.

The library was considerably enlarged to furnish adequate books of reference and scientific periodicals which are essential to the efficiency and progress of a scientific institution.

Six officials including the Director General went abroad, some to Europe and others to the Far East, for periods varying from a few months to over a year for specific trainings in various laboratories and institutions so as to permit them to observe the general trend of progress and new developments in the different branches of work. They were thus given the valuable opportunity to come in contact and exchange ideas with scientists in different parts of the world, from which they derived much benefit.

The Director General as well as a few members of the staff served as president and members of several committees appointed by the various Ministries, and the Council of Ministers.

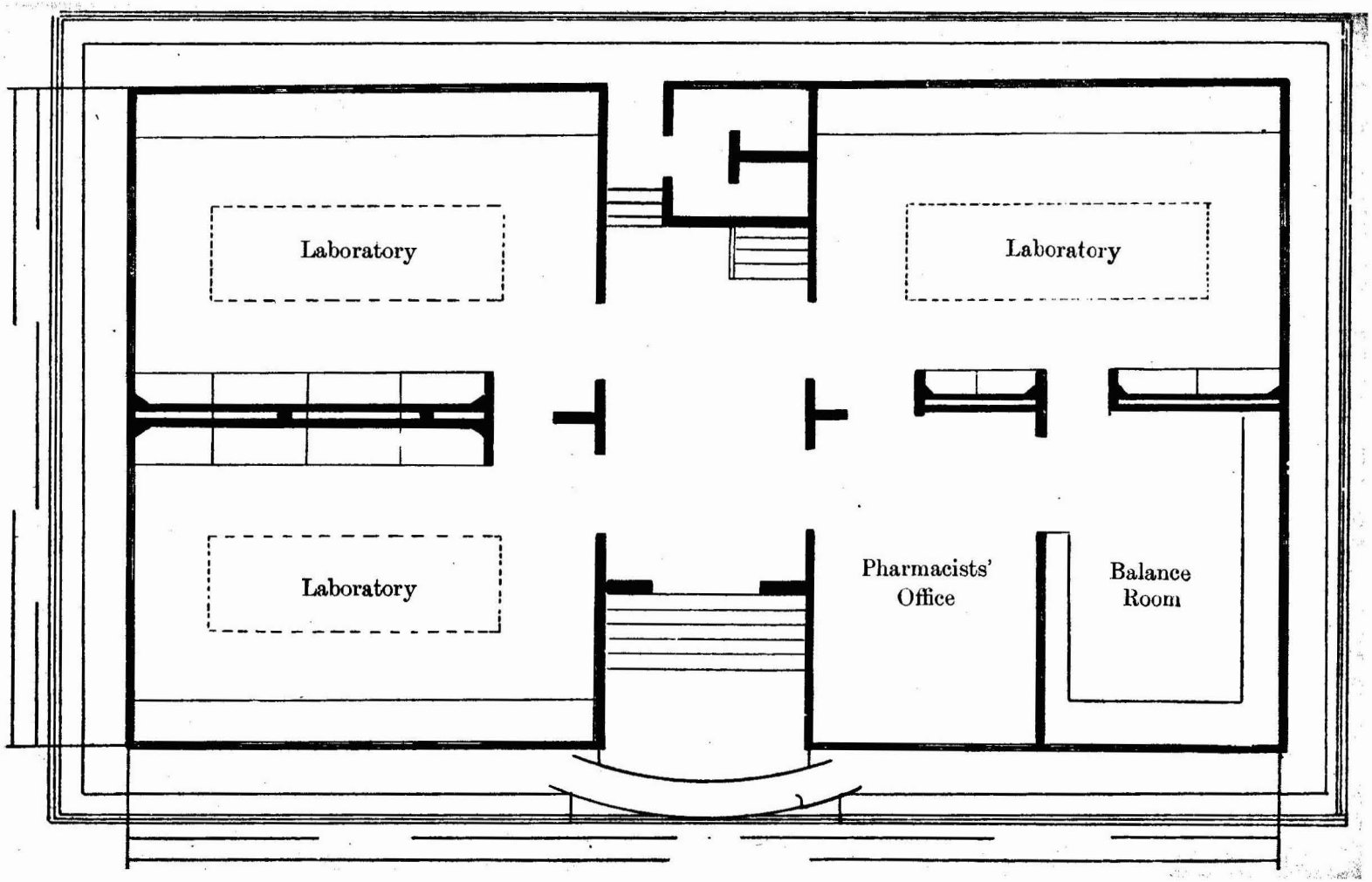
The Department put up a stall in the Constitution Fair in B. E. 2479 and in B. E. 2480, to give the public the opportunity to acquaint themselves with the sphere of activity of the Department, and to stimulate their interest in science.

It will be seen that over and above the large increase of the volume of usual work done in the Department, the energy of the staff was utilized in many other ways with a view to improve the quality of work and add to the usefulness of the Department to the nation.

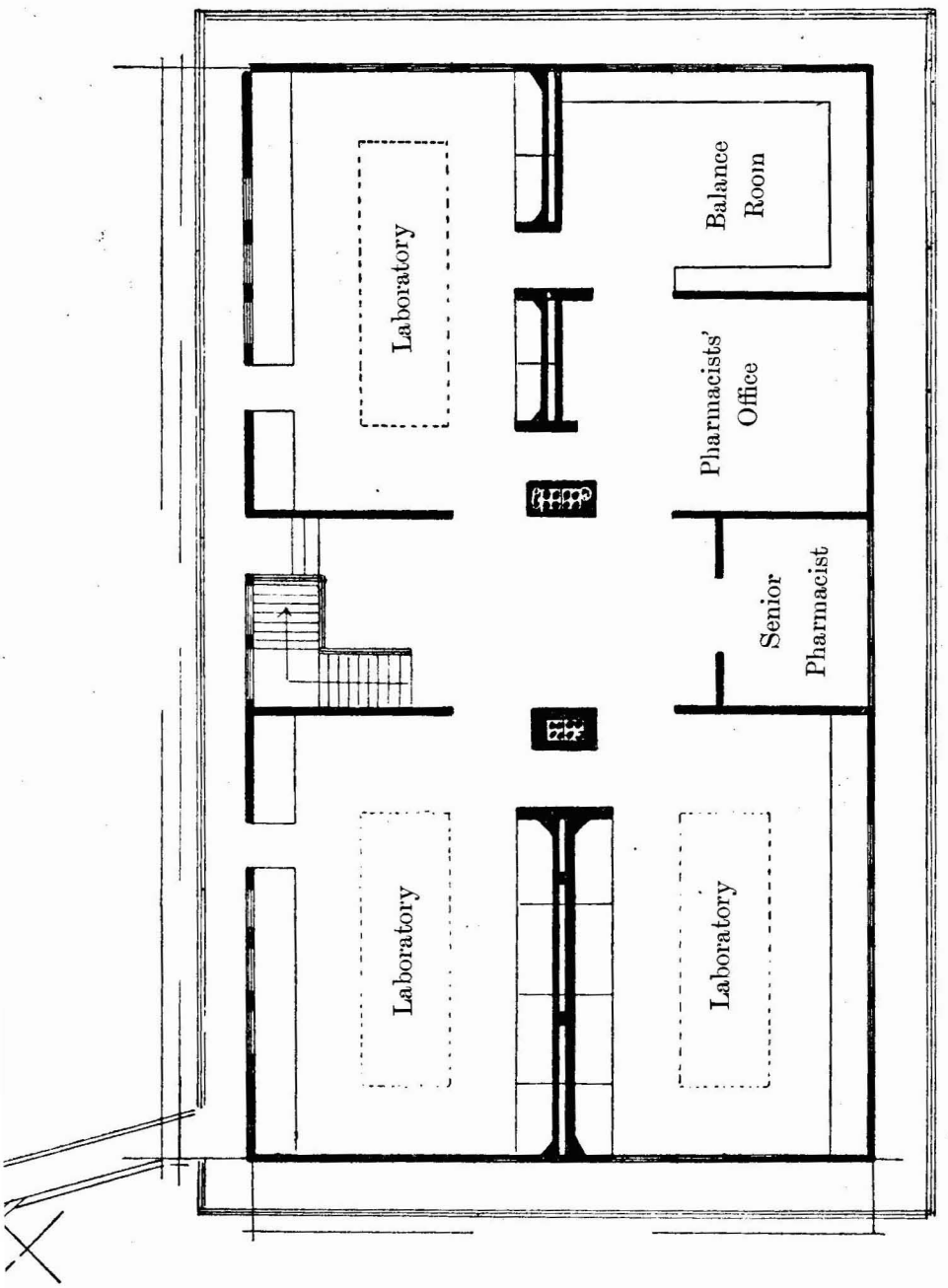
A perusal of the list of the new members of the staff will show that four officials joined the Department in 1936, three in 1937, while the other three were recruited only towards the end of the period of this report i. e. in 1938. Against this new addition to the staff, two retired and six went abroad.

The effective increase of the staff was negligible compared to the accomplishments of this period. This is due to the remarkable improvement in the organization of the Department as well as to the efficiency of the entire staff.

The Pharmacy Building.
Side view.



Pharmacy Building
Ground floor plan.



Pharmacy Building
Upper floor plan.

THE PHARMACY BUILDING.

With the formation of the Division of Pharmacy, it was necessary to find accommodation for the newly projected work. A two storied building was constructed to the east of the main building. The plans of the ground and the first floor are practically identical. It is 24.50 x 17 meters, the first floor being surrounded by a railed verandah 1.20 meters broad. All windows are fitted with sliding glass panes behind the conventional wooden shutters. The accomodation provided are as follows:—

Ground Floor, (4 meters high)

1.	Three laboratories each	10 x 7 meters	= 210 m^2
2.	One balance room	7 x 5 „	= 35 m^2
3.	One Pharmacists' office	7 x 5 „	= 35 m^2
4.	One hall accomodating the entrance, the staircase and a lounge for receiving visitors. Two water closets are provided under the staircase	4.5 x 14 „	= 63 m^2

First Floor (3.75 meters high)

1.	Three laboratories each	10 x 7 meters	= 210 m^2
2.	One balance room	7 x 5 „	= 35 m^2
3.	One Pharmacists' office	7 x 5 „	= 35 m^2
4.	One hall, part of which (5 x 4.5 m) is partitioned off as an office for a senior chemist	14 x 4.5 „	= 63 m^2

Each of the laboratories is provided with

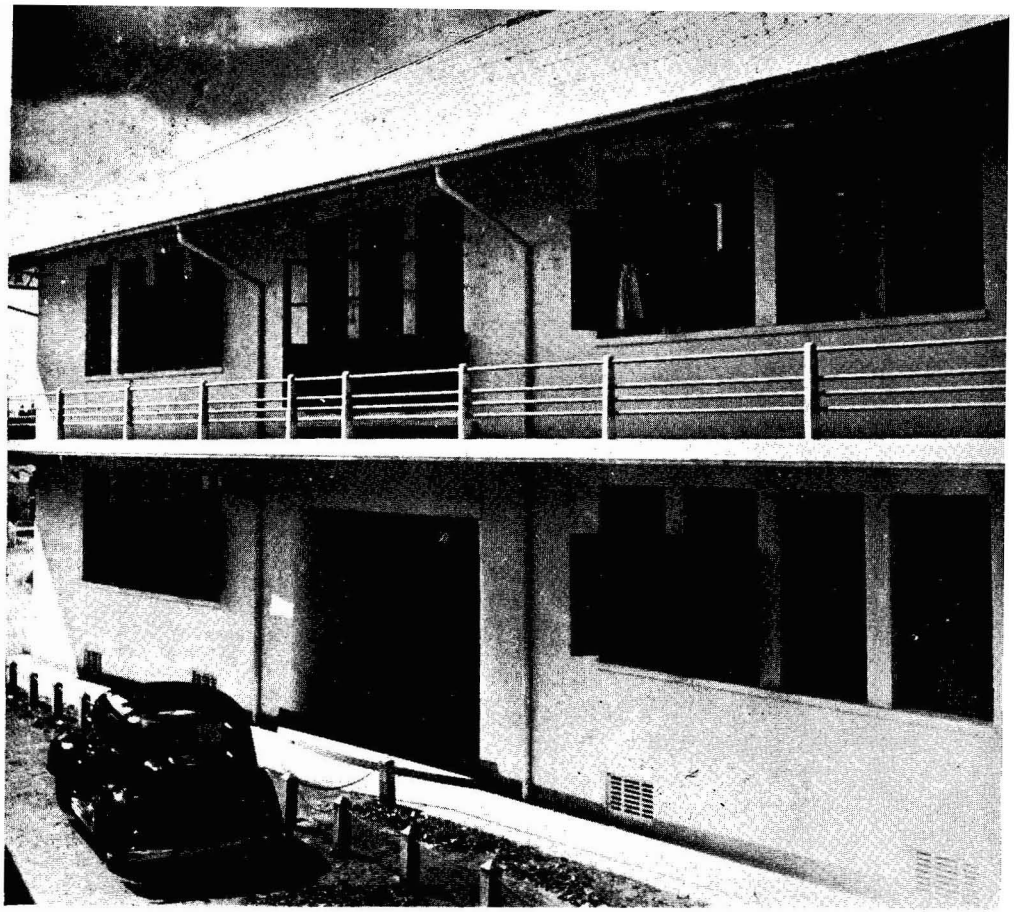
45	points gas
44	points water
7	sinks
2	fume cupboards
2	hoods

The fume cupboards and hoods are constructed with ferro-concrete and lined with white porcelain tiles. The fumes are carried through flues housed in the double walls of the building, to the chimneys which rise above the roof of the building.

Thus the six laboratories provide an extra laboratory floor space of 420 square meters, 270 points gas, 244 points water, 42 sinks, 12 fume cupboards and 12 hoods.

The upper floor of this building is connected to the upper floor of the main building by a railed ferro-concrete bridge, offering convenient communication with the administrative office.

The cost of construction complete with the necessary fixtures was Baht 39,522.50. The building was formally opened on the 28th February B. E. 2480.



The Pharmacy Building.
Front view.

THE SCHOOL OF PRACTICAL CHEMISTRY.

The need of laboratory assistants with a reliable training in the methods of practical chemistry and sufficient theoretical knowledge to carry out the instructions of a chemist with precision and carry on routine analysis independently was keenly felt years ago. This would relieve the qualified chemist of a part of his routine work and leave him sufficiently free to devote a part of his time in improving the analytical methods in use, gathering informations and investigating problems that often crop up in the course of his work.

As the volume of work was growing at a rate which was out of all proportion to the additional staff we could hope to secure, it was deemed necessary to start a school to train such assistants.

The Director General took up the post of Superintendent of the School and Nai Pue Rochanapurananda acted as Assistant Superintendent.

The candidates seeking admission must have passed their High School Examinations. They would be given a two years' course in theoretical and practical chemistry, comprising of inorganic, physical and organic chemistry, qualitative and quantitative analysis.

Accordingly in October B. E. 2480 twelve students were admitted by competitive examination. The room on the first floor of the main building directly above laboratory No. 1 served as the lecture room, and a laboratory was set apart for their practical work.

The course is given free of charge and the instructions were entirely imparted by the members of the staff of the Department, who took turns at the lectures and in the demonstrations and practical instructions in the laboratory. There might seem to be some disadvantage in the lack of continuity, because the same teacher cannot devote his time to the whole course, but the benefits derived from this system more than offset this slight disadvantage. The members of the staff are given the opportunity to refresh their knowledge and renew their acquaintance with their text books which are generally very sadly neglected and the students have the opportunity to come into personal contact with every chemist in the Department and the tie of teacher and pupil binds every chemist to every student thus paving a way for very close collaboration in the future.

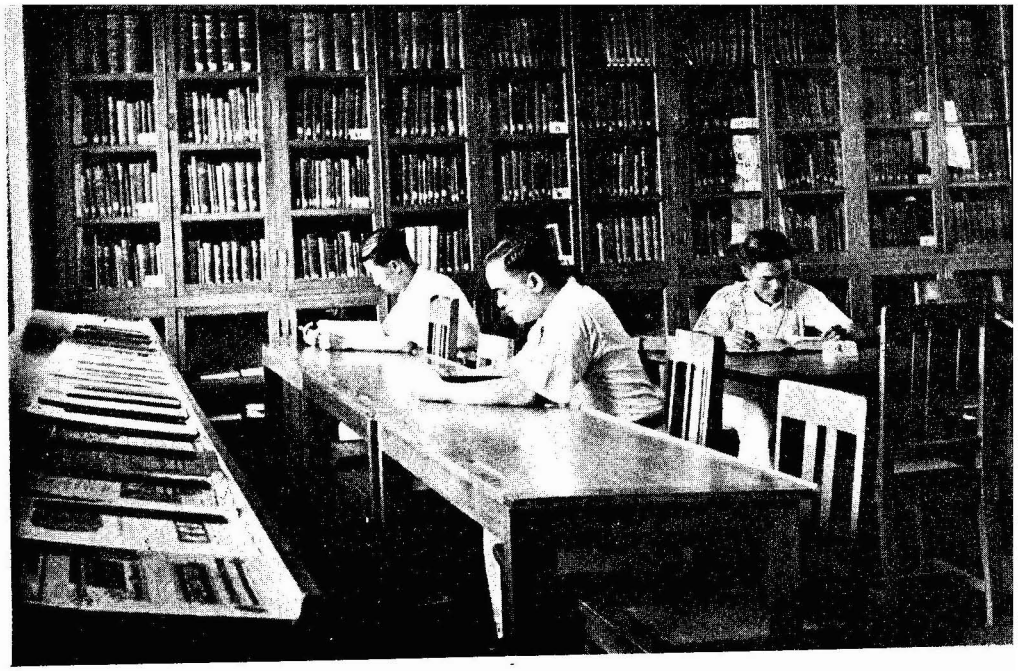
THE LIBRARY.

The library plays a very important part in the progress of a scientific institution. Without a proper supply of periodicals and books no considerable improvement can be expected. During the past few years in which an immense progress has been made by the Department, the library was proportionally enlarged and equipped with additional periodicals and books dealing with all the branches of work done.

Before B. E. 2477 the number of books in the library was 547. During the period B. E. 2477-78, 279 additional volumes were purchased and during B. E. 2479-80, 488 more volumes were added, bringing the total to 1314 volumes or 2.4 times the number of books we had in the library four years before.

If the increase in the number of books has been considerable, the additional number of journals and periodicals subscribed to has been more remarkable. While the number of journals received before B. E. 2477 was less than 10, in B. E. 2480 it amounted to 48.

Formerly the library was housed in the balance room of the main building which is now equipped with an air-conditioning system. In B. E. 2479 it was removed to a room twice as large on the first floor of the main building, where it was thought that the accommodation would be ample for years to come. But we are again faced with the problem of finding space for the books that are constantly pouring in.



The Library.

THE VIDYASASTRA MAGAZINE.

The Vidyasastra Magazine or the Science Magazine in Thai language was first published in September 1937. Its aims may be summarized as follows:—

1. To popularize the knowledge of science among the general public in Thailand.

2. To encourage the people to apply scientific knowledge to their daily work.

3. To publish practical formulae for common articles which can be readily prepared at home or in any small laboratory.

4. To report the results of investigations being carried out in Thailand.

6. To report the advance of science in foreign countries.

From the time of its inception, the Vidyasastra Magazine was given much support by people in all walks of life. Students, teachers, officials and business men were numbered among the subscribers. There were 1325 members in B. E. 2479 and 2558 members in B. E. 2480.

The staff of the magazine for the year 2479 were as follows:—

Dr. Toa Labanukrom	Editor
Pue Rochanapurananda	Asst. Editor and Business Manager
Siri Juvidya	Treasurer

Publication Committee.

Phra Krasapana Bhibag	C. J. House
Sanga Sharasuwarna	Klieu Bunnag
Tongchai Punyasingha	Sroung Charuprakara
Banbota Suddhikam	Boonsuep Alopho
Ua Rasmidatta	Pravat Isarankura

For the year B. E. 2480 the staff consisted of the following:—

Dr. Toa Labanukrom	Editor
Pue Rochanapurananda	Asst. Editor
Pravat Isarankura	Business Manager
Siri Juvidya	Treasurer

Publication Committee.

Phra Krasapana Bhibag	C. J. House
Dr. Prachuab Bunnag	Luang Vichien Dhatukarn
Sanga Sharasuwarna	Aree Supol
Chalaem Bhumiratana	Siri Tewyananda
Aroon Israbhakdi	Pravat Isarankura

ERRATA

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SOLAR SALT.

The production of solar salt is an industry of considerable importance in Thailand. The salt fields in operation along the coast of the Gulf of Thailand cover an area of nearly nine thousand rais (1 hectare = 6.25 rais). In B. E. 2470 the price of salt was nearly Baht 1 per picul, when 781,243 piculs were exported for the sum of Baht 776.577. The production rose to 3,546,531 piculs in B. E. 2477, of which 222,369 piculs or 62% were exported for the sum of Baht 563,032, or at an average price of a little over 25 stangs per picul.

The serious decline in price caused much distress to the producers. An investigation into the problem was necessary and a suitable solution had to be found out to save the industry from the danger of being destroyed. The Ministry of Economic Affairs therefore appointed a committee to study the position of the industry in all its aspects. The committee consisted of the following:

Dr. Toa Labanukrom	President of the Committee
M. C. Sakala Varnakar Varawan	Member „ „ „
Lt.-General Phya Chalerm Akas	„ „ „
Col. Phra Udom Yodhadhiyut	„ „ „
Phra Pramon Panya	„ „ „
Commander Phra Bhara Samudra, R. N.	„ „ „
Luang Prakich Sahakorn	„ „ „
Nai Vanich Panananda	„ „ „
Nai Aree Supol	„ „ „
Nai Pue Rochanapurananda Secretary and	„ „ „

The problems before the committee were as follows:

1. To study the methods used in producing solar salt in Thailand, and to modify them by the application of scientific principles in order to obtain an improved quality of salt which could be more readily exported.

2. To produce a high grade salt suitable for the salted fish industry.

3. To recommend an organised system of transport, distribution, sale and export.

The first meeting of the committee was held on the 11th June B. E. 2480. Later the committee made a trip to Changwad Samudra Sagorn and Changwad Samudra Prakarn by boat to study the production, storage and transport of salt, as well as the condition of the workers in the salt fields. Samudra Sagorn and Samudra Prakarn were chosen because these two Changwads alone account for 90% of the annual salt production in Thailand. The sixth and last meeting of the committee was on the 10th March B. E. 2480, after which an interim report was submitted to the Ministry of Economic Affairs.

The findings and recommendations of the committee may be summarized as follows:

The prices of salt at the salt fields were below the cost of production. The standard of living of the small producers and workers were correspondingly low.

Quite a number of transhipments from smaller boats to larger ones must be made during the transport of salt from the salt fields to the port of Bangkok. Salt is a bulky commodity with comparatively small value, consequently the costs of transport and transhipments exceed the price ruling at the sites of production considerably. The canals through which the salt boats passed were too shallow in the dry season. This made the passage difficult, the duration longer and the costs higher. The prices are controlled by the middle men.

Although 60% of the annual production of salt was exported and the prices ruling at the salt fields were ridiculously cheap, the supply of salt in the distant provinces were inadequate and the prices exorbitant. In a few provinces of the South salt was imported from Aden for consumption.

The technique employed in the production of salt was elaborate and the salt obtained was of fairly good quality. A considerable improvement could be made in this direction through the employment

of simple scientific principles. A pamphlet was published and distributed by the Department of Science towards this end.

The dredging and proper maintenance of certain portions Bang Khun Thien and Bang Pla Kod Canals were recommended for the facility and economy in transport.

The relative merits of the (a) Monopoly System
(b) Excise System
(c) Modified Excise System or Public Corporation

were submitted to the Ministry of Economic Affairs for consideration as a means of organizing the industry on a basis that would assure the producers of a reasonable price, supply the commodity to the consumers throughout the kingdom at a fixed fair retail price and render possible an organized and economic system of transport, distribution and export. The quality of the product could be later controlled through the same mechanism.

The establishment of an experiment salt farm and salt refinery was proposed. The available area for the potential increase of the output of salt was also pointed out.

The Monopoly System was adopted by the Government in B. E. 2482.

SOY BEANS.

Owing to the fact that soy beans grow abundantly in the North of Thailand and in so far as these plants are important in the agricultural, economic and nutritional problems of the country, it was deemed advisable to increase their production and to bring the matter to the attention of both the farmers and the consuming public. To promote soy bean production and utilization, the Government has, accordingly, appointed a committee consisting of the following members from the various departments:

Director General of the Department of Science	President
Director General of the Department of Interior	Member
Director General of the Department of Commerce	„
Dr. Yong Huar Chuacharoenwongse	„
Luang Ingkasri Kasikara	„
The Quarter Master General	„
Lieut. Proe Vichien Bhakdi	„
Nai Sangar Sharasuvana	„
Nai Pue Rochanapurananda	Member and Secretary

The Director General of the Department of Science, to whose keen interest and untiring effort this work is due, was appointed President of this committee.

The first meeting of the Committee was held on September 29,1937. Its resolutions were as follows:

1. To undertake research on soy beans concerning cultivation maintenance, and control of the quality of the beans.
2. To advise and encourage farmers in the cultivation of soy beans.
3. To undertake studies on the uses of soy beans in different ways.
4. To popularize the use of soy beans in every day diet.
5. To promote the sale of soy beans.
6. To promote soy bean industries.

During the period covered by this report six subsequent meetings were held. Advices and seeds for distribution were given to officials concerned in the various provinces throughout the kingdom.

The Committee also considered a scheme for erecting a plant for the extraction of soy bean oil. This scheme was submitted to the Government for approval with the result that a budget of 200,000 baht was promised for this purpose. Consequently a subcommittee, with the Director General as chair man, held its first meeting in the beginning of B. E. 2481, the resolutions of which will be published in a subsequent report.

The subcommittee consisted of the following members:

The Director General of the Department of Science	Chairman of the Subcommittee
Col. Mom Sanidwongse Seni	Member of the Subcommittee
Luang Prachakr Bhandhalakara	„
Captain Pravitra Hatabhundu	„
Dr. Prachuab Bunnag	„
Luang Videt Yandarakich	„
Luang Vidura Vidikol	„
Nai Pue Rochanapurananda	„ and Secretary.

Furthermore, the Department of Science put up a stall in the Constitution Fair B. E. 2480, displaying various uses of soy beans. This was well received by the public as well as prominent members of the Government, including the Premier.

Three lectures were delivered by Nai Pue Rochanapurananda at the Bangkok Y.M.C.A., the Bureau of Publicity and the Bangkok Women's Club. The subjects were "Soy Bean and National Diet," "Soy Bean Food" and "Soy Bean Milk," respectively.

Various samples of soy beans from the North were analysed. Their nutritional value was found to be comparable to that of the Manchurian species. The results of analysis of a sample of Thai soy beans are as follows:

Moisture	11.08%
Ash	4.82%
Protein	34.04%
Ether extract	18.68%
Crude fibre	4.66%
Carbohydrate	26.72%

THE CONSTITUTIONAL FAIR EXHIBITIONS.

The Department of Science was invited to take part in the Constitutional Fair Exhibitions from the year B. E. 2479. The stall of the Department of Science was arranged so that the public may have the opportunity to acquaint themselves with the sphere of activity of the Department. The other aim was to stimulate their interest in the application of science in industry as well as every day life.

In the year B. E. 2479 the exhibition was arranged thus:

Vitamin B_1 Extract Section:— It was found impracticable to put on show all the apparatus used in the preparation of the extract, so explanatory diagrams and drawings were shown along with the raw materials required for the process and the finished product.

Ester of Hydnocarpus Oil Section:— The apparatus used in the preparation of this product was not unwieldy, so it was exhibited with all the necessary raw materials and chemicals in situ.

Medicinal Plant Section:— All the medicinal plants shown were indigenous and included those that grow wild and those that are poisonous. A sample of derris root was shown together with the data of its analysis.

Tanning Material Section:— The properties of some native plants as tanning materials were demonstrated, such as those of catechu which can be used for tanning hides.

Ceramics Section:— Samples of clay used in ceramics were put on display. Successive steps in the production of earthenware were illustrated by samples in show case.

Lac Section:— Samples of lac obtained from various trees were exhibited.

Copra Section:— A model of the oven for drying coconut-meat constructed at the Department was displayed.

Papaya Latex Section :— Steps in the preparation of papaya latex were shown from the incision of the fruit to the final drying of the latex.

Industrial Section :— There were show cases in which the raw materials and the successive steps in the manufacture of glass paper and earthenware were schematically shown with diagrams, sketches and explanatory notes. These cases were so constructed that they could be kept for other exhibitions without inconvenience.

Agricultural Section :— Samples of soils suitable for various agricultural purposes were shown together with the data of their analyses.

Advertisement Section :— The main purpose of this section was to popularize the Journal " Vidyasastra," a quarterly popular science journal published by the Department. Subscriptions to the journal were invited and received here.

In the year B. E. 2480 the exhibits included :

Pharmaceutical Section :— There were exhibited about a hundred growing medicinal plants, besides thirty bottles of various alkaloids, and some ninety posters.

Industrial Section :— The exhibits of this section were :

a. Tanning materials
b. Hydnocarpus oil and its ethyl esters
c. Vitamin B_1 Extract
d. Cakes and biscuits made from rice bran.

Food Section :— There were displayed bottles of pickled vegetables, cereals and other foodstuff, accompanied by the data of their analyses.

Soy Bean Section :— The purpose of this section was to popularize the consumption of soy beans.

Agricultural Section :— Samples of soil profile from various localities were exhibited.

Advertisement Section :— Copies of the " Vidyasastra " Magazines were retailed to the public and subscriptions were also invited.

NOTES OF INTEREST.

Kratom (Mitragyne speciosa).

The Department has continued to keep in touch with Dr. H. R. Ing of University College, London, who is working on the problem of isolating alkaloids other than mitragynine which are believed to exist in these leaves.

In a private communication, Dr. H. R. Ing stated:

"The total alkaloid was isolated from the extract by the method of Field (J. C. S., 1921, 119, 887). Analysis of mitragynine picrate (and other derivatives) shows that mitragynine has the formula $C_{22}H_{30}O_4N_2$ and not $C_{22}H_{31}O_5N$ as recorded by Field. The alkaloid contains three methoxy groups, one of which is present as a carbomethoxy group, since it can be hydrolysed to a carboxylic acid which, however, does not regenerate mitragynine on methylation with diazomethane. Mitragynine forms a mono-methiodide and a mono-acetyl derivative (both amorphous) and it can be methylated with diazomethane. Oxidative degradation has so far yielded no useful results.

"The Kratom extract also contains a second alkaloid which has only been obtained as an amorphous picrate. The latter analyses excellently for $C_{30}H_{33}O_{12}N_5$, which implies an alkaloid $C_{24}H_{30}O_5N_2$. No crystalline salt or derivative of this second alkaloid has been obtained as yet. It is only present in very small amount.

"We have discovered two facts of importance for further work on these alkaloids. 1. Mitragynine picrate is converted by hot glacial acetic acid into an amorphous product from which mitragynine cannot be recovered. This observation probably accounts for the poor yield of mitragynine picrate when isolated and purified by Field's method which involves the use of hot glacial acetic acid at several stages; it also suggests that this solvent should be avoided and raises the important question whether the second alkaloid mentioned above may not be produced from mitragynine during the Field process of isolation, 2. Mitragynine readily combines with methyl alcohol in the presence of alkali. This curious behaviour raises the question whether the extraction of Kratom leaves with alcohol is advisable."

In order to enable Dr. H. R. Ing to continue his research the Department has sent him 50 kg. of dried Kratom leaves.

The valued cooperation of Dr. H. R. Ing is hereby acknowledged with thanks.

Harmful Habit-forming Drug Law.

During this period, 154 samples suspected to contain harmful habit-forming drugs were submitted by the Ministry of the Interior, the Department of Police, the Department of Public Health and the Customs Department. They were in the form of powder, pills or liquid mixture advertised and sold as medicinal preparations for cough and 'Opium Cure.' Eighty-four samples or 54.5% were found to contain principles prohibited by the law, while 3 contained novocaine and 1 acetanilid which are not prohibited. Of the positive samples, morphine is the most frequently added ingredient, comprising 80 out of 84 samples or 95%.

Samples submitted by the Opium and Excise Department are not included under this heading and are dealt with under 'Suspected Illicit Opium.'

The results are summarised as follows:

Submitted by	*Opium*	*Morphine*	*Codeine*	*Negative*	*Total*
Ministry of the Interior	–	13	–	2	15
Department of Police	–	20	–	10	30
Department of Public Health	3	41	–	21	65
Customs Department	–	6	1	37	44
Totals	3	80	1	70	154

The work compares favourably with that of the previous period which consisted of 176 samples.

Quantitative analysis was made on two samples submitted by the Department of Public Health. One sample was a medicinal preparation designated as 'Opium Cure.' The object of the analysis was to determine the permissibility of importing such preparation under exemption of the law by a private individual. The other

sample was a solution containing morphine employed by a quack resulting in the death of an infant. Chemical evidence was necessary for legal proceedings.

In addition to the above mentioned work, the Department has also purified 915.15 grammes of morphine as per request of the Department of Public Health.

The Skimmed Milk Act, B. E. 2470.

168 samples of tinned and dried milk were submitted compared with 222 during the previous period.

144 samples were submitted by the Customs Department, 17 by the Public, 2 by the Department of the Public Health, 2 by the Ministry of Defence and 3 by the South District Court.

Of these, 17 samples were found to be below minimum standard and were thus reported as being skimmed milk within the terms of the Act. The results are summarised as follows:

Category	*No. of samples analysed*	*Samples below minimum Standards*	
		No.	%
Sterilised natural milk	7	2	28.75
Unsweetened evaporated milk	44	9	20.45
Sweetened condensed milk	108	3	2.77
Dried milk	9	3	33.33
Total	168	17	10.12

Suspected Illicit Opium.

The Excise and Opium Department submitted 227 samples of suspected illicit opium. The majority were black sticky masses, while 17 samples were in the form of pills. Analyses were performed on all samples except two which were omitted because the amount sent as sample was inadequate. Fifty samples or 22% were found to contain opium and 18 or 8% contain morphine.

Quantitative determinations were conducted on all 68 positive samples. They were found to contain morphine ranging from 0.5% to 12.9%.

A laboratory in the Pharmacy Building.

Potash in Bamboo Ashes.

It is known that the bamboo plant is a heavy feeder on Potash and that the ashes of some varieties of bamboo have a high K_2O content, so that they are used as raw material for the extraction of potash for making fertilizers and also for the production of some potassium compounds. The Forest Department was kind enough to send in 13 samples of ashes of different species of bamboos, some of which were identified. Two samples showed very high K_2O contents, (P. 755 Mai Pai See Sook (ไม้ไผ่สีสุก) 28.82% K_2O, P. 754 Mai Pai Pa, (ไม้ไผ่ป่า) 28.19% K_2O) three samples gave medium results P. 749 Mai Hob (ไม้หอบ) 21.51% K_2O, P. 751 Mai Lai (ไม้ไล่) 17.61% K_2O, P. 748 Mai Bong Kai (ไม้บงคาย) 13.04% K_2O) and the rest were comparatively poor in this respect.

The following are the results of the analyses :—

Lab. No.	*Name*	*From*	*Calculated from Total Ash* K_2O %
P. 743	Mai Sang (ไม้ซาง) (unidentified)	Changvad Saraburi	4.63
P. 744	Mai Liang (ไม้เลี้ยง) (unidentified)	Changvad Saraburi	5.78
P. 745	Mai Sang (ไม้ซาง) Dendrocalamus membranceus, Munro.	Changvad Prae	1.72
P. 746	Mai Hiah (ไม้เฮี๊ยะ) Cephalostachyum virgatum, Kurz.	Changvad Prae	4.72
P. 747	Mai Kao Lam (ไม้เข้าหลาม) Cephalostachyum pergracile, Munro.	Changvad Prae	4.15
P. 748	Mai Bong Kai (ไม้บงคาย) Bambusa pallida, Munro.	Changvad Lampang	13.04
P. 749	Mai Hob (ไม้หอบ) Bambusa polymorpha, Munro.	Changvad Lampang	21.51
P. 750	Mai Bong (ไม้บง) Dendrocalamus Brandisii, Kurz.	Changvad Kanchanaburi	6.26
P. 751	Mai Lai (ไม้ไล่) Oxytenanthera albociliata, Munro.	Changvad Kanchanaburi	17.61

Lab. No.	*Name*	*From*	*Calculated from Total Ash* K_2O%
P. 752	Mai Pak (ไม้ผาก) Oxytenanthera nigrociliata, Munro.	Changvad Kanchanaburi	6.81
P. 753	Mai Ruak (ไม้รวก) Thyrsostachys siamensis, Gamble.	Changvad Kanchanaburi	5.04
P. 754	Mai Pai Pa (ไม้ไผ่ป่า) Bambusa spinosa, Roxb.	Changvad Prachin	28.19
P. 755	Mai Pai See Sook (ไม้ไผ่สีสุก) Bambusa spinosa, Roxb., var.	Changvad Prachin	28.82

Acid Resisting property of Wood.

Tests were made on ten samples of wood sent by the Forest Department in order to find out which sample could better withstand the action of acids. Samples of wood were allowed to remain in contact, dipped and submerged in 6% HCl and in H_2SO_4 for a month then taken out and examined to find out to what extent the tissues and fibres of each sample were effected by the acid. They are arranged below in order of their ability to resist the action of the acids.

I. The most resistant samples are:
- U. 384 Mai Daeng. (ไม้แดง)
- U. 385 Mai Payoong. (ไม้พยุง)
- U. 386 Mai Ching Chan. (ไม้ชิงชัน)

II. Those with medium resisting quality are:
- U. 381 Mai Kwao. (ไม้ควาว)
- U. 382 Mai Rok Fah. (ไม้รกฟ้า)
- U. 383 Mai Khleng. (ไม้เขลง)
- U. 388 Mai Pood. (ไม้พุด)
- U. 389 Mai Pradoo. (ไม้ประดู่)

III. Below are given those with poor resisting quality.
- U. 387 Mai Takien Thong. (ไม้ตะเคียนทอง)
- U. 390 Mai Mok Man (ไม้มกมัน)

Oil of Turpentine.

The Department of Public Health sent a sample of oil which was distilled from indigenous plants and sold in the local market as oil of turpentine, for analysis in order to find out if it was up to the specification of any Pharmacopoeia. The following is the result of the analysis :—

Colour	... Colourless and transparent
Specific Gravity at 25°C.	... 0.9595
Refractive index N_D^{20}	... 1.469
Residue from evaporation of 5 c.c.	0.0378 gm.
U. S. P. Oxidation test ...	... 0.00
Distillation test ...	... 90% distilled over between 154° & 156°C.

The sample is therefore up to the specification of the U. S. P. X. for Turpentine Oil for external use.

Raw Turpentine.

Two samples of raw turpentine were received from the Forest Department for distillation in order to find out the quality of the oil of turpentine and the resin obtained therefrom.

		Steam Distillation	
Lab. No.	*Raw turpentine from*	*Oil of turpentine* V/W	*Resin* W/W
Q. 838	Tambol Busung, Amphur Srisaket, Changvad Srisaket ตำบลบุสูง อำเภอศรีสะเกษ	22.6%	71.8%
N. 337	Changvad Bejraboon (จังหวัดเพ็ชรบูรณ์)	26.2%	—

The following is the result of the analysis of the oil of turpentine obtained from the first steam distillation.

	No. Q. 838	*No. N. 337*
Colour	—	Colourless and transparent
Reaction in alcoholic solution	—	slightly acid
Specific gravity 25°C	0.8565	0.8583
Refractive index N_D^{20}	1.469	1.468
Specific Rotation	+26.23	+16.14
Residue from 5 c. c.	0.0534 g	0.07458 g
U. S. P. Oxidation test	0.00	0.00
Distillation test	90% distilled over at 160°C.	

The product of the first distillation was shaken up with 100 c.c. of 5% NaOH solution and again distilled until 75 c. c. of oil was obtained. The product of the second distillation is colourless, clean, transparent and has a pleasant odour. The following is the result of the analysis :

	Q. 838	*N. 337*
Colour	—	Colourless & clear
Specific gravity at 25°C.	0.8565	0.8570
Refractive index N_D^{20}	1.4689	1.468
Specific rotation	+21.48	+17.39
Residue from 5 c. c.	0.012 g.	0.0021
Distillation test	—	99% distilled over between 155° – 167°C.

Resin.

The residue was resin mixed with earth sand and wood splinters, from which the resin was separated while hot by passing through copper wire gauze with 144 meshes per square centimetre. The resin was dried at 100°C. until the resin was clear and transparent. It was then allowed to cool. The product was clear transparent yellowish brown resin.

	Q. 838	*N. 337*
Specific Gravity 30°C.	1.071	1.09
Acid value*	185.57	180.10
Melting point	76°C	78°C.
Moisture	0.2%	2.2%
Ashes	0.06%	0.01%

*Acid value expressed as mgm. of KOH required to neutralize 1 gm. of sample.

Lard.

A certain trading company, desiring to build a business of refining lard and exporting same to Europe, inquired at the Department of Commerce whether the Government would undertake to inspect such edible product and if satisfied to grant a seal or certificate of purity signed by a responsible official. This matter was referred to the Department of Science.

Hitherto Thai lard was exported to Hong Kong, refined there, and then re-exported. In Hong Kong, the lard to be exported must conform to certain standards of purity required by the Public Health Authority. A sample of lard exported from Hong Kong was analysed with the following results:

Halphen test	negative
Baudouin test	negative
Kerr test	positive
Nitric acid test	positive
Acidity expressed as oleic acid ...	0.82%
Iodine value	64.8 %
Moisture	0.09%

The Department of Commerce also submitted a sample of unrefined lard for analysis. The results are as follows:

Halphen test	negative
Baudouin test	negative
Kerr test	positive
Acidity expressed as oleic acid ...	0.25%
Iodine value	77.4 %
Moisture	0.06%

It is evident from these analyses that the Iodine Value of unrefined Thai lard is much higher than that of the Hong Kong exported lard. The Iodine Value of lard permissible for exportation must not be higher than 69 as specified by the Public Health Authority of Hong Kong. If we were to concede to this standard, the Thai lard to be exported should be subjected to some processes by which its iodine value is reduced to or below this figure.

Insecticide.

The root of Ka Piad (กะเพียด) or Non Thai Yak (หนอนตายหยาก) an unidentified species of Stemona is widely used as an insecticide on the pepper plantations at Chantaburi (จังหวัดจันทบุรี). A sample of the root was sent to us by the Department of Agriculture and Fisheries to find out the active principle in the root which acts as poison. An alkaloid with a melting point of 160°C. was isolated which corresponds to the m. p. of stemonine which is found in the root of Stemona tuberosa.

Fish Poison.

The root of Rag Pa Mee (ราก พา หมี) Phallanthus sp. is frequently used as fish poison by the inhabitants of south Thailand. This tree is grown there in abundance. Samples of the roots were sent by the South Thailand Agricultural Experimental Station.

The following is the result of the analysis:

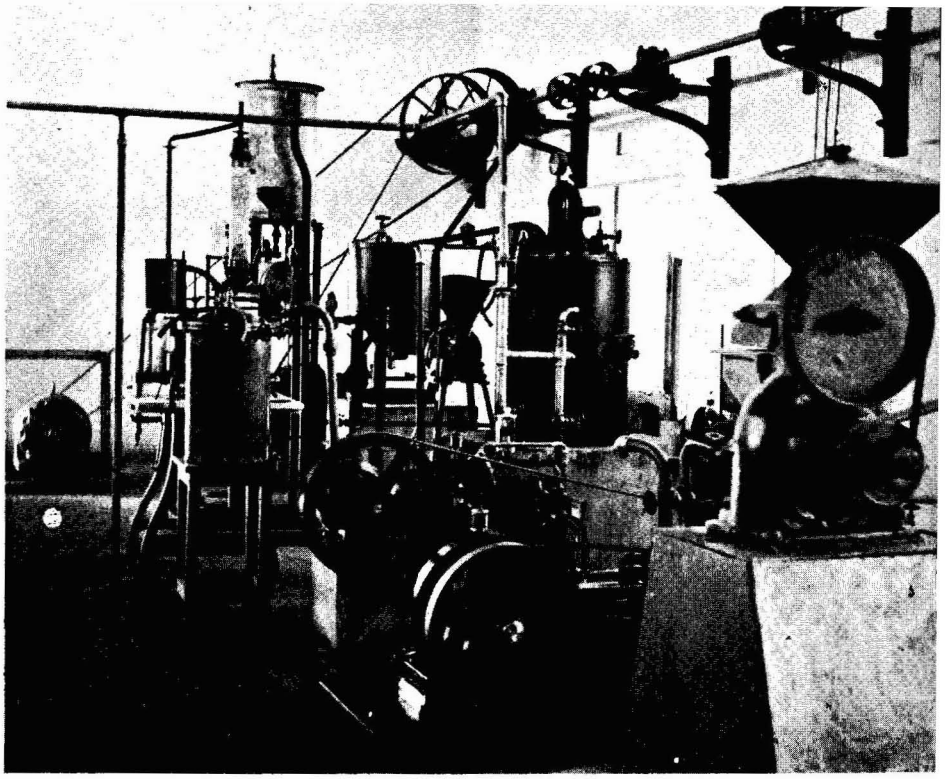
Moisture	8.51%
Ether extract	13.70%
Rotenone	1.19%

Edible Seaweed from Phatalung Lake. (ทะเลสาบพัทลุง)

A certain kind of seaweed that grows in abundance in the lake between Koh Si (เกาะสี่) and Koh Ha (เกาะห้า) is used as food for men as well as animals. The Department of Agriculture and Fisheries sent a dried sample to us for analysis.

The results are as follows:

Moisture	12.61%
Ether extract	2.52%
Ash	8.70%
Crude fibre	14.83%
Protein	8.96%
Carbohydrates	52.38%
Total food value	2749 cal/kg.



A Section of the Division of Industrial Chemistry.

Salt used in Fishing Industry.

Two samples of salt were sent by the Bureau of Fisheries for analysis in order to find out their chemical compositions.

Sample P. 877 is from Bang Taboon, Amphur Kao Noi, Bejraburi (บางตะบูน อำเภอเขาน้อย จังหวัดเพ็ชรบุรี).

Sample P. 878 is from Ban Laem, Amphur Kao Noi, Bejraburi (บ้านแหลม อำเภอเขาน้อย จังหวัดเพ็ชรบุรี).

The following is the result of the analysis:

	P. 877	*P. 878*
Moisture	5.68	7.78
Insoluble matter ...	0.28	0.24
NaCl	89.68	85.60
$MgCl_2$	0.90	2.19
$CaSO_4$	0.44	1.32
$CaCl_2$	—	1.52
Na_2SO_4	0.27	—
Other impurities ...	2.75	1.37

The Seeds of Tung.

The seeds of Tung (Litsea grandis) were sent from Pattani (ปัตตานี) by a forest officer in order to find out the oil contents.

The following are the results of analysis:—

Moisture 8.45%

Ether Extract 37.5 % (moisture free basis).

The gummy substance obtained was too small in quantity to serve as material for further analysis.

FORENSIC CHEMISTRY.

Sixty-three cases of suspected poisoning were submitted during the two years under review as compared with 54 cases during the previous period. The actual number of exhibits examined was 95. Human viscera were submitted in 11 cases, and vomits in 4 cases.

Poisons were found in 34 cases or 54%. The percentage of positive findings is comparable to that of the previous period, viz. 55.5%.

The poisons found were as follows:

Acids, mineral	3	cases
Adalin	1	„
Arsenic	5	„
Cantharidin	1	„
Copper	2	„
Cyanide	12	„
Datura or mydriatic alkaloids ...	2	„
Gelsemium elegans	1	„
Glass, powdered	1	„
Holarrhena antidysenterica	1	„
Luminal	1	„
Mercury	1	„
Morphine	1	„
Strychnine	1	„
Veronal	1	„
Total ...	34	„

Notes on Poisoning Cases.

Cyanide and arsenic are the most popular and frequently used poisons. Cyanide constitutes 35% of all the positive cases.

Gelsemium elegans.

A case was reported in which man died half an hour after drinking a decoction of certain roots meant to be used externally. Chemical test showed the presence of Gelsemine which is an alkaloid obtained from Gelsemium elegans. Chemical assay revealed that the

roots contained 0.2% of gelsemine. Physiological tests also confirmed the presence of this alkaloid. Twenty-nine milligrammes of the alkaloid were extracted from the stomach content. This is more than the usual fatal dose and indicates that the death of the victim was due to this poison. Further confirmation may be obtained from the fact that the interior wall of the stomach was blackened. This is said to be one of the symptoms of gelsemium elegans poisoning. One of the Chinese names for gelsemium elegans is 'Lan Chang Soa' meaning "the root that makes the viscera black."

Powdered Glass.

In the Province of Naradhivas, South Thailand, a man was accused of attempting to poison another by offering the latter rice mixed with curry and some white powder. The suspected food was not taken but sent to the Department a few days later. On examination the exhibit consisted of 10 gms. of material in a very advanced stage of putrefaction, which was found to contain 30.5% of powdered glass. This substance is used as a poison by the Malays under the name '*Serbock Kacha.*' The symptoms vary with different people but a dose of 3 gms. is considered likely to cause serious symptoms of the digestive tract and may or may not cause death.

Holarrhena antidysenterica.

The victim of this case suffered from a skin disease and took a medicinal preparation bought from the accused. He was drowsy for eight days during the treatment, and finally had cramp in the feet, delirium and loss of consciousness. He recovered in ten days after stopping the medicine. The accused stated that the medicine consisted of a mixture of equal parts of datura and bark of Holarrhena antidysenterica (เปลือกโมก).

The sample consisted of 42 gms. of brown vegetable powder. It was found to contain 1.7% of an alkaloid having a very bitter taste, finally identified as "Conessine", an alkaloid of the bark of Holarrhena antidysenterica. Careful test for atropine showed that none was present, other known poisonous alkaloid were not found. The powder appeared to be wholly the bark of Holarrhena antidysenterica.

The alkaloid conessine is used in the treatment of dysentery. Nothing is known of its toxic properties as there are no recorded cases of any one being poisoned by it. The medicinal dose of conessine is 0.25 to 0.6 gms.

Mercury

The victim of this case suffered from yaws. He received 300 pills and a bottle of washing from the mortar used in preparing these pills from the accused who was by no means a qualified doctor. Before sleeping the victim took one dose of the liquid, at midday another dose, and in the evening finished all the liquid medicine. The victim experienced much itching after taking the liquid. Later he took two doses of the medicine, 25 and 31 pills respectively. He then felt pain and swelling of the mouth and throat. In spite of that he took another 35 pills, and the swelling and pain increased so that he could not swallow anything. He eventually died 12 days after commencing the course of treatment. Three days before death there was severe bleeding from the mouth. After death the tongue, mouth and throat were found to be swollen and ulcerated. The accused, in defence, stated that he ordered the liquid medicine to be taken during three days in three daily doses; and the pills to be commenced after finishing all the liquid medicine, and only in three daily doses of 7 to 11 pills. After that the dose was to be reduced to one or two pills daily until the pills were finished.

The pills received for analysis were 234 in number. The total weight of the pills was 39 gms. with an average of 0.1666 gm. for each pill. These pills contained 8.2% of mercury and of this 5.6% is soluble in dilute hydrochloric acid, equivalent to 7.5% of mercuric chloride. The minimum fatal dose of mercuric chloride is 0.2 gm., and the victim took 91 pills, equivalent to 1.15 gm. of $HgCl_2$ in the course of a short time. This dose is likely to cause death and the description of the symptom leaves no room for doubt that death was due to mercuric chloride poisoning.

As regards the defendant's statement, it is to be noted that he advised caution in the use of the pills. A dose not less than 7

pills (0.088 gm. $HgCl_2$) and not more then 11 pills (0.1386 gm. $HgCl_2$). This daily dose is well below the minimum fatal dose and, although likely to cause heavy symptoms, could neither cause death nor permanent injury.

Examination of Stains for Human Blood.

The Ministry of the Interior submitted 14 exhibits in 6 cases in which a positive finding was reported in 3 cases (50%). This work is much reduced in comparison with that of the previous period viz. 71 cases.

Examination of Stains for Semen.

Four pieces of wearing apparel in two cases were submitted for examination of stains for semen. It was found to be positive in two pieces or 50%.

Counterfeit Coins, and Gold Ornaments.

Twenty-seven exhibits were sent by the Police Department, in connection with nine cases. Twenty exhibits were coins and metal sheets in connection with six cases of counterfeit coins. Four samples of aqua regia were suspected to be used for dissolving out gold from customers' ornaments in two cases. Three necklaces, sold as gold, were found to be gold plated articles in one case.

The accused were found guilty in all 9 cases.

Examination of Documents.

One case of questioned document was submitted. The document comprised of two pieces of writing. In one piece erasures were detected with the ultra-violet rays.

Examination of Explosives.

An explosive was submitted for examination. It was found to consist of a mixture of potassium chlorate and sulphur.

DIVISION OF CHEMISTRY.

During this period the pressure of work has been enormous as this Division accounts for most of the analytical work done in the Department. Every section felt the strain of the unusual increase of the numbers of samples that came in for analysis. A few figures below will give some idea of the increase in the amount of work done:

	B. E. 2477-78	B. E. 2479-80	Ratio of Increase
Bronze samples	326	1,866	5.7 times
Total samples from the Customs House ...	1,104	2,621	2.37 „
Samples for Tariff Classification ...	625	1,005	1.68 „
Water Samples	427	676	1.58 „

Opium Dross Control.

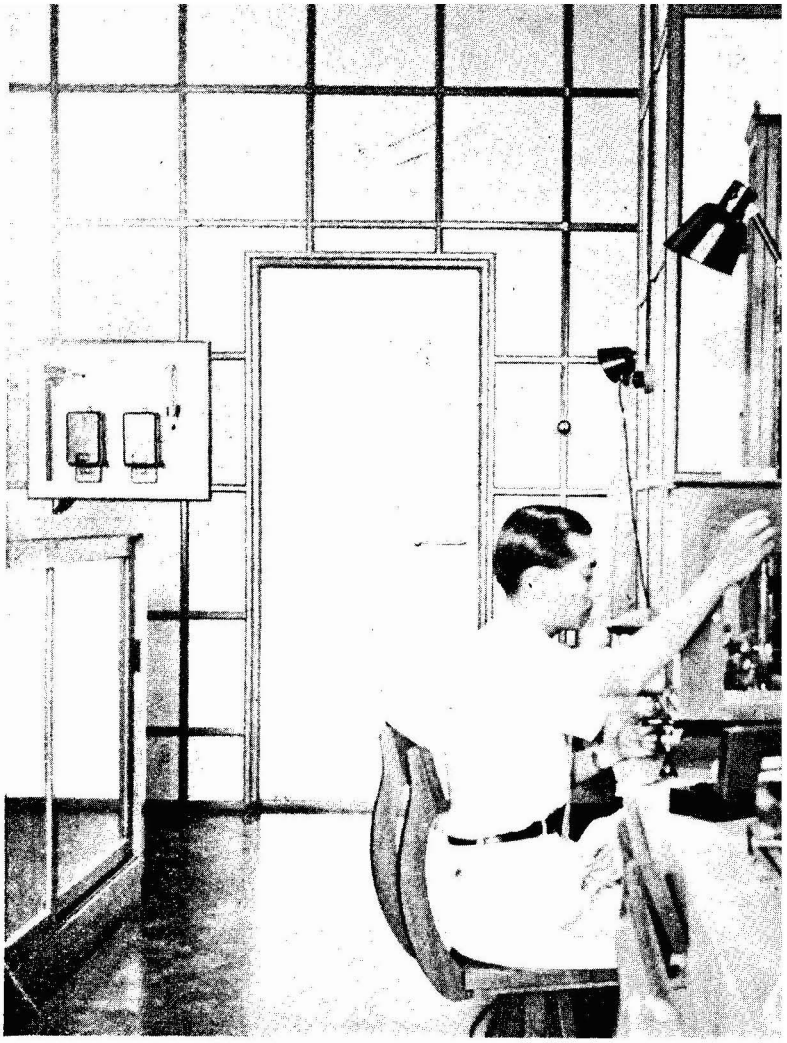
Formerly the opium dross for routine assay were sent after a selection had been made by the Excise and Opium Department. Later on the preliminary selection was done away with and all the samples were sent on to the Department of Science for assay. The increase of the samples may be seen from the following figures:—

Year	Number of Samples
B. E. 2477	12,589
B. E. 2478	19,300
B. E. 2479	20,380
B. E. 2480	3,833

The peak figure was reached in B. E. 2479, when some 70 samples had to be assayed daily. The number of samples would have gone on increasing had not the former system of preliminary selection been reverted to and the number of samples climbed down from 20,380 in B. E. 2479 to 3,833 in B. E. 2480.

Bronze for Coinage.

There has been an unprecedented increase in the bronze assays done for the Treasury Department. As much as 1,866 samples were examined against 326 samples of the previous period. Out of this number the compositions of 21 samples were found to vary beyond the limit allowed by the regulations governing the composi-



The air conditioned Balance Room.

tions of coins, consequently they had to be remolten with additions of calculated amounts of the deficient components to bring the compositions within the limits required.

Water and Water Supplies.

The work in the Water Analysis Section is growing in magnitude each year as Water Works are being started in most of the important towns of the kingdom. The New Harbour Scheme as well as the dredging of the river bar will be responsible for further increase of work in this section.

Two more items have been added to the analysis of the water samples from the various water works, i. e. the pH values and the electrical conductivities.

The average values of the analytical results of the Bangkok tap water for the previous ten years (B. E. 2469 to 2478) are given for comparison. It will be seen that the figures for both years B. E. 2479 as well as B. E. 2480 are slightly higher than the average.

A study of the present as well as the past figures reveals the following relationships: The absolute agreement between the total solids and the dissolved solids shows that there is no trace of suspended matter in the tap water. There is a close relationship between the electrical conductivity, the dissolved solids, the total hardness and the chlorides. These figures rise and fall together in almost mathematical proportion.

The reaction of the water is neutral or very slightly alkaline throughout the year. It varies from pH 7.0 to 7.4. The figures for conductivity, dissolved solids, total hardness, chlorides are usually at their lowest in November and gradually rise to a peak in May. This is because April and May are the driest months of the year, and the months of October and November mark the end of the rainy season. In the dry season the water flowing down the river is small in volume and the tide from the sea can go further up the river than during and at the end of the rainy season when the volume of water discharged by the river into the sea is much larger, and the concentration of the salts leached out by the rain from the plains of the Menam valley is proportionally low. The slight but unmistakable increase of these figures usually in October is, however, not so easily explained.

Tap Water Average for ten Years (B. E. 2469-2478).

Date	Total solids	Dissolved solids	Total hardness	Permanent hardness	Temporary hardness	Chlorides as chlorine	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrites as nitrogen	Nitrates as nitrogen	Loss on ignition	Iron*
April	19.25	19.25	11.72	1.3	9.42	3.03	0.128	0.0011	0.0039	0.0004	0.0195	2.61	0.01
May	20.74	20.74	11.83	2.77	9.03	2.95	0.136	0.0012	0.0039	0.0011	0.022	3.19	0.0125
June	17.91	17.91	10.03	1.91	8.12	1.87	0.153	0.0011	0.0048	0.0005	0.0285	2.28	0.0094
July	15.74	15.74	8.73	2.61	6.12	1.27	0.157	0.0016	0.0047	0.0001	4.0221	2.68	0.0075
August	13.25	13.25	7.23	2.75	4.48	0.86	0.147	0.0014	0.0054	0.0001	0.022	2.62	0.01
September	11.7	11.7	6.16	1.86	4.3	0.66	0.144	0.001	0.0064	0.0006	0.0133	2.43	0.0088
October	13.21	13.21	5.67	3.15	2.52	0.79	0.141	0.0013	0.005	..	0.0093	2.84	0.0120
November	10.01	10.01	5.18	2.15	3.03	0.59	0.187	0.0014	0.006	..	0.0086	1.91	0.01
December	10.55	10.55	5.38	1.37	4.01	0.66	0.213	0.0015	0.0076	..	0.0126	1.86	0.0075
January	13.47	13.47	8.03	1.17	6.86	1.04	0.2	0.0022	0.007	..	0.0232	2.23	0.0075
February	14.85	14.85	9.45	1.17	8.28	1.28	0.139	0.0012	0.0054	..	0.0184	2.05	0.01
March	15.8	15.8	9.81	0.99	8.82	1.53	0.13	0.0011	0.0045	..	0.0139	2.12	0.0075
Average	14.735	14.735	8.175	1.919	6.256	1.37	0.156	0.00136	0.00576	0.0002	0.0179	2.407	0.0103

* Iron data available for the last 8 years.

Note :- Results are expressed as parts per 100,000. Hardness is expresssed as parts of $CaCO_3$ per 100,000.

Tap Water

B. E. 2479

Date	pH value	Electrical Conductivity	Total solids	Dissolved solids	Total hardness	Permanent hardness	Temporary hardness	Chorides as chlorine.	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrites as nitrogen	Nitrates as nitrogen	Loss on ignition	Iron
April	7.4	at 31°C. 230	18.7	18.7	12.0	2.0	10.0	2.0	0.20	0.002	0.005	nil	0.023	1.6	nil
May	7.4	at 30°C. 230	18.2	18.2	12.0	2.7	9.3	2.2	0.15	0.001	0.005	nil	0.025	1.2	nil
June	7.2	at 28°C. 240	20.7	20.7	14.0	5.8	8.2	2.0	0.18	0.001	0.010	nil	0.020	2.5	nil
July	7.0	at 28°C. 180	17.2	17.2	8.5	3.6	4.9	1.4	0.17	0.001	0.008	nil	0.022	2.8	nil
August ..	7.0	at 25°C. 140	12.3	12.3	7.0	2.5	4.5	0.9	0.15	0.001	0.007	nil	0.018	2.1	nil
September ..	7.0	at 27°C. 120	11.3	11.3	8.0	2.6	5.4	0.5	0.19	0.002	0.008	nil	0.015	1.6	nil
October ..	7.1	at 28°C. 165	15.7	15.7	9.0	5.0	4.0	1.2	0.17	0.002	0.010	nil	0.018	1.8	0.01
November ..	7.1	at 26°C. 145	13.7	13.7	7.0	3.6	3.4	0.8	0.20	0.001	0.012	nil	0.020	2.2	nil
December ..	7.2	at 27°C. 158	13.5	13.5	8.0	1.9	6.1	1.0	0.23	0.002	0.009	nil	0.015	2.3	nil
January ..	7.2	at 19°C. 185	15.3	15.3	10.0	1.5	8.5	1.4	0.18	0.001	0.008	nil	0.020	1.8	nil
February ..	7.3	at 27°C. 190	16.1	16.1	9.0	nil	9.0	1.5	0.13	0.001	0.007	nil	0.020	2.0	nil
March	7.3	at 29°C. 215	17.7	17.7	12.0	1.9	10.1	2.2	0.17	0.001	0.008	nil	0.015	1.9	nil
Average ..	7.1	at 27°C. 183	15.9	15.9	9.7	2.8	7.0	1.7	0.18	0.001	0.006	nil	0.019	2.0	nil

Note :– Results are expressed as parts per 100,000. Hardness is expressed as parts of $CaCO_3$ per 100,000.

Tap Water

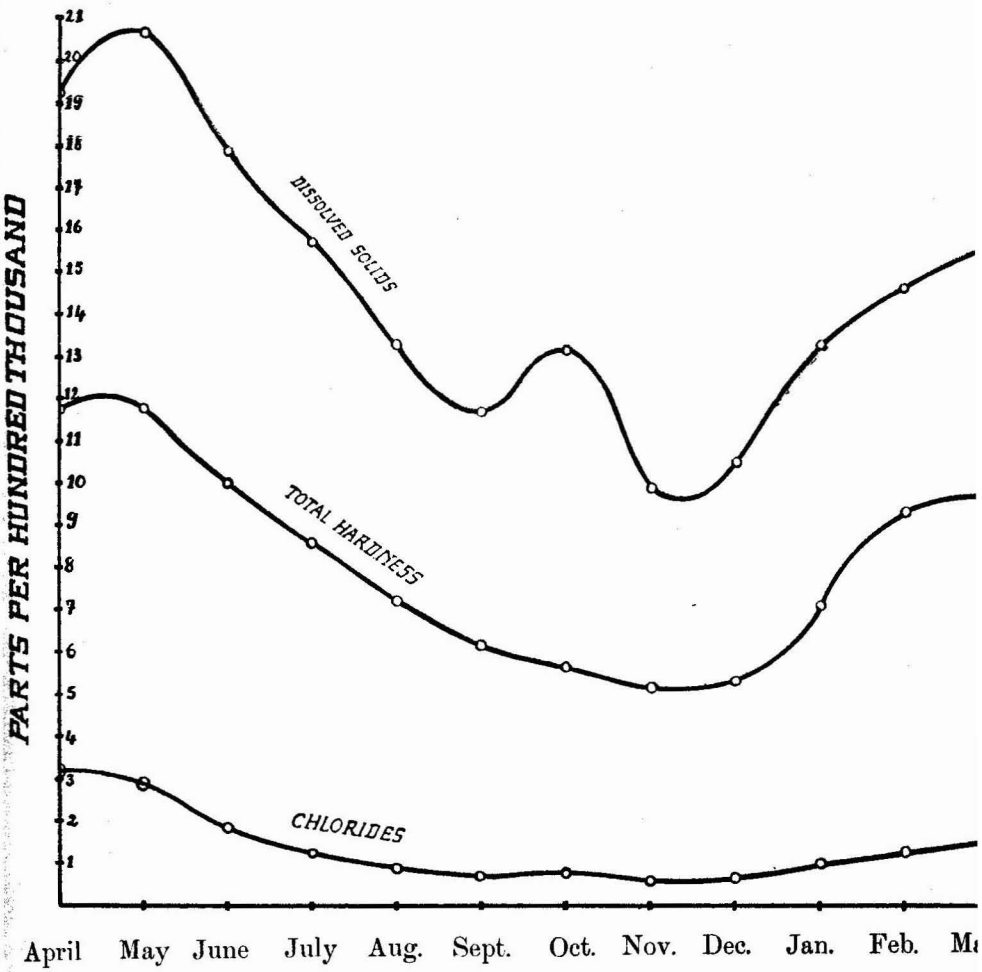
B. E. 2480

Date	pH value	Electrical conductivity	Total solids	Dissolved solids	Total hardness	Permanent hardness	Temperary hardness	Chlorides as chlorine	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrites as nitrogen	Nitrates as nitrogen	Loss on ignition	Iron
April	7.2	at 35°C. 245	18.8	18.8	11.0	0.7	10.3	3.1	0.15	0.001	0.007	nil	0.020	1.8	nil
May	7.3	at 28°C. 305	25.2	25.2	12.0	2.6	9.4	5.7	0.13	0.001	0.006	nil	0.020	2.0	0.01
June	7.4	at 29°C. 182	17.0	17.0	11.5	4.5	7.0	1.3	0.23	0.003	0.009	nil	0.025	2.0	nil
July	7.2	at 28°C. 145	13.8	13.8	9.0	2.8	6.2	0.9	0.18	0·002	0.008	nil	0.020	2.1	nil
August ..	7.2	at 28°C. 120	11.1	11.1	7.0	1.6	5.4	0.6	0.16	0.001	0.009	nil	0.020	2.0	nil
September ..	7.3	at 27°C. 132	12.2	12.2	7.0	1.6	5.4	0.5	0.15	0.001	0.006	nil	0.020	1.9	nil
October ..	7.3	at 28°C. 162	15.1	15.1	10.0	6.1	3.9	1.0	0.11	0.001	0.007	nil	0.015	2.1	nil
November ..	7.3	at 28°C. 130	12.3	12.3	9.0	3.6	5.4	0.6	0.12	0.002	0.010	nil	0.020	2.0	nii
December ..	7.0	at 26°C. 140	12.7	12.7	9.0	2.7	6.3	0.7	0.28	0.002	0.013	nil	0.020	2.1	nil
January ..	7.2	at 27°C. 170	14.8	14.8	10.0	2.0	8.0	1.1	0.21	05001	0.009	nil	0.023	2.1	nil
February ..	7.2	at 28°C. 180	15.3	15.3	10.0	1.5	8.5	1.4	0.13	0.001	0.007	nil	0.020	1.7	nil
March	7.3	at 28°C. 193	16.5	16.5	10.0	0.6	9.4	1.5	0.12	0.002	0.006	nil	0.023	2.0	0.01
Average ..	7.2	at 28°C. 175	15.4	15.4	9.6	2.5	7.1	1.5	0.16	0.002	0.008	nil	0.021	2.0	nil

Note :– Results are expressed as parts per 100,000. Hardness is expressed as parts of $CaCO_3$ per 100,000.

BANGKOK TAP WATER.

AVERAGE VALUES FOR 10 YEARS (B. E. 2469-2478).



BANGKWANG WATER.

B. E. 2479.

Date	pH value	Electrical conductivity	Total solids	Dissolved solids	Total hardness	Permanent hardness	Temporary hardness	Chlorides as chlorine	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrites as nitrogen	Nitrates as nitrogen	Loss on ignition	Iron
April	6.9	at 29°C. 250	21.2	21.2	12.0	7.5	4.5	2.2	0.13	0.001	0.009	nil	0.020	2.0	nil
May	7.0	at 30°C. 250	22.8	22.8	14.0	9.2	4.8	2.5	0.10	0.002	0.004	nil	0.025	3.0	nil
June	7.0	at 28°C. 235	20.3	20.3	11.0	7.1	3.9	1.8	0.16	0.001	0.005	nil	0.025	2.9	nil
July	6.9	at 26°C. 160	14.9	14.9	7.0	6.2	0.8	0.9	0.16	0.002	0.005	nil	0.025	2.3	nil
August ..	6.9	at 28°C. 142	14.0	14.0	7.5	6.8	0.7	1.1	0.17	0.001	0.006	nil	0.015	2.5	nil
September ..	6.8	at 30°C. 138	14.1	14.1	8.0	7.5	0.5	0.5	0.19	nil	0.010	nil	0.015	2.6	nil
October ..	7.1	at 28°C. 118	10.7	10.7	7.0	4.2	2.8	0.14	0.14	0.002	0.013	nil	0.015	1.6	nil
November ..	7.0	at 26°C. 108	10.5	10.5	7.0	3.6	3.4	0.5	0.14	0.002	0.012	nil	0.015	1.6	nil
December ..	7.1	at 24°C. 142	12.6	12.6	8.0	2.8	5.2	1.5	0.21	0.001	0.009	nil	0.020	2.1	0.001
January ..	7.2	at 24°C. 195	17.1	17.1	10.0	5.7	4.3	1.5	0.11	0.001	0.009	nil	0.020	1.6	nil
February ..	7.2	at 26°C. 210	18.9	18.9	11.0	7.0	4.0	1.8	0.10	0.001	0.007	nil	0.025	2.3	nil
March	7.1	at 29°C. 240	21.0	21.0	12.0	8.3	3.7	2.3	0.07	0.001	0.007	nil	0.020	1.1	nil
Average ..	7.0	at 27°C. 182	16.5	16.5	9.5	6.3	3.2	1.0	0.14	0.001	0.008	nil	0.021	2.1	nil

Note :- Results are expressed as parts per 100,000. Hardness is expressed as parts of $CaCO_3$ per 100,000.

BANGKWANG WATER

B. E. 2480

Date	pH value	Electrical conductivity	Total solids	Dissolved solids	Total hardness	Permanent hardness	Temporary hardness	Chlorides as chlorine	Oxygen consumed	Saline ammonia	Albuminoid ammonia	Nitrites as nitrogen	Nitrates as nitrogen	Loss on ignition	Iron
April	7.0	at 30°C. 900	76.4	76.4	20.0	18.1	1.9	28.1	0.12	0.001	0.004	nil	0.050	3.2	nil
May	6.9	at 38°C. 1040	89.9	89.9	22.0	19.8	2.2	34.4	0.12	0.001	0.009	nil	0.040	2.9	nil
June	7.2	at 30°C. 200	18.3	18.3	12.0	8.0	4.0	1.6	0.18	0.004	0.014	nil	0.032	2.5	nil
July	7.0	at 27°C. 170	16.7	16.7	8.0	6.3	2.7	1.0	0.11	0.002	0.016	nil	0.025	2.1	nil
August ..	7.0	at 29°C. 135	13.0	13.0	7.0	6.1	0.9	0.6	0.10	0.001	0.006	nil	0.025	1.8	0.01
September ..	7.2	at 27°C. 120	10.6	10.6	6.0	3.0	3.0	0.5	0.11	0.001	0.005	nil	0.015	1.5	nil
October ..	7.0	at 28°C. 115	10.7	10.7	7.0	4.3	2.7	0.5	0.11	0.001	0.008	nil	0.015	1.5	nil
November ..	7.1	at 29°C. 110	10.1	10.1	7.0	2.8	4.2	0.4	0.19	0.002	0.010	nil	0.025	1.5	nil
December ..	7.0	at 27°C. 120	11.4	11.4	8.0	3.0	5.0	0.5	0.22	0.002	0.011	nil	0.020	2.2	0.01
January ..	7.2	at 25°C. 160	14.4	14.4	9.0	2.8	6.2	1.1	0.17	0.001	0.008	nil	0.025	1.6	0.01
February ..	7.1	at 27°C. 178	16.5	16.5	10.0	4.6	5.4	1.4	0.10	0.001	0.006	nil	0.020	1.9	nil
March	7.1	at 28°C. 205	18.6	18.6	10.0	5.1	4.9	2.8	0.10	0.001	0.007	nil	0.030	2.0	0.01
Average ..	7.0	at 28°C. 287	25.6	25.6	7.2	7.0	3.5	6.1	0.14	0.002	0.009	nil	0.035	2.5	nil

Note :- Results are expressed as parts per 100,000. Hardness is expressed as parts of $CaCO_3$ per 100,000.

NAKORN RAJASIMA WATER.

B. E. 2479

Date	pH value	Electrical conductivity	Total solids	Dissolved solids	Total hardness	Permanent hardneas	Temporary hardness	Chlorides as chlorine	Oxygen consumed	Saline ammonia	Albuminoid ammonio	Nitrites as nitrogen	Nitrates as nitrogen	Loss on ignition	Iron
April	7.4	at 31°C. 375	29.2	29.2	16.0	1.8	14.2	5.8	0.41	0.004	0.020	nil	0.025	1.9	nil
May	7.4	at 28°C. 380	29.5	29.5	16.0	0.3	15.7	5.1	0.42	0.002	0.011	nil	0.020	3.0	nil
June	7.1	at 28°C. 200	16.4	16.4	10.0	3.5	6.5	2.6	0.37	0.001	0.012	nil	0.025	1.1	nil
July	7.4	at 26°C. 500	41.5	41.5	14.0	3.9	10.0	12.9	0.46	0.004	0.019	nil	0.030	3.5	nil
August ..	7.2	at 26°C. 280	25.9	25.9	13.0	6.3	6.7	5.5	0.41	0.002	0.017	nil	0.028	2.5	nil
September ..	7.4	at 27°C. 225	24.0	24.0	14.0	6.6	7.4	3.6	0.35	0.006	0.015	nil	0.021	nil	nil
October ..	7.2	at 27°C. 200	18.2	18.2	11.0	2.4	8.6	2.6	0.32	0.002	0.012	nil	0.018	2.0	nil
November ..	7.4	at 27°C. 285	25.6	25.6	13.0	3.3	9.7	5.6	0.32	0.002	0.014	nil	0.023	2.9	0.01
December ..	7.3	at 26°C. 520	42.4	42.4	15.0	2.5	12.5	14.7	0.31	0.002	0.013	nil	0.010	2.1	0.01
January ..	7.4	at 26°C. 290	22.8	22.8	13.0	nil	13.0	3.5	0.28	0.002	0.011	nil	0.010	1.7	nil
February ..	7.4	at 25°C. 355	29.7	29.7	15.0	nil	15.0	5.8	0.38	0.002	0.009	nil	0.018	2.4	0.01
March ..	7.4	at 29°C. 356	50.5	50.5	17.0	nil	17.0	16.8	0.42	0.007	0.017	nil	0.020	3.0	0.01
Average ..	7.3	at 25°C. 356	29.6	29.6	13.9	2.6	11.4	7.0	0.38	0.003	0.014	nil	0.021	2.2	nil

Note :– Results are expressed as parts, per 100,000. Hardness is expressed as parts of $CaCO_3$ per 100,000.

NAKORN RAJASIMA WATER.

B. E. 2480.

Date	pH value	Electrical conductivity	Total solids	Dissolved solids	Total hardness	Permanent hardness	Temporary hardness	Chlorides as chlorine	Oxygen consumed	Saline ammonia	Albuminiod ammonia	Nitrites as nitrogen	Nitrates as nitrogen	Loss on ignition	Iron
April	7.4	at 30°C. 1000	77.8	77.8	21.0	2.2	18.8	31.1	0.42	0.002	0.022	nil	0.040	3.5	0.01
May	7.5	at 29°C. 1500	130.3	130.3	26.0	13.4	12.6	59.6	0.49	0.001	0.031	nil	0.023	4.6	0.02
June	7.2	at 29°C. 180	16.5	16.5	9.5	3.3	6.2	2.0	0.54	0.003	0.030	nil	0.016	1.2	nil
July	7.2	at 28°C. 190	16.1	16.1	9.0	0.2	8.8	1.8	0.44	0.002	0.019	nil	0.020	2.8	nil
August	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
September ..	7.3	at 27°C. 150	12.7	12.7	8.0	0.2	7.8	1.0	0.28	0.002	0.016	nil	0.020	1.9	nil
October ..	7.2	at 27°C. 135	11.3	11.3	7.0	0.6	6.4	1.1	0.19	0.001	0.010	nil	0.015	1.2	nil
November ..	7.3	at 27°C. 160	13.6	13.6	9.0	1.9	7.1	1.8	0.20	0.001	0.010	nil	0.015	1.3	nil
December ..	7.2	at 27°C. 200	17.0	17.0	9.0	0.1	8.9	2.6	0.28	0.002	0.012	nil	0.020	2.4	nil
January ..	7.4	at 25.5°C. 400	33.6	33.6	15.0	0.8	14.2	8.9	0.24	0.062	0.011	nil	0.015	2.1	nil
February ..	7.4	at 30°C. 420	33.1	33.1	18.0	2.0	16.0	8.2	0.29	0.001	0.012	nil	0.018	1.1	nil
March	7.3	at 28°C. 400	32.3	32.3	17.0	0.4	16.6	7.2	0.48	0.003	0.020	nil	0.025	2.6	0.01
Average ..	7.3	at 25°C. 430	35.8	35.8	13.5	2.2	11.8	11.3	0.35	0.0018	0.017	nil	0.026	2.2	nil

Note :- Results are expressed as parts per 100,000. Hardness is expressed as parts of $CaCO_3$ per 100,000.

Pepper plantation, at the base of Kao Ploi Waen, Amphur Ta Mai, Changvad Chantaburi.

DIVISION OF AGRICULTURAL SCIENCE.

There has been a very remarkable increase in the amount of work done by this division, especially on soil analysis, during this period.

The total number of samples of all kinds examined was 1022 as compared with 334 during the previous period. Out of the 1022 samples there were no less than 694 soil samples and 116 samples of rocks and concretions.

Probably these figures scarcely convey to most people the full significance of the amount of work involved. But actually, soil analysis, as realized by the agricultural chemist, is far more tedious than many other kinds of analysis. Furthermore all soil samples in connection with soil-survey, had to undergo an analysis more detailed than that usually required in any other laboratory in all the continents.

In order to give an idea of what are actually determined in a sample of soil, a list is here appended :—

Physical Analysis.

1. Apparent specific gravity
2. Real specific gravity
3. Amount of water taken up per unit
4. Pore space
5. Volume expansion
6. Sticky point
7. Rolling out limit
8. Non plastic range.

Mechanical Analysis.

1. Moisture
2. Loss on Ignition
3. Gravels and Concretions
4. Coarse Sand
5. Fine Sand
6. Silt
7. Clay
8. Loss by solution
9. Carbonates.

Chemical Analysis.

1. Organic carbon
2. Nitrogen
3. Silica
4. Iron
5. Aluminium
6. Magnesium
7. Calcium
8. Potassium
9. Phosphoric acid
10. Available Potassium
11. Available Phosphoric acid
12. Hydrogen Iron concentration (pH).

Rock and Concretions.

1. Silica
2. Iron
3. Aluminium
4. Calcium
5. Magnesium
6. Titanium.

From a perusal of the list, a chemist will not hesitate to admit that the time consumed for such complete analysis must necessarily be a lengthy one. Yet criticisms have been met with regarding the rate of work of the division. Unfortunately the criticisms generally came from those who know nothing or very little about this branch of work.

Foods and Feeding Stuffs.

Several kinds of food were analysed during this period, for examples, milk, Casava, Koa Tu, Rice, Soyabean, and Cabin biscuit.

As for fodder, Sudan grass is one of the most important forage crops introduced into Thailand in the recent years. It is cultivated in Egypt under the name of "Garawi" and is probably a native of northern Africa.

The leafage of Sudan grass and Johnson grass looks practically the same. Sudan grass is a heavy feeder and for this reason it would not be advisable to plant it for two consecutive years on the same soil, no matter how rich the latter may be.

From general observations made in our country, Sudan grass does not appear to be particular in its soil requirements. Perhaps the most important character of Sudan grass is its resistance to drought. For this reason the Quarter Master General's Department is experimenting on the Sudan grass with the purpose of utilising it as fodder. Some 47 samples of Sudan grass were sent to determine their feeding values, and the results have proved that our Sudan grass is in no way inferior to those grown in the United States, New South Wales, or other places. No less than 75 samples of grass of all kinds including Johnson, Mauritius, Napier, Rhodes, Doris etc. have been analysed.

The other kinds of feeding stuff which have undergone examination were Sorghum, Rice straw, Rice bran, Soyabean cake and Pitecobobium Saman.

Insecticides.

By request, an experiment on derris root had been carried out in order to ascertain whether or not the water extract of derris root can be kept indefinitely without losing its killing effect. The experiment started on 3rd October B. E. 2479 and ended on 2nd October B. E. 2480, covering a period of exactly one year.

In all cases, the amount of derris root powder (Derris Eliptica 27 month old, grown at Haad Yai experiment station) used were 50 grams and extracted with 100 cc. of (a) cold and (b) hot distilled water. They were filtered off and the filtrates stored in sealed glass bottles. In certain cases a few ccs. of alcohol were used as preservative.

The results obtained were that the cold water extract without alcohol maintained its natural colour. The cold water extract with alcohol changed to dark brown colour. The hot water extract without alcohol turned to light brown colour and the hot water extract with alcohol became dark brown. But the killing powers were maintained in all cases. The killing powers were tested on fish of about 10 cm. in size, in a large quantity of very dilute derris extract. Fish were found to be dead within 5 minutes.

For our immediate purpose there is no need to study it in detail and is, therefore, briefly concluded here.

It is generally known that that the derris root is also used in the form of dust, being diluted with the requisite amount of inert material such as talc or clay to a definite rotenone content. But the objection is that in practice it is very difficult to obtain a uniform distribution of a small amount of rotenone in very large mass of filling material in which the dilution is to be effected.

However, whichever way the rotenone is to be employed, there is one serious drawback to the use of this insecticide and that is the comparatively rapid deterioration in toxicity of the material when exposed to the light and air. At present research workers are trying to find ways and means to prevent this deterioration.

Rotenone dissolved in Ethylene dichloride can be used as spray.

Fertilizers and Manures.

Several samples of bat guano collected from Kao Chaisont, Changwad Patalung (เขาไชยสน จ. ว. พัทลุง) and swallow guano collected from the small and uninhabited islands known as Koh See Koh Hah (เกาะสี่ เกาะห้า) in the lake at Songkla were brought for analysis in order to compare their fertilizing values.

The deposits, being the excreta of the birds, consisting very largely of uric acid, should he highly nitrogenous. But the results of analysis show that the percentages of the total nitrogen of bat guano are comparatively low in most cases.

Lab. No.	Type	% Moisture	% Nitrogen	% Phosphoric acid	% Potash
T. 680	Bat guano	5.71	0.49	27.35	0.20
T. 681	„ „	7.38	0.13	31.42	0.26
T. 682	„ „	2.53	0.25	22.49	0.29
60/722	„ „	9.29	0.43	26.78	0.28
60/723	Swallow guano	7.57	7.86	6.68	0.67

A simple explanation is that in our tropical climate change goes on rather rapidly; the uric acid is fermented to urea and to ammonium salts, some of which are volatilized, while the rains dissolve out some of the ammonium compounds.

All the samples sent are probably old deposits and have been subjected to a long period of weathering thus resulting in great loss of nitrogen.

Naturally the greater the loss of nitrogen by washing, the richer in phosphoric acid it becomes. It may be taken as a general rule that the lower the percentage of nitrogen, the less of it will be found in a soluble form.

All these deposits, being similar in origin, possess many features in common. It can be seen from the data of analysis that guano is naturally a well balanced manure, rich in phosphates and to some extent in nitrogen and containing also a small proportion of potash. An analysis of Peruvian guano showed as much as 18.3 per cent of nitrogen and only 9.2 per cent of phosphoric acid. This is, of course, an exceptionally high percentage for nitrogen content even in a very fresh deposit.

The use of bat guano on rice has already gained much popularity among the farmers in Changwad Songkla but swallow guano has not yet been tried. It is very likely that swallow guano having as high as 7.86 per cent of nitrogen and 6.68 per cent of phosphoric anhydride will, in the near future, prove itself to the farmers that it is in no way inferior to bat guano.

Here is a good example of the progress in our farming practice. The farmers are beginning to wake up from their stupor and take notice of what is good for the soil and for the crop.

Soil.

Investigation was made to ascertain the possibility of adopting the new method of mechanical analysis by George John Bouyoucos, using a special hydrometer. The accuracy and efficiency of the method are still doubtful. It must be, however, admitted that the method is quite useful where brief and quick determinations are concerned.

Although the trial might not have been a lengthly one it is justifiable to conclude that the temperature correction given as $\pm$ 0.2 for each degree above or below 67°F is still too high for

Thailand. It will be remembered that Bouyoucos in his first publication of the method recommended ± 0.35 as a correction factor but later on it was reduced to the present factor.

After the investigation, it was decided that this new method shall not be adopted for our routine analysis in spite of its well-known rapidity and simplicity because comparisons have been made between the hydrometer method and the International pipette method and the results obtained go to show that in some cases the two methods disagree distinctly. Another reason is that we have been using the International pipette method for so long and should it be discarded in favour of the new method, the great amount of data, acquired over a long period and found quite reliable would be unnecessarily interrupted.

Nevertheless the hydrometer method is becoming useful in the determination of the total colloidal content of soils where no simpler method is available.

Soil Survey.

The modern method as worked out in the United States has been adopted here. It consists of a detailed study of standard profiles and subsequent grouping of soils having similar profiles. A large number of profiles from representative fields are subjected to a preliminary examination, followed by a detailed study of typical ones among them. The mapping is carried out by the use of the plane table traverse board and distances measured by chain or tape.

During the time covered by this report Mr. M. Cero has completely mapped out :—

1. Klong Tan Experiment Station, Amphur Klong Tan, Changwad Sawankalok.
   (สถานีทดลองคลองตาล อำเภอคลองตาล จังหวัดสวรรคโลก)
2. Tung Maha Mek, Bangkok.
   (ทุ่งมหาเมฆ พระนคร)
3. Padang Besar, Amphur Sadao, Changwad Songkla.
   (ปาดังเบซาร์ อำเภอสะเดา จังหวัดสงขลา)
4. Kuan-Nieng Experiment Station, Amphur Kampangpet, Changwad Songkla.
   (สถานีทดลองควนเนียง อำเภอกำแพงเพ็ชร์ จังหวัดสงขลา)

Surveying along a slope in Ban Cacha, Amphur Muang, Chantaburi.

5. Kuan Nieng Railway Station, Amphur Kampangpet, Changwad Songkla.
   (สถานีรถไฟควนเนียง อำเภอกำแพงเพ็ชร์ จังหวัดสงขลา)
6. Koh Ka, Changwad Lampang.
   (เกาะคา จังหวัดลำปาง)
7. Amphur Ta Mai, Changwad Chantaburi.
   (อำเภอท่าใหม่ จังหวัดจันทบุรี)

Klong Tan Experiment Station.

The cotton experiment station is situated in the southern part of Amphur Klong Tan, Changwad Sawankalok. It has an area of approximately 200 rai. The land which had been purchased by the Department of Agriculture and fisheries was intended for experiment on cotton. Prior to the commencement of experimental work on the site, Mr. Cero was requested to survey and map out the whole area. The soil was found to be very fertile and in excellent physical condition. The work undertaken in this survey included (a) the making of a 1 : 1000 scale base map (b) the determination of the different elevations of the different parts of the field, and (c) the collection of soil samples from the different soil types for analysis.

The fundamental principle of such experiment is based upon the fact that the best results cannot be obtained unless the soil in which the crop grows is of uniform character. When variations are known, proper steps can be taken into consideration to justify the results.

There are numerous isolated spots of soils differing from the main soil type. These isolated spots are portions occupied by excavations of large tree trunks, termite mounds, field boundaries and bamboo groves. These are the four factors causing soil variations in this station. Light silty clay loam is the main soil type here. The surface soil is light greyish brown in colour, with a depth of about 22 cm. But in most cases a large amount of organic matter has been thoroughly incorporated with the surface soil, which makes the structure mellow and friable. The subsoil is medium greyish brown clay loam of friable nature, with a uniform distribution of small specks of iron oxide. The depth of the subsoil generally ranges

from 25 to 55 cm. The survey was conducted from April 26th to May 3rd and from June 22nd to June 26th, B. E. 2479.

Tung Maha Mek, Bangkok.

The Department of Agriculture and Fisheries forwarded a scheme of turning Tung Maha Mek area into a central experimental station and the survey was therefore undertaken. The main purposes of this survey were, firstly, to make a map of the locality including every feature such as roads, houses, canals, fences and boundary marks, and secondly, to classify and map out the soils as well as to determine their actual uses.

The survey has covered an area of approximately 559 rai. The work was carried out between May 18th, and June 9th, B. E. 2479. Being in the rainy season, the field work was very much interrupted by the rain. The actual number of working days were only eight in all.

The soils of this area are apparently typical of the lower central flood plain of the Menam Chao Phya. The soil was formed by the sedimentation of the mud suspended in the river water. The soils of the whole area are practically of clay type and are dark greyish brown in colour. Drainage is generally poor. The land is more suitable for rice than upland crops.

Padang Besar.

The object of mapping the soils close to the Padang Besar International Railway Station was to determine the approximate area and details of the site which could be devoted to the establishment of a quarantine station for hogs exported from Thailand into the Federated Malay States.

The surface soil is generally light, ranging from a very light fine sandy loam in the well eroded soil to a loam in the well vegetated soil. The latter type is found most dominant in this area. The depth of the surface soil ranges from 12 cm. to 18 cm. and is dark greyish brown in colour. But the colour changes abruptly into a light greyish brown subsoil with a depth ranging from 20 to 60 cm. The gravels coated with iron oxide, giving the appearance of iron concretions are

found in abundance in the subsoil. The gravelly nature of the soils of the Padang Besar region clearly distinguishes this soil from all other soils so far encountered in the soil mapping of this Kingdom. The topography is quite irregular.

The area covered by the survey was approximately 25 rai. It was conducted from September 7th, to September 12th, B. E. 2479. A detailed base map on a scale of 1 : 1000 has been completely drawn up.

Kuan Nieng Experiment Station.

In continuation of the program of mapping the soils of the agricultural experiment stations, a soil survey was made at the Ta Chamuang near Kuan Nieng, a substation of the South Agricultural Experiment Station.

The experiment station is located at 15.5 km. south-west of Kuan Nieng Railway Station and has an area of approximately 294 rai. The topography of the locality is almost flat, while the surrounding country ranges from slightly undulating to hilly. In the distance are mountain ranges about 30 km. to the south and southwest and the precipitous limestone hill about 9 km. to the northeast.

Inspite of the relatively flat topography of the locality, the soil types are very variable in texture and the deposition of alluvial material from the river which overflows nearly every year is quite irregular. As is usual in such cases, the soils nearer the river are lighter in texture and darker in colour and as a whole more fertile than the soils farther away from the river. During early stages in the deposition of the sediments there has been very irregular shifting of the flood water along its banks and the distribution of the various materials deposited from flowing water is very irregular. Consequently, the streaks and patches of lighter soils are found farther away from the river bank, and beyond the zones of sandy loams, loams, and clay loams. Termite mounds which were quite numerous here before the establishment of the station had been levelled down making distinct local variations in the soil.

The soils are classified into two series, namely, the Kampangpet series and the Ta Chamuang series. The Kampangpet series has been developed from alluvial material and is grey or greyish brown while the Ta Chamuang series is alluvial and usually brown to greyish brown. Both series are represented by three soil types namely, sandy loam, loam, and clay loam. Drainage is generally poor.

The soil survey was carried out between September 20th and 30th B. E. 2479.

Kuan Nieng Railway Station.

A piece of land about a kilometer northeast of the Kuan Nieng Railway Station was being considered by the Department of Agriculture and Fisheries as a possible experiment station. Therefore soil survey was requested to be carried out soon after the completion of mapping out Ta Chamuan Experiment Station.

This survey was mainly for the making of a base map on the scale of 1:4000 and classifying the soils into broad groups which were mostly governed by the hydrographical and topographical features of the locality. The survey was started at 1.5 km. on the road from the Kuan Nieng Railway and continued southeast through the undulating and hilly lands up to the 4 km. post. The general groups of soils, streams, trails, and buildings encountered were plotted on the map from the data obtained by chaining and triangulation.

The topography is hilly in the northern central and southern portions while the eastern and western sections of the area are fairly undulating. Drainage is excessive in the hilly portions and only fair in the eastern and western portions. The soils are generally light brown to dark greyish brown loams on the well drained portions while the low poorly drained soils are grey fine sandy loams. The well drained soils seems suitable for rubber and some of the deep dark greyish brown soils for general agriculture.

The total area covered by the survey was approximately 3,500 rai. The work was performed from November the 2nd to November 24th B. E. 2479.

Pepper garden in the midst of bananas and coco-nut palms.

Koh Ka, Lampang.

The purpose of the survey at amphur Koh Ka about 11 km. south of Changwad Lampang, was to study the character of the soils which were already devoted to the cultivation of sugar cane and to determine the possibility of growing sugar canes on the other parts of the area.

Koh Ka, is situated in the valley of River Wang. Very close to the river, the land is slightly higher and is better drained on account of its light texture. Beyond the river belt, begins the poorly drained soils which are devoted to the cultivation of lowland rice. These rice fields extend out to the lower foot slopes of the low lying hills which are about 2 km. away from the river. The rain water runs off from this uncultivated slope and carries silt and clay along with it down to these lower lands. The alluvial soils occur as two strips, one along each bank of the river. These strips, known as "river belts" have an average width of about 150 meters. The surface soil is a light greyish brown loam with a fine granular structure extending to a depth of about 12 cm. The subsoil is a medium greyish brown light clay loam extending to a depth of about 40 cm. From this depth down to 70 cm. the texture gradually merges into a light brown loam and from 80 cm. down to 1.5 m. the texture becomes fine sandy loam with comparatively loose structure. The soil within the river belts is fertile on account of the fresh deposits of silts from the yearly enundation of the River Wang. It is on this soil that sugar cane is grown successfully.

Adjacent to and along the river belts, colluvial soils are to be found in strips having an average width of about 1.5 km. The soils here are devoted to the cultivation of lowland rice. The texture of the surface soil ranges from a silt loam to a light silty clay loam. Below the surface soil lies the subsoil or second horizon which extends down to about 50 cm. It has a peculiar property of being extraordinarily plastic when wet. It is extremely difficult for water to percolate down to the substrata but when once the water penetrates through this layer, it will never rise again by capillary force to feed the surface layer in the dry period. Such soil is liable to be flooded in the rainy season and be absolutely dry later on. Consequent-

ly, the plants, especially those requiring large amount of water will suffer severely from drought. It is true that there is a number of cases of converting rice fields into sugar cane plantations with satisfactory results but generally the soils in these cases are adequately provided with irrigation and drainage and their physical properties are perfectly normal.

Chemical composition of a soil may be improved to a certain extent by applying fertilizers and manures but to alter its entire physical composition is practically impossible. It is uneconomical and unwise.

The upland soils particularly on the upper slopes are generally light and shallow. The depth of the surface soil varies from 8 to 12 cm. It is a dark greyish brown loam and fairly compact. The subsoil is only a transition between the parent rocks and the top soil. It is a medium greyish brown loam to light gravelly loam with a slightly loose structure. The parent rocks lie immediately below the subsoil at the depth of about 25 cm. from the surface.

In general the upland soils are not suitable either for raising sugar canes or any other intensive agricultural use. They are not only too shallow but also are neither very fertile nor well supplied with soil moisture.

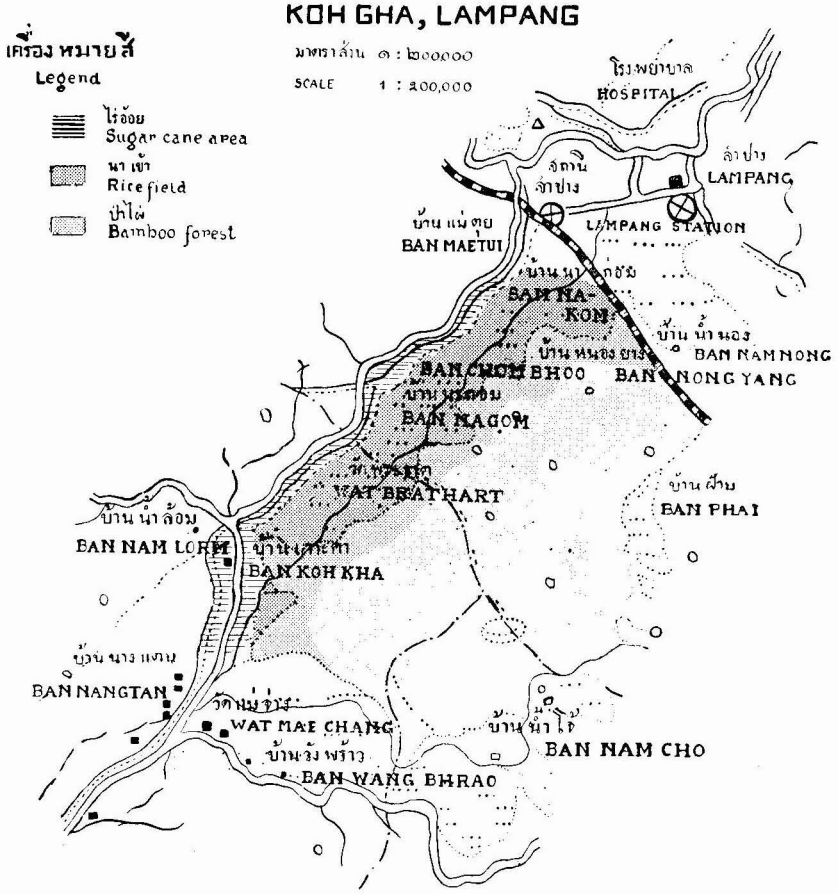
It must be remembered that in the preparation of the land for sugar cane, thorough ploughing and harrowing are essential, and in doing so the surface soil and a portion of the gravelly subsoil will be turned up and as a consequence there will certainly be a loss of soil through erosion by the rainfall. There is no doubt that under such circumstances the soil cannot maintain its fertility for a considerable length of time.

This preliminary survey was conducted from November the 2nd to November the 6th B. E. 2479.

Chantaburi.

The main object which leads to the execution of the work at Amphur Ta Mai, Changvad Chantaburi, was the need of a systematic study of the precarious situation of the pepper gardens and of the other crops that are grown in garden fashion in this locality.

แผนที่แสดงเนื้อที่ปลูกอ้อย
MAP SHOWING AREA UNDER SUGAR CANE
เกาะคา ลำปาง
KOH GHA, LAMPANG



An endeavour was also made to map the soils according to their texture, colour, profile and topography. So this map which combines the features of physiography, soil and cost all in one, is the first of its kind to have been made.

The area included in the survey consisted of the regions from the north with the villages of Nong Chawe, Nern Soong and Ban Cha-am and southward through the Tambol Kao Ngna, Siphya down to Tambol Ban Caccha, with a general width of about 2 km. from east to west, and practically covering the whole ridge of reddish brown soils of Amphur Ta Mai.

The topography of the land is characterised by the prominence of the irregular ridge formation of the reddish brown soils in the central region with Kao Ngua and Kao Ploi Waen hills as the outstanding features of the whole landscape. In the northern part, the small hill of Nern Soong which is sparsely covered with vegetation, is seperated from the Kao Ngua Hill and the generally elevated lands around it by a small perennial stream with a narrow valley of Wat Mai. On the other hand Kao Ngua Hill and Kao Ploi Waen are barely separated by a small stream which flows from the northeastern footslope of Kao Ploi Waen down to Wat Sae Kaew. The rest of the area from Kao Ploi Waen down to Ban Caccha to the south is one continuous broad ridge and gentle slopes with a few ravines running down its eastern and western sides. So that as a whole the topography of the entire area is fairly irregular being made up mostly of very gentle slopes, knolls, hills, and some water logged valleys,

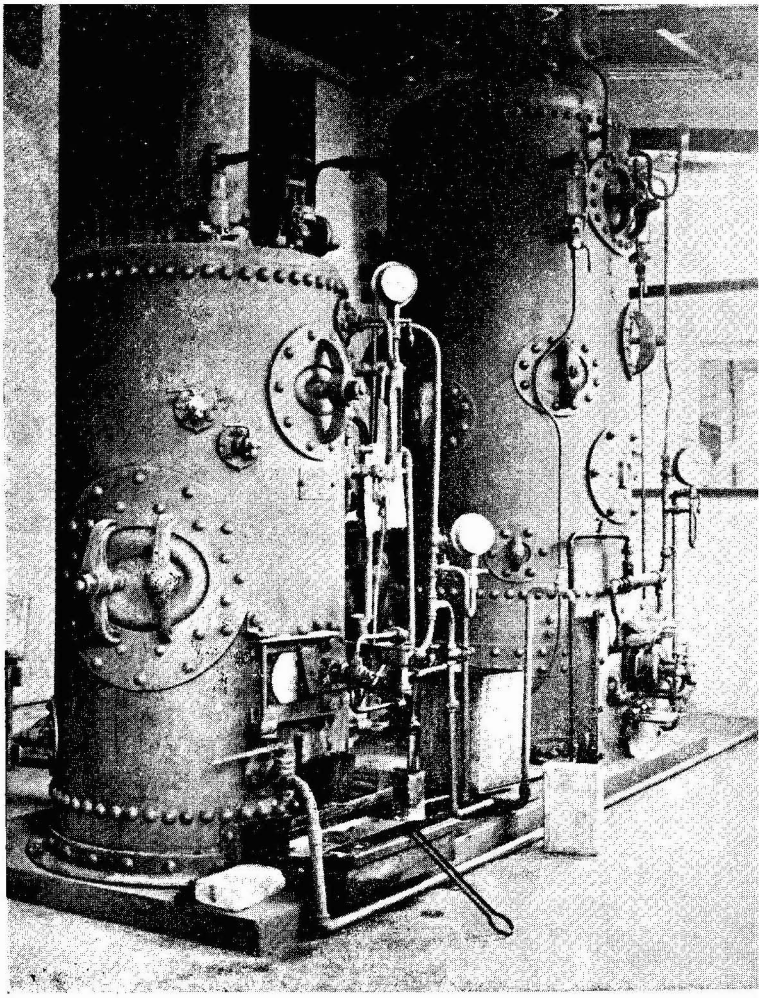
The soils of the area can be classified into two general groups, first, the well drained upland reddish brown soils which are mostly clay loams, loams, and gravelly clay loams and second, the poorly and fairly drained flat land grey soils which are characteristically loams and fine sandy loams.

The reddish brown soils are the most intensively cultivated and utilized in the production of various crops, the most prominent being pepper. The pepper gardens occupy the gently sloping and level sections of the area which are fairly to excessively drained and

very deep reddish brown soils. The soils on the sides of the hills, which are steep and gravelly are easily eroded so that they are very seldom utilized in the cultivation of pepper. The soils of the pepper district although high in clay content, as high as 60 per cent clay, are fairly granular and do not hold much water. Fruit trees notably rambutan and durian as well as rubber are also found growing abundantly on the reddish brown soils. The low current price of pepper (8 to 10 ticals per picul) has created a situation in favour of crops other than pepper of which sugar cane comes foremost.

The grey soils which are outside of the reddish brown soils are also devoted to pepper gardens but they can only be maintained through a liberal application of organic fertilizer because of the light character of the soils as well as low fertility. Durian and rubber which are deep rooted trees thrive well on the grey soils while the poorly drained and water logged portions are used as rice fields with satisfactory results.

The whole area surveyed covers about 19,260 rai. The work was conducted in three periods : January 14th to March 9th and April 12th to May 20th in 1937, and the third was in January 24th to March 30th in 1938.



The Boilers.

DIVISION OF INDUSTRIAL CHEMISTRY.

Formerly known as the Division of Technology, this Division was exclusively devoted to the manufacture of Vitamin B_1 Extract and drugs for the treatment of leprosy, with a small workshop for the repairs of machinery used in the manufacture of the above preparations. The former activities are still continued in this Division, the workshop was considerably enlarged to make it a more useful unit of the Department. The Section of Ceramics was formed in B. E. 2479 and incorporated with this Division.

During these two years there has been an increase in the manufacture and sale of the preparations as will be seen from the following figures:

	Hydnocarpus Anthelmintica in litres			Vitamin B_1 Extract in litres
	Mixed Ethyl Esters	Plain Oil	Oil with 4% Creosote	
B. E. 2475–76	239.55	751.25	131.40	466.85
B. E. 2477–78	443.61	713.68	160.05	1,372.95
B. E. 2479–80	910.79	1,734.30	168.50	1,611.65
Increase in litre over previous period	467.18	1,020.62	8.45	238.70
Increase in %	105.5%	143%	5.2%	17.4%

The unprecendented rise in the sales of Hydnocarpus oil and its mixed Ethyl Esters were due to the large purchases made by the Thai Medicinal Oil Works for export.

From the letters received by the Thai Medicinal Oil Works, it appears that the high quality of our products has met with the approval of medical men in many parts of the world.

The increase in the demand for our products has outgrown the capacity of our plants, consequently a good deal of overtime work had to be put in to meet this demand. Attempts have been made to obtain larger plants. At first a grant for this purpose could not be obtained from the budget. When the budget was finally sanctioned, tenders for suitable plants were not coming forth.

Vitamin B_1 Extract.

Hitherto the quality and appearance of the Vitamin B_1 Extract prepared in the laboratory was not consistent. Sometimes the product was dark brown, clear and of sweetish taste. Sometimes the product was reddish brown and cloudy on account of a fine colloidal suspension which could not be centrifuged or filtered off. The latter could not be bottled and stored for long, because fermentation soon set in and caused the bottles to explode. (In B. E. 2479, 61 bottles exploded and in B. E. 2480, 105 bottles exploded.)

Investigation revealed that, however well sterilized, the cloudy product could not be kept for more than seven days. But the clear product could be kept for months even though unsterilized.

Inorder to trace the source of the colloidal suspension, the rice bran was examined. It was found that rice bran generally contained from 11 to 34% of broken rice, husks and other impurities. The figures usually lie between 15 and 20%. To improve the quality of rice bran, a large mechanically operated sieve with 1 mm. perforations was constructed in the workshop of the Division for seperating the bran from most of the impurities.

Another modification was introduced.

Rice bran was extracted with 35% alcohol by allowing the two to remain in contact with daily stirring for about seven days, to allow the proteins and other solids to settle down completely, instead of only two days, as was formerly the practice, which was found to be inadequate for all the proteins to settle. The latter modification was introduced according to the suggestion of Nai Tong Kham Milintalek, who had the opportunity to observe the practice in the Bureau of Science in the Philippine Islands.

An automatic filling machine was also constructed in the workshop so that the process of filling was made continuous and the temperature of the extract kept at 70°C throughout. The bottled extract was then sterilized for another 30 minutes. This was found to be adequate. Formerly the process of sterilization was carried on at intervals for three days.

A step in the preparation of Vitamin B_1 Extract.

The Workshop.

The workshop of the Division has been considerably enlarged, fitted with many new equipments and the personnel increased. Skilled artisans, such as carpenters, fitters, turners, plumbers, electricians and welders, were engaged. Besides carrying out minor and major repairs of the machinery and apparatus used in the laboratories, the staff of the workshop constructed many of the appliances that used to be either imported or constructed outside the Department. Burners and stands for burettes, pipettes and test tubes are among the standard apparatus made in large quantities. The usefulness of the workshop is most evident when apparatus with special designs must be constructed to meet particular requirements, or when the final design of an apparatus can only be arrived at after the trials and modifications of tentative designs.

The outlay demanded by the upkeep of a well equipped and efficient workshop proved to be a distinct economy. Much time is also saved, and the skill and experience acquired and accumulated by the artisans remain at the service of the Department.

Ceramics Section.

The work in this section was started in October B. E. 2479 after Nai Chalaem Bhumiratna's return from Japan, where he had the opportunity to study the theory and practice of the ceramic industry.

The first step was to obtain samples of raw material available in the kingdom and find out their chemical compositions and physical properties, in order to ascertain their suitablility for the various requirements of the industries.

The materials analysed during this period are as follows :—

Quartz, flint and feldspar	29 samples
Sand	55 samples
Clay	71 samples
Total	155 samples

Table (a) gives the chemical compositions of 14 samples sand from different parts of the kingdom. They are tabulated in order of their Fe_2O_3 content. Only the first sample R. 476 has an Fe_2O_3 content below 0.30% which brings its within the specification of sand suitable for window and sheet glass. These samples are evidently inferior to the samples sent from Songkhla of which only Fe_2O_3 contents were analysed and the results published in the last report.

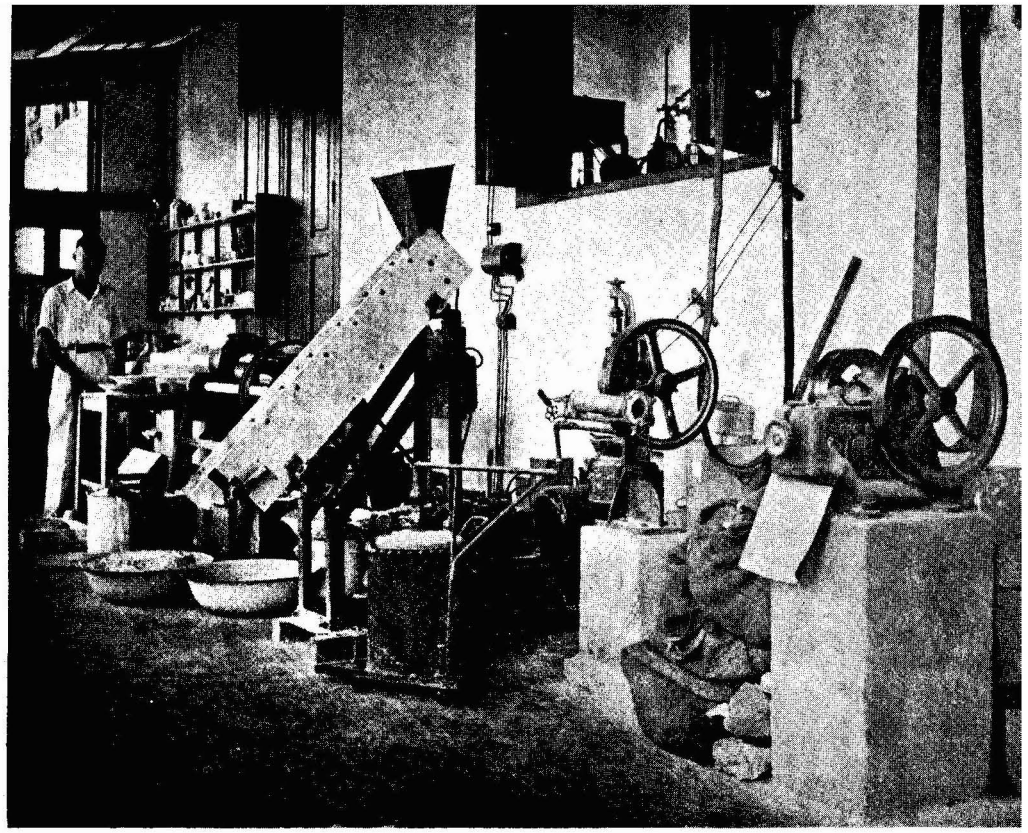
Table (b) gives the chemical compositions of quartz and flint samples from the different Changvads. Feldspar was the material actually needed and searched for, but a proper deposit has not yet been located. The samples sent as Hin Fan Ma or Feldspar turned out to be mostly quartz.

Table (c) gives the chemical compositions of 24 samples of kaolin, ball clay, white clay and plastic clay. Only the first sample R. 644 from Prachinburi could be classified as kaolin. Its composition may be compared with kaolin as follows:

	Kaolin	R. 644
SiO_2	45%	46.33%
Al_2O_3	39%	39.37%
H_2O	13%	12.78%
Fe_2O_3	—	1.04%
CaO		0.32%
MgO		0.14%
K_2O	3%	—
Na_2O		—

The Fe_2O_3 of R. 644 is however too high to allow it to be classified as good kaolin the iron content of which should be well below 1% or nil.

Table (a) see page 64.
Table (b) see page 66.
Table (c) see page 68.



Ceramics Section.

Samples 2 to 6 are classified as Ball Clays, the compositions of which should lie within the following limits :—

SiO_2	... ...	40–48%
Al_2O_3	... ...	32–36%
Fe_2O_3	less than ...	2%
CaO, MgO	less than ...	1%
K_2O, Na_2O	less than ...	3%

It will be seen that the silica and alumina contents are approximately the same as Kaolin, but the iron content is somewhat higher, *i. e.* it should be less than 2%, but the chief difference lies in the physical property; the Ball Clay is somewhat more plastic than Kaolin.

Even then the Fe_2O_3 contents of samples 5 and 6 are too high.

The silica contents of the rest of the samples are very high and so they are classified as white clays or plastic clays according to their chemical compositions and physical properties.

The physical tests could not be carried out thoroughly for lack of sufficient samples.

TABLE (a).

Results of Analysis of Samples of White Sand.

No.	Lab. No.	After analysis sample classified as	Chemical Composition						From	Changvad	Suitable for making
			SiO_2 %	Al_2O_3 %	Fe_2O_3 %	CaO %	MgO %	H_2O %			
1	R. 476	White Sand	96.41	2.05	0.29	0.86	..	0.38		Takuapa (ตะกั่วป่า)	Window glass, Sheet glass
2	R. 443	White Sand	76.43	5.93	0.31	9.16	0.08	7.62	King Amphur Koh Sichang (กิ่งอำเภอเกาะสีชัง)	Samudra Prakan (สมุทรปราการ)	Common Green Bottle
3	R. 444	White Sand	80.34	7.49	0.36	5.37	0.25	4.56	King Amphur Koh Sichang (กิ่งอำเภอเกาะสีชัง)	Samudra Prakan (สมุทรปราการ)	Common Green Bottle
4	R. 589	White Sand	95.85	1.72	0.56	0.13	..	0.25	Mai Fad (ไม้ฝาด)	Trang (ตรัง)	Green-Black Bottle
5	R. 636	White Sand	96.40	2.36	0.61	0.22	0.06	0.32	Amphur Thamai (อำเภอท่าใหม่)	Chandaburi (จันทบุรี)	Green-Black Bottle
6	R. 639	White Sand	95.02	3.53	0.62	0.22	0.10	0.48	Kwian Hak-Klung (เกวียนหัก ขลุง)	Chandaburi (จันทบุรี)	Green-Black Bottle
7	R. 593	White Sand	63.01	29.20	0.62	0.32	0.04	6.65	Ma Tam Tai (มาท่ามใต้)	Trang (ตรัง)	Green-Black Bottle
8	R. 588	White Sand	94.74	4.01	0.73	0.13	..	0.38	Si Kao (สิเกา)	Trang (ตรัง)	Green-Black Bottle

TABLE (a)—(*continued*).

Results of Analysis of Samples of White Sand.

No.	Lab. No.	After analysis sample classified as	Chemical Composition						From	Changvad	Suitable for making
			SiO_2 %	Al_2O_3 %	Fe_2O_3 %	CaO %	MgO %	H_2O %			
9	S. 237	White Sand	85.25	6.86	0.73	4.58	0.06	1.48	Amphur Muang (อำเภอเมือง)	Nakorn Sridhamaraj (นครศรีธรรมราช)	Green-Black Bottle
10	R. 637	White Sand	95.43	2.07	0.78	1.33	0.07	0.28	Pliew Laem Sing (พลิ้ว แหลมสิงห์)	Chandaburi (จันทบุรี)	Green-Black Bottle
11	S. 277	White Sand	88.63	9.42	1.08	0.29	0.05	0.43	Kotabaru (โกตาบารู)	Yala (ยะลา)	Green Black Bottle
12	R. 509	White Sand	86.01	8.90	1.14	0.56	0.04	1.14	Ban Kotr (บ้านโขทร์)	Jolburi (ชลบุรี)	Green-Black Bottle
13	R. 582	White Sand	90.29	7.02	1.71	0.53	..	0.38	Kantang (กันตัง)	Trang (ตรัง)	Green-Black Bottle
14	R. 756	White Sand	76.25	14.11	1.81	2.55	0.96	1.37	Ban Prai (บ้านไพร)	Sawankaloke (สวรรคโลก)	Green-Black Bottle

TABLE (b).

Results of Analysis of some Quartz and Flint sample.

No.	Lab. No.	Sample sent as	After analysis sample classified as	Chemical Composition						From	Changvad	Suitable for mixing with clay for making
				SiO_2 %	Al_2O_3 %	Fe_2O_3 %	CaO %	MgO %	H_2O %			
1	S. 276	Hin Fan Ma	Quartz	96.03	2.26	0.52	0.53	0.05	0.21	Kabu (กาบู)	Yala (ยะลา)	Porcelain
2	R. 641	White stone	Quartz	93.91	3.15	0.71	1.96	0.15	0.03	Tapon Klung (ตะปอน ขลุง)	Chandaburi (จันทบุรี)	Porcelain
3	R. 812	Hin Fan Ma	Quartz	93.66	3.29	0.72	1.92	0.19	0.20	Amphur Krok Phra (อำเภอโกรกพระ)	Nakorn Sawan (นครสวรรค์)	Porcelain
4	R. 510	Hin Fan Ma	Quartz	96.25	2.90	0.78	..	..	0.69	Land Registration Office (หอทะเบียนชลบุรี)	Jolburi (ชลบุรี)	Porcelain
5	R. 903	Hin Fan Ma	Quartz	93.85	4.87	0.84	0.22	..	0.21	Amphur Koh Samui (อำเภอเกาะสมุย)	Surasdr Dhani (สุราษฎรธานี)	Porcelain
6	R. 754	Hin Fan Ma	Quartz	96.19	1.54	0.87	1.35	..	0.04	Sukodhaya Dhani (สุโขทัยธานี)	Sawankalok (สวรรคโลก)	Porcelain
7	S. 236	Hin Fan Ma	Quartz	96.17	2.03	0.90	0.21	..	0.68	Amphur Muang (อำเภอเมือง)	Nakorn Sridhamaraj (นครศรีธรรมราช)	Porcelain
8	R. 597	Hin Fan Ma	Quartz	96.82	2.10	0.96	..	..	0.13	Kao Kao (เขาขาว)	Trang (ตรัง)	Porcelain
9	S. 279	Hin Fan Ma	Quartz	93.26	4.23	1.04	0.50	0.07	0.02	Tam Tale Tanohbuh (ตำทะเล ตะเนาะบู)	Yala (ยะลา)	Earthen Ware

TABLE (b)—*(continued)*.

Results of Analysis of some Quartz and Flint sample

No.	Lab. No.	Sample sent as	After analysis sample classified as	Chemical Composition						From	Changvad	Suitable for mixing with clay for making
				SiO_2 %	Al_2O_3 %	Fe_2O_3 %	CaO %	MgO %	H_2O %			
10	R-643	Hin Fan Ma	Quartz	94.79	3.43	1.20	0.43	0.05	0.03	Wat Mai (วัดใหม่)	Chandaburi (จันทบุรี)	Earthen Ware
11	R. 813	Hin Fan Ma	Quartz	93.68	1.24	1.29	3.62	0.08	0.08	Aumphur Bayuhakiri (อำเภอพยุหะคีรี)	Nakorn Sawan (นครสวรรค์)	Earthen Ware
12	R. 625	Hin Fan Ma	Quartz	94.70	2.61	2.12	0.48	0.05	0.03	Nong Boh Jum Koh (หนองโพ ชุมโค)	Jum Porn (ชุมพร)	Stone Ware
13	R. 26	Stone	Quartz	94.28	1.63	2.65	0.38	0.75	0.02	Land and Mines Department (กรมที่ดิน และโลหกิจ)	Kanjanaburi (กาญจนบุรี)	Stone Ware
14	R. 105	Brittle Hin Keo Ma	Quartz	93.71	2.35	2.90	0.86	0.03	0.03	Land Registration Office (หอทะเบียนที่ดิน)	Uttaradit (อุตรดิตถ์)	Stone Ware
15	R. 27	Flint	Flint	90.10	4.46	3.51	0.48	0.60	0.69	Land and Mines Department (กรมที่ดิน และโลหกิจ)	Kanjanaburi (กาญจนบุรี)	Stone Ware

TABLE (c).

Results of analysis of clay samples.

No.	Lab. No.	Sample sent as	After analysis sample classified as	Chemical Composition						From	Changvad	Suitables for making
				SiO_2 %	Al_2O_3 %	Fe_2O_3 %	CaO %	MgO %	H_2O %			
1	R. 644	White clay	Kaolin	46.33	39.37	1.04	0.32	0.14	12.78	Saha Utsahakarm Thai (สหอุตสาหกรรมไทย)	Prachinburi (ปราจีนบุรี)	Procelain or Earthen Ware
2	R. 638	White clay	Ball Clay	49.21	35.07	1.61	0.87	0.12	13.12	Kwian hak Klung (เกวียนหัก ขลุง)	Chandaburi (จันทบุรี)	Earthen Ware
3	T. 151	White clay	Ball Clay	47.01	37.63	1.74	0.22	—	13.40	Ban Kee Lek Amphur (บ้านขี้เหล็ก อำเภอเมือง)	Prachinburi (ปราจีนบุรี)	Earthen Ware
4	R. 209	White clay	Ball Clay	50.65	36.73	1.90	0.54	0.07	10.11	Amphur Chwang (อำเภอฉวาง)	Nakorn Sridharmaraja (นครศรีธรรมราช)	Earthen Ware
5	S. 88	White clay	Ball Clay	44.80	37.74	2.45	0.50	—	14.48	Luang Kla Pachon Suk (หลวงกล้าผจญศึก)	Prachinburi (ปราจีนบุรี)	Earthen Ware

TABLE (c).—*(continued)*.

Results of analysis of clay samples.

No.	Lab. No.	Sample sent as	After analysis sample classified as	Chemical Composition						From	Changvad	Suitable for making
				SiO_2 %	Al_2O_3 %	Fe_2O_3 %	CaO %	MgO %	H_2O %			
6	R. 196	White clay	Ball Clay	47.78	36.94	2.47	0.29	0.04	12.40	Siam White Clay Co. (บริษัทดินขาวสยาม)	Prachinburi (ปราจีนบุรี)	Earthen Ware
7	R. 594	Fine White clay	White clay	63.17	26.20	0.58	4.81	—	4.96	Koh Chong Tab Tieng (เกาะชอง ทับเที่ยง)	Trang (ตรัง)	Porcelain
8	R. 656	White clay	White clay	69.76	21.05	0.83	1.24	—	7.06	White Clay Co. (บริษัทดินขาว)	Prachinburi (ปราจีนบุรี)	Porcelain
9	R. 978	White clay	White clay	65.51	22.55	1.14	0.44	0.09	3.37	Prom mani Wang Krachom (พรมมณี วังกระโจม)	Nakorn Nayok (นครนายก)	Earthen Ware
10	R. 441	White clay	White clay	65.91	26.03	1.16	0.40	0.15	5.75	King Amphur Koh Sichang (กิ่งอำเภอเกาะสีชัง)	Samudra Prakarn (สมุทรปราการ)	Earthen Ware
11	R. 905	White clay	White clay	76.97	14.53	1.24	3.52	—	3.72	Motai Muang Chaiya (โมถ่าย เมืองไชยา)	Surasdr Dhani (สุราษฎรธานี)	Earthen Ware
12	S. 275	White clay	White clay	64.29	25.36	1.25	0.59	0.10	8.19	Kai bokoh Kotabaru (กายบอเกาะโกตาบารู)	Yala (ยะลา)	Earthen Ware

TABLE (c).—*(continued).*

Results of analysis of clay samples.

No.	Lab. No.	Sample sent as	After analysis sampla classified as	Chemical Composition						From	Changvad	Suitable for making
				SiO_2 %	Al_2O_3 %	Fe_2O_3 %	CaO %	MgO %	H_2O %			
13	R. 635	White clay	White clay	67.48	23.47	1.31	2.65	0.09	4.96	Bang Ka Cha (บางกะจะ)	Chandaburi (จันทบุรี)	Earthen Ware
14	S. 456	White clay	White clay	64.58	25.36	1.32	0,36	0.08	8.29	Ao Nang (อ่าวนาง)	Krabee (กระบี่)	Earthen Ware
15	S. 235	White clay	White clay	72.28	19.76	1.36	1.09	0.12	5.39	Amphur Muang (อำเภอเมือง)	Nakorn Sridharmaraja (นครศรีธรรมราช)	Earthen Ware
16	S. 712	White clay	White clay	72.33	17.97	1.52	0.77	0.32	6.43		Chieng Mai (เชียงใหม่)	Earthen Ware
17	S. 278	White clay	White clay	72.75	16.10	1.73	1.25	0.06	4.61	Banang Star (บันนังสะตา	Yala (ยะลา)	Earthen Ware
18	R. 501	White clay	White clay	69,67	23.08	1.95	0.42	—	4.67	Amphur Ngao (อำเภองาว)	Lampang (ลำปาง)	Earthen Ware
19	R. 604	White clay	White clay	61.54	23.22	2.18	7.48	0.07	4.20	Amphur Ban Rai (อำเภอบ้านไร่)	Udai Dhani (อุทัยธานี)	Stone Ware

TABLE (c).—*(continued)*.

Results of analysis of clay samples.

No.	Lab. No.	Sample sent as	After analysis sample classified as	Chemical Composition						From	Changvad	Suitable for making
				SiO_2 %	Al_2O_3 %	Fe_2O_3 %	CaO %	MgO %	H_2O %			
20	R. 907	White clay	White clay	64,99	22.62	2.46	2.42	0.15	6.89	Ta Kradan, Ta Kanon (ท่ากระดาน ท่าขนอน)	Surasdr Dhani (สุราษฎรธานี)	Stone Ware
21	R. 642	White clay	White clay	62.33	26.79	2.67	0.15	0.15	7.89	Tok Prom Klung (ตกพรม ขลุง)	Chandaburi (จันทบุรี)	Stone Ware
22	R. 755	White clay	Plastic clay	55.08	21.79	2.70	7.65	—	12.77	Savankalok (สวรรคโลก)	Savankalok (สวรรคโลก)	Stone Ware
23	R. 104	While clay	Plastic clay	69.36	18.30	2.73	4.35	1.02	3.36	Land Registration Office (หอทะเบียนที่ดิน)	Uttaradit (อุตรดิตถ์)	Stone Ware
24	S. 711	White clay	Plastic clay	68.72	20.61	2.94	0.41	0.21	6.17		Chieng Mai (เชียงใหม่)	Stone Ware

THE DIVISION OF PHARMACY.

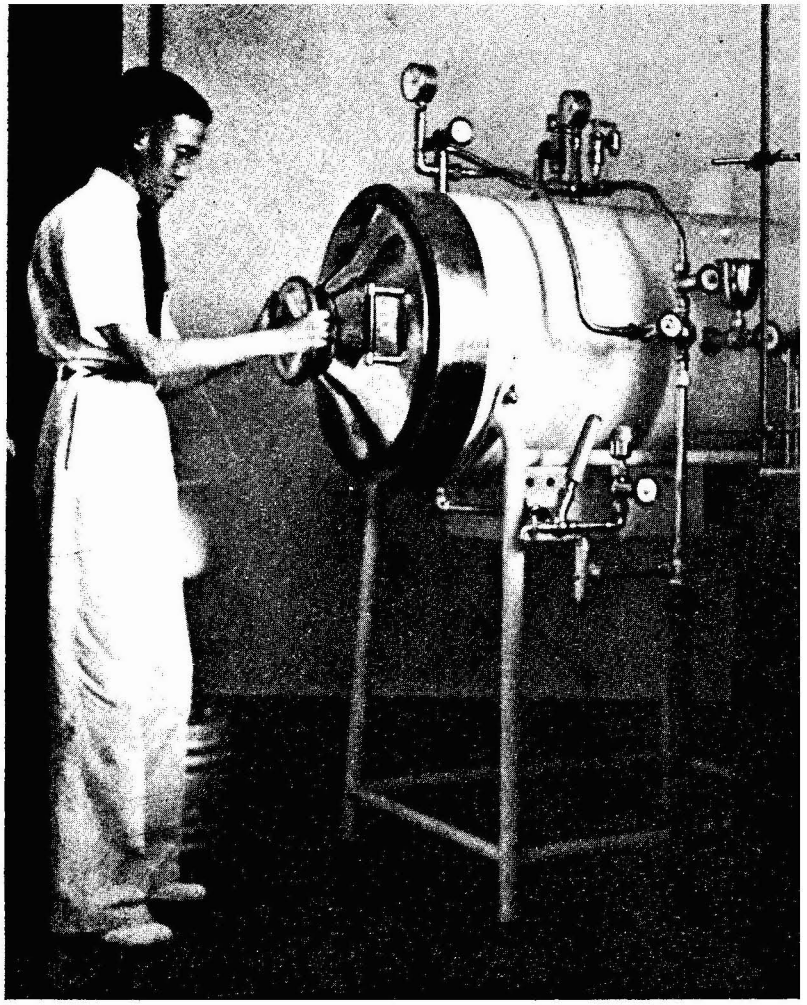
It was stated in the previous report that a scheme for pharmaceutical development was considered by a committee composed mainly of the staff of the Department of Science. This committee modified the original scheme to one for research into indigenous drugs and manufacture of certain galenical preparations. This was approved by the Government and the Department of Science was entrusted with the responsibility of carrying out this scheme. The scheme was later modified to include the examination and standardization of drugs and biological preparations imported into or manufactured in Thailand.

The budget for B. E. 2479 contained an appropriation of Baht 50,000 for carrying out the first part of this scheme. In B. E. 2480 the Division of Pharmacy was formed and incorporated into the Department of Science. The budget was spent in the erection of a building and a supply of chemicals and apparatus.

The new Division comprises of the following sections:

1. Phyto-Chemistry
2. Pharmaceutical Chemistry
3. Pharmacognosy
4. Bio-Chemistry
5. Pharmaceutics
6. Factory

Towards the end of B. E. 2480 (March, 1938) the staff of this Division consisted of two pharmacologists, three pharmacists and eight assistants. The work as outlined in this scheme was not yet begun, pending the arrival of chemicals and apparatus ordered from abroad, consequently the staff was engaged in performing chemical analysis for the Division of Chemistry.



A Sterilizer in the Division of Pharmacy.

SUMMARIES OF REPORTS OF OFFICIALS WHO WENT ABROAD.

DR. TOA LABANUKROM.

Dr. Toa Labanukrom left Bangkok on the 28th March, 1936. His first destination was Formosa where he visited the Imperial University, the National Museum, and the camphor factory. The Kinkasek gold mine, the Kanan Irrigation Works, the Government Sugar Experiment Station and the Takao Sugar Factory were also included in his visits. From Formosa he travelled to Japan where he spent the greater part of his time abroad. There he went through a series of visits of inspection to the more important Scientific Institutes and Industrial works of the country. Among the institutes and laboratories visited were the Imperial University, the Imperial Agricultural Experiment Station, the Institute of Physical and Chemical Research, the Imperial Government Institute for Nutrition and the Tokyo Industrial Research Institute. His visits to the industrial factories included some oil refineries, pharmaceutical laboratories and metal works. Other factories visited were those famous for canned food, paper, glass, textile, rubber, ceramic and lacquer manufacture. He was also accorded the rare privilege to inspect many important military and naval works. From Japan he went on to Manchukuo, where he visited coal mines, industrial museums, oil refineries and research laboratories. Then he returned to Thailand via Shanghai and Saigon. He arrived in Bangkok on the 11th June, 1936, thus completing a most interesting tour lasting nearly three months.

NAI CHALAEM BHUMIRATNA.

Nai Chalaem Bhumiratna accompanied Dr. Toa Labanukrom to Formosa and Japan where he stayed nearly three months more after the latter had left the country. He followed Dr. Toa to all the institutes and factories the latter visited. From the 21st May to the 2nd July he studied ceramics at the Technical Engineering Industrial University. The rest of his time was spent in visiting all the important ceramic factories of the island. He also visited other industrial works such as paper, silk, cellophane, textile and electrical factories. He left Japan on the 11th August, and reached Thailand

on the 19th of the same month, after having been abroad nearly five months.

NAI AREE SUPOL.

Nai Aree Supol left Thailand for Europe on the 11th April, 1936, in order to study the latest development in spectrography, and the applications thereof.

While passing through Paris he visited the Mint. He was initiated into the practical methods employed in qualitative and quantitative, emission and absorption spectrography in Messrs. Adam Hilger's Laboratory in London. After being conversant with the methods employed, Mr. F. Twyman was kind enough to obtain permission for Nai Aree to see the applications of spectrographic analysis in the following laboratories.

At the British Non-Ferrous-Metal Research Association, he was shown the methods employed in and the technique developed to cope with this branch of work by Mr. D. M. Smith.

At the Royal Cancer Hospital in London, he was shown the application of absorption spectrography in studying the structures of cancer producing organic compounds.

At the Imperial Chemical Industries Laboratory in Birmingham, he saw the use of spectrography in controlling the quality and compositions of various alloys produced by the I. C. I. plants.

At the Macaulay Institute in Aberdeen, he was taught Lundegardh's method of flame spectrography used in agricultural analysis by Dr. R. Mitchell, with the kind permission of Dr. W. Ogg, the Director of the Institute.

Before he left for Germany via Belgium, where he visited the Royal Mint, he also had the opportunity to visit the National Physical Laboratory in Teddington, Essex, the Royal Mint in London, and a few glass and bottle factories in the neighbourhood of London.

Most of his time in Germany was spent in Jena where he attended a course of lectures on spectrography, microscopy and metallography sponsored by Messrs. Carl Zeiss, in whose laboratories he was given a thorough training in spectrophotometry and was

taught the uses and manipulations of various optical instruments for which the firm is justly famous. He also studied the technique employed in metallography there. Through the introduction of this firm he was enabled to work and study a few other optical instruments in the laboratories of Messrs. Zeiss Ikon in Dresden.

He visited the Physikalische-Technische-Reichsanstalt, the Technische Hochschule, the factory of Messrs. Askania and the Mint in Berlin. While in Hamburg he visited Dr. Hopfner's Laboratory and the Mint. On his way to Italy he stopped in Munich to visit the Deutsche Museum. His activities in Germany were made possible through the kindness of Mr. R. Link of Messrs. B. Grimm & Co.

On his way home he travelled overland through India, and visited the University Science College, the Indian Scientific Research Association and the Mint in Calcutta. He also visited a paper factory in the neighbourhood of that city.

He returned to Thailand on the 7th December 1936 after an absence of eight months.

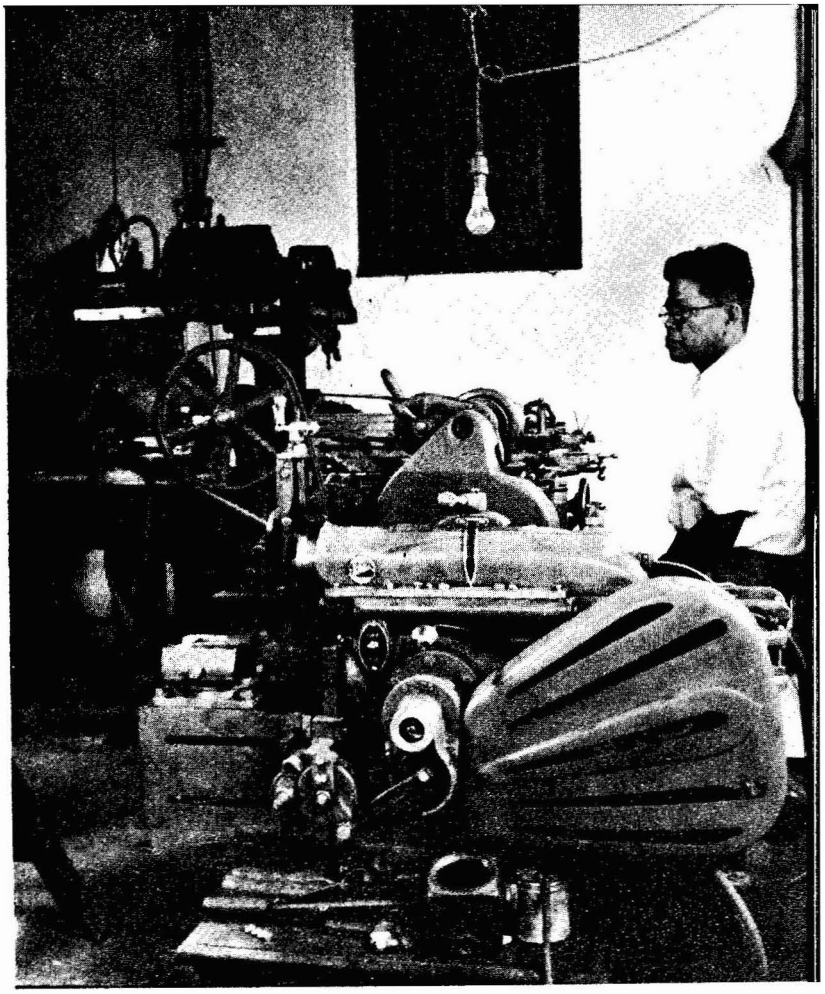
NAI TONG KHAM MILINDALEKHA.

Nai Tong Kham Milindalekha went to the Philippine Islands on the 20th April 1937. He spent two semesters in the University of the Philippines on Chemical Toxicology, Plant Chemistry and Forensic Chemistry. He also had one month's training at the School of Hygiene and Public Health on Pharmacopoeal Testing and Pharmaceutical Assaying. The rest of his time was spent at the Bureau of Science in which he acquainted himself with the various sections of the Institution, viz. Plant Research, Tests and Standards, Leather Tanning, Manufacture of Vitamin B_1 and Biological Standardization of Vitamin B_1. He returned to Thailand on the 17th May, 1938 after an absence of thirteen months.

NAI KLIAU BUNNAG.

In April, 1938, Nai Kliau Bunnag went to Europe to acquire some knowledge on Biological Assaying. He spent six months in the Pharmacological Laboratory of the Pharmaceutical Society of Great Britain, under the supervision of Dr. J. H. Burn and Dr. K. H.

Coward. He studied the methods of standardization of digitalis, strophanthus, squill, ergot, parathyroid extract, adrenal extract, organic arsenic and antimony compounds, insulin, vitamin B_1 by rat method, and male and female hormones. He also visited drug manufacturing plants of Messrs. Stafford Allen & Sons Ltd., May & Baker and the British Drug House. After that he went to Germany and visited the I. G. Farbenindustrie Aktiengesellschaft, at Leverkusen, the Chemische Fabrik Promonta, and the Technische Hochschule in Hanover. He stayed three weeks in Copenhagen and studied the manufacturing of galenicals in the Rigs Hospital through the courtesy of Professor Dr. Phil. Svend Aage Schou. Lion's Chemical Factory, Den Farmaceutiske Laereanstalt and the Royal Institute of Serum of Copenhagen were also visited. He also spent two weeks in the chemical laboratory of Messrs. Schering, Adlershof, where he was interested in the chemical standardization of drugs supervised by Dr. Alfred Gilg. The manufacturing plant of Riedel was later visited. The visits in Germany to manufacturing plants were made possible through the courtesy of Mr. R. Link, Mr. W. P. Cocqui and Mr. Hans Geyer, to whom thanks are hereby duly expressed.



A corner of the well equipped workshop.

APPENDIX.

I. PREPARATIONS.

Description	Issued to	Quantity in litres
Mix ethyl enters of Hydnocarpus anthelmintics	Department of Public Health	14.00
do.	Thai Medicinal Oil Works.	873.90
do.	Siriraj Hospital	.05
do.	Public	22.84
	Total	910.79
Oil of Hydnocarpus anthelmintica	Department of Public Health	18.50
do.	Chiengmai Leper Asylum	611.00
do.	Thai Red Cross Society	5.00
do.	Siriraj Hospital	.50
do.	Thai Medicinal Oil Works	751.80
do.	Public	347.50
	Total	1,734.30
Vitamin B_1 Extract	Public	915.55
do.	Department of Public Health	487.40
do.	Chulalongkorn Hospital	77.50
do.	Police Department	114.00
do.	Army Medical Service	5.50
do.	Chiengmai Dispensary	11.70
	Total	1,611.65

II. ANALYSIS.

Ministry of Finance.

From	Description	Number of Samples
Dept. of Customs	Fuel oils.	896
	Lubricating oils.	409
	Milk.	170
	Samshoo.	56
	Drugs and materials for examination under the harmful habit forming drug law	43
	Imports for alcoholic determination.	22
	Wood Naphtha.	20
	Total	1,616
	The followineg were sent for Tariff Classification.	
	Textiles.	328
	Edibles.	114
	Essences.	90
	Metals and alloys.	88
	Vinegar.	65
	Non-mineral oils and fats.	55
	Papers and cardboards.	48
	Disinfectants, insecticides and fungicides.	39
	Mineral oils.	29
	Chemicals.	27
	Miscellaneous.	122
	Total	1,005

ANALYSIS.—*(continued).*

MINISTRY OF FINANCE.—(contd)..

From	Description	Number of Samples
Excise Department	Opium dross, routine assays.	24,213
	Metals.	522
	Substances suspected to contain opium.	133
	Substances suspected to contain opium or morphine.	91
	Opium dross, special assays.	65
	Opium.	56
	Miscellaneous.	27
	Total	25,107
Treasury Department	Bronze.	1,863
	Nickel.	24
	Copper ingot.	29
	Tin ingot.	14
	Zinc ingot.	12
	Carbon steel.	15
	Alloy steel.	1
	Mint sweep.	2
	Silver alloys.	2
	Sulphuric and Nitric Acid.	88
	Total	2,050
Store Department	Minerals.	3
	Metal polish	1
	Total	4
	Grand Total	29,782

ANALYSIS.—*(continued).*

MINISTRY OF AGRICULTURE.

From	Description	Number of Samples
Department of Lands and Mines	Minerals.	51
	Wolfram ore.	44
	Fuller's earth.	2
	Stone samples,	2
	Schilite.	1
	Tantalum Columbite.	1
	Total	101
Department of Agriculture and Fisheries	Soils.	949
	Derris roots.	35
	Water.	17
	Salt.	13
	Fertilizers.	7
	Tobacco.	7
	Miscellaneous.	19
	Total	1,047
Forest Department	Bamboo (to find acid resistance).	13
	Wood (to find property as charcoal).	10
	Benzoin.	3
	Miscellaneous.	2
	Total	28
Irrigation Department	Metals.	4
	Coal Tar.	1
	Water.	1
	Total	6
	Grand Total	1,182

ANALYSIS.—(*continued*).

MINISTRY OF INTERIOR.

From	Description	Number of Samples
The Ministry	Materials & drugs suspected to contain poison.	44
	Articles for detection of human blood stains.	14
	Material & drugs for examinaiion under the harmful habit forming drug law.	8
	Decayed rubber.	7
	Materials & drugs suspected to contain morphine.	7
	Kaolin.	5
	Viscera.	5
	Counterfeit coins.	4
	Miscellaneous.	3
	Total	97
Department of Public Health	Water supply	204
	Water.	143
	Drug & materials for examination under the harmful habit forming drug law	55
	Drug & materials suspected to contain poisons.	18
	Miscellaneous	12
	Total	432

ANALYSIS.—*(continued).*

MINISTRY OF INTERIOR.—(contd.).

From	Description	Number of Samples
Police Department	Articles for detection of human blood stains.	54
	Firearms & cartridges.	38
	Drugs & materials for examination under the harmful habit forming drug law	30
	Drugs & materials suspected to contain poison.	24
	Counterfeit coins.	23
	Viscera.	6
	Goods suspected to be imitations.	4
	Miscellaneous.	25
	Total	204
Municipal Works Department	Water.	60
	Sewage disinfectants.	2
	Miscellaneous.	4
	Total	66
Bangkok Water-Works.	Lime.	10
	Alum.	10
	Total	20
	Grand Total	819

ANALYSIS.—*(continued)*.

MINISTRY OF ECONOMIC AFFAIRS.

From	Description	Number of Samples
The Ministry	Water.	2
	Total	2
Department of Science	Water.	119
	Materials for ceramics.	85
	Minerals.	29
	Food and beverage.	27
	Clay.	16
	Rice bran.	5
	Chemicals.	3
	Total	284
The State Railways of Thailand	Fuels.	22
	Metals.	19
	Water.	18
	Chemicals.	11
	Oils.	7
	Miscellaneous.	5
	Total	82
Department of Commerce	Vegetable oil and resin.	4
	Vegetables.	3
	Minerals.	2
	Water.	2
	Total	11

ANALYSIS.—*(continued).*

MINISTRY OF ECONOMIC AFFAIRS.—(contd.).

From	Description	Number of Samples
Post & Telegraph Department	Chemicals.	1
	Metals.	5
	Water.	1
	Total	7
	Grand Total	386

ANALYSIS.—*(continued).*

MINISTRY OF DEFENCE.

From	Description	Number of Samples
Royal Survey Department	Kaolin.	13
	Turpentine glue.	5
	Chemicals.	5
	Soapstone.	1
	Total	24
The Ministry	Minerals.	41
	Metals.	15
	Chemicals.	13
	Grasses.	9
	Fuel oils.	6
	Fresh sorghun plants.	6
	Food and beverage.	5
	Miscellancous.	10
	Total	105
	Grand Total	129

ANALYSIS.—*(continued).*

MINISTRY OF JUSTICE.

From	Description	Number of Samples
	Metals used in counterfeit coins	8
	Substance suspected to be opium	1
	Total	9

MINISTRY OF PUBLIC INSTRUCTION

	Medicine.	4
	Total	4

THE ASSEMBLY OF PEOPLE

REPRESENTATIVES

	Samshoo	2
	Drug suspected to contain poison	1
	Viscera.	1
	Total	4

ANALYSIS.—(*continued*).

PUBLIC.

From	Description.	Number of Samples
	Damaged cargoes	230
	Minerals	194
	Water	109
	Textiles	23
	Food and beverage	20
	Fuel oils	12
	Chemicals	10
	Metals	9
	Paddy	8
	Miscellaneous	26
	Total	641

PUBLICATIONS OF THE DEPARTMENT OF SCIENCE, MINISTRY OF ECONOMIC AFFAIRS, THAILAND.

A. *Bulletins* (in Thai language) issued free for circulation in Thailand only.

1. Improved Method in Making Solar Salt, by Areè Supol and Pue Rochanapurananda.
2. Sand for Glass Making, by C. J. House.
3. Methods of Curing Ginger, by Pue Rochanapurananda.
4. Turpentine and Rosin, by Klieu Bunnag.
5. Jelly from Thai Seeweed, by Klieu Bunnag.
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B. *Biannual Reports of the Department of Sciences*, in (English) Published since 1917.

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