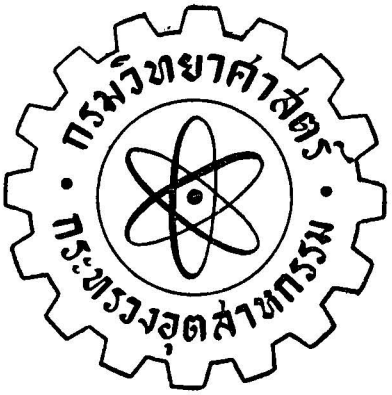


REPORT UPON THE WORK OF THE

DEPARTMENT OF SCIENCE

Ministry of Industry
Bangkok, Thailand

No. 17

FOR THE YEARS 1953 (B.E. 2496)—1954 (B.E. 2497)

FOREWORD

The Department of Science Bi-Annual Reports were issued regularly since the institution of the Department as the Government Laboratory. This is the Seventeenth Report covering the work performed during the years 1953 and 1954. Owing to the increasing interest shown by public and to the rapid accumulation of scientific materials, future reports will be issued annually, starting from the Eighteenth Report covering the work done during the year 1955. Apart from this, the Department's quarterly Bulletin in Thai has been published regularly since 1953 and, in addition, the work of the Department has also been broadcasted every month. To keep the public well informed of recent developments in science in general, this Department has made a joint effort with the Science Society of Thailand, in the same year, to give a monthly broadcasting programme of "Science for the Public". In all, these new services have had considerable success in all circle, and I am proud to report that increasing numbers of the public have made inquiries and have requested various scientific papers, reports and news.

As for the report itself, the English edition rather lags behind the Thai edition; however, it is hoped that it will catch up with the Thai edition in the near future.

Lastly, I would like to take this opportunity to mention that the Department of Science is always ready to render services to all inquiries to the utmost extent of the facilities available.

Charng Ratanarat
Dip. chem., Dr. phil. nat. (magna cum laude)
Director-General

Department of Science
Ministry of Industry
Bangkok, Thailand

STAFF

1954

Position	*Number of Position*	*Vacant Position*
Director-General	1	—
Senior Scientific Officer, Chief of Division, First Grade Officer	4	—
Senior Scientific Officer, First Grade Officer	3	—
Director of School of Analytical Chemistry Training, First Grade Officer	1	—
Secretary, First Grade Officer	1	—
Scientific Officer, Chief of Section Second Grade Officer	14	1
Scientific Officer, Second Grade Officer	12	—
Chief, Second Grade Officer	4	—
Assistant Scientific Officer, Third Grade Officer	30	2
Assistant Technician, Third Grade Officer	7	—
Section Staff, Third Grade Officer	5	—

NEWLY APPOINTED OFFICERS

	1953	1954
Senior Scientific Officer	—	1
Assistant Scientific Officer	3	1
Section Staff	—	1
Assistant Technician	—	1
Laboratory Assistant	1	—
Clerk	—	3
Probational Officer	4	6

PROMOTIONS

	1953	1954
Second Grade Officer, promoted to First Grade Officer	1	—
Third Grade Officer, promoted to Second Grade Officer	4	2
Fourth Grade Officer, promoted to Third Grade Officer	1	—

STAFF CHANGES AND MOVEMENTS

a) TRANSFERRED TO OTHER DEPARTMENTS

	1953	1954
Scientific Officer	2	—
Assistant Scientific Officer	3	—
Clerk	1	1

b) TRANSFERRED FROM OTHER DEPARTMENTS

	1953	1954
Assistant Scientific Officer	—	1

c) RESIGNING OFFICER

	1953	1954
Scientific Officer	—	2
Assistant Scientific Officer	2	—
Laboratory Assistant	3	1
Probational Officer	3	5

THE ROYAL DECREE

The organization of the Department of Science, Ministry of Industry shall be hereafter according to the new Royal Decree, which was published in the Government Gazette, volume 70, section 26, dated 21st. of April 1953 from page 523 to page 527, as follows:-

I. Office of Secretary of the Department shall consist of 5 sections as follows:-

1) Registration Section
2) Finance Section
3) Store Section
4) Library Section
5) Statistics, Museum and Information Section.

II. Division of Chemistry shall consist of 8 sections as follows:-

1) General Analysis Section
2) Minerals and Ores Section
3) Metals and Alloys Section
4) Water Section
5) Opium Section
6) Forensic Chemistry Section
7) Fuel and Lubricant Section
8) Analytical Methods Section.

III. Division of Biological Science shall consist of 4 sections as follows:-

1) Biochemistry Section
2) Plant Chemistry Section
3) Nutrition and Beverage Section
4) Micro-biology Section.

IV. Division of Physics and Engineering shall consist of 4 sections as follows:-

1) Physics Section
2) Strength of Material Testing Section
3) Chemical Engineering and Industrial Processes Section
4) Workshop Section.

V. Division of Analytical Chemistry Training.

VI. Division of Research.

SPECIAL DUTIES

Dr. Charng Ratanarat, the Director-General, was elected to become:-

1) National Committee member of the UNESCO.

2) Chairman of the National Committee, Science Division of the UNESCO.

3) Member of Committee of Industrial Economic Branch, National Economic Council.

4) Member of the Board of Directors, Pharmaceutical Factory.

5) Executive member of the Economic Council.

6) Member of the Committee for Improvement of the Thai Paper Factory.

7) Executive member of the Committee on Petroleum, Fang, Shaengmai.

8) Member of the Board of Directors, Alcohol Distillery, Ayuthaya.

9) Member of the National Air Defense Committee.

10) Representative of the Ministry of Industry attending a meeting on the Erection of Ministry of Defense's Light Ammunition Factory.

11) Member and Secretary-General of the Thai Atomic Energy for Peace Committee.

12) Executive Manager and Deputy Chairman of the Government Alum Plant Committee.

13) Member and Representative of the Ministry of Industry for the Import Control of Goods, organized by the Ministry of Economic Affairs.

ASSISTANCE FROM FOREIGN EXPERTS AND OFFICERS OF OTHER DEPARTMENTS

1. Sir Charles G. Darwin, UNESCO's Scientific Expert, came to investigate and give advice to the Science Division of the UNESCO and worked at the Department of Science from 12th. October 1953 to 11th. February 1954.

2. Captain Sombhandhu Bunnag R.N., assisted the Department of Science in the erection of the government Alum Plant and in the planning of other Chemical Plants, from 1st. March 1954 for approximately 6 months.

3. Professor Dr. Herbert Brintzinger of Oberlenningen / Teck and Dipl. Ing. K.A. Koppenhöfer of Stuttgart, Germany, two Chemical Industrial Experts, who were under a contract with the Ministry of Industry to survey and plan out the Department of Science's Chemical Plants, were both at the Department of Science from 15th. May 1954 for 6 months.

4. Group Captain Dr. Swasdi Srisuk of the Royal Thai Air Force, for twice a week throughout the period of this report, made himself available for work with the Division of Biological Science.

5. Dr. Satang Mongkolsuk of the Faculty of Pharmacy, University of Medical Sciences, assisted the work of the Department of Science for 3 months from July to October 1954.

THE NEW BUILDING OF THE DEPARTMENT OF SCIENCE

On 7th. May 1953, an Openning Ceremony of the Department of Science's new building at Rama VI road was performed under the presidency of Field Marshal P. Pibulsonggram, the then prime-minister.

The new office is a two storied building except at the central entrance which is of three stories. The building is 160 metres long and 15 metres wide with two wings extending from both ends, and with a total working space of approximately 7,000 square metres. The building was designed and supervised throughout its entire construction by the Department of Municipal Works.

The foundation work was started in 1941 at a cost of 112,625.00 Baht, while Dr. Toa Labanukrom was the Director-General of the Department. The main construction of the building, costing 5,640,000.00 Baht, was started after the foundation stone was laid by the then prime-minister on 16th. June 1951. During the years 1951 and 1952, the Department of Science was granted an additional sum of 3,105,166.18 Baht for the constructions of a Gas Generator, its staff's residences, a water tank, roads, workshops and miscellaneous accessories such as fume cupboards, desks and shelves for chemical reagents and for wiring and piping. The total cost of the new Department thus amounted to 8,857,791.18 Baht.

THE CERTIFICATION OF LOCALLY-MANUFACTURED PRODUCTS

During 1953-1954, 64 kinds of merchandise were sent in for analysis and approval; of this total, 28 kinds had previously been approved, only 36 were new products. The followings are the merchandise analysed by the Department of Science during 1953-1954.

1953				1954			
Product	Kind	Certified	Not Certified	Product	Kind	Certified	Not Certified
Cosmetics	13	13	—	Cosmetics	19	18	1
Foods	11	5	6	Foods	8	6	2
Distilled Water	2	1	1	Distilled Water	1	—	1
Soap	1	1	—	Detergents	1	—	1
Plasticene	1	1	—	Stencil Correcting Ink	1	—	1
Oxygen Gas	1	1	—	Ink (blue)	1	1	—
				Dry Cells	7	7	—

GENERAL REVIEW

The Department of Science started moving its facilities to the new office at the beginning of 1953. The transfer of the major part took about three months, since special precaution in handling and installation of all delicate scientific instruments had to be observed. Despite all these time-consuming handicaps, statistics indicated an increase in the number of samples submitted for analysis, i.e., 2,468 samples in 1953 and 2,943 in 1954.

After long discussion and exhaustive efforts, the Department of Science was (in April 1953) able to reorganize its many and diverse functions by the Royal Decree. This change caused all apparatus to be regrouped and placed in the right divisions, thus making full use of the instruments possible and thereby increasing the efficiency of its tasks. Though the change, brought about by the Royal Decree, is not entirely as originally planned, it may be considered as an advanced step towards better functioning of the Department.

During the period of this report, nine scientific officers joined the staff of the Department. Five of the scientific officers were transferred to other departments and four resigned, making no change in the total number of technical personnel. There were 13 new non-technical staff officers, 10 resigned or being transferred, resulting in an increase of 3 officers of this category. The Department had altogether 82 officers, ranging from third grade officials upwards and had 3 vacant positions to be filled. There have been 17 officers studying or attending conferences abroad, of which 15 have returned. These officers, with their knowledges and experience gained abroad will, certainly, contribute a great deal towards the carrying out of the tasks of the Department of Science.

The Office of Secretary of the Department has improved its opération by the establishment of a Registration, Finance, Store and Statistics Section according to the newly organized

system. Besides its routine work, it had to help in organizing the meetings of many committees whose members were staff of the Department.

With its still insufficient funds, the Library Section had to stop ordering publications which were not of essential importance. However, it was believed that if every scientific institute would co-operate closely in acquiring technical publications systematically, there would be more complete varieties available for all, at less individual expenses since duplications would be avoided.

After the reorganization, the Division of Analytical Chemistry Training was, in 1954, permitted to extend its course from 2 to 3 years. A Graduate would receive a diploma and would be engaged as a third grade official at a starting salary of 90 Baht instead of fourth grade official at 70 Baht. The curriculum was revised accordingly both in theory and practice. It is, therefore, believed that this improvement will attract more students to attend this course.

During the period of this report, the Division of Chemistry received the highest number of samples for analysis, namely 3753 samples. This was attributed to the increasing number of wells sunk for both drinking and industrial purposes.

The Division of Biological Science was newly established in 1953 by the Royal Decree, and was assigned most of the work of the dissolved Division of Industrial Chemistry. Owing to the Ministry of Public Health's new Regulations, there was a sharp increase in the number of samples of non-alcoholic beverages sent in for analysis. Only a few samples were found able to meet the requirements of the new Regulations. In co-operation with the Factory Control Division, Ministry of Industry and the Health Department, Ministry of Public Health, inspectors were sent out to observe the manufacturing processes and take samples for analysis, with a view to advising the public regarding their health and safety in the consumption of these increasingly popular drinks. At the same time, the Division of Biological Science prepared some concentrated fruit juices which found considerable popularity among the public, and were believed to be able to compete with other similar types of drink if the production would be expanded to cope with a large demand.

Physics and Engineering was also a newly established Division receiving part of the work from the old Divisions of Industrial Chemistry and Industrial Research. Its duties include physical tests, operating the Department's workshops and testing of Industrial processes (semi-pilot scale). During the period of this report, the Division had a special work of transferring and installing all equipments from the old office to the new building. New instruments and the Government Alum Plant were also installed and erected under the supervision and responsibility of the Division of Physics and Engineering.

The duty of the newly formed Division of Research is to find the applicabilities and uses of raw materials available in this country. Some of the more interesting subjects will be briefly discussed in this report. Other problems deserving mention here are; the process testing and the control of raw materials for and products of the Government Alum Plant; research on ceramics which resulted in Governmental permission to build a Ceramics Factory, which was also planned and designed almost entirely by staff of the Division of Research. Table salt, perfume, writing ink and shoe polishes were produced on a small scale with a view to demonstrate to interest the public the feasibilities as commercial possibilities. If funds were available and full scale plants built, these products could certainly compete with imported goods, both in quality and in price.

During the period of this report, an Alum Plant was built. The machinery was purchased in Japan by the Director-General and the Chief of the Division of Physics and Engineering by special permission granted by the Council of Ministers. At the time of writing this report, most of the construction and installation has been completed and a trial run will be made shortly.

As far as co-operation with other scientific organizations is concerned, an annual scientific exhibition and conference was jointly arranged by the Department of Science and the Thai Science Society in 1953, under the chairmanship of the Director-General.

The Director-General attended a UNESCO conference in Paris and an International Conference on Agriculture and Food

Industries in Madrid. Five representatives from the Department attended a symposium on Problems in Scientific Research and a conference of Directors of National Research Councils sponsored by UNESCO in Italy; and lastly, the Director of the Division of Biological Science attended the third meeting of the Technical Committee on Lac and Shellac in London.

At all times, the Department of Science has tried its best to serve the public in technical fields. The Department has always encouraged its staff to send in scientific papers for broadcasting and publication in various scientific magazines and journals. In order to keep the public well informed, the Department of Science issues a quarterly "Department of Science Bulletin", and monthly broadcasts scientific work accomplished. In addition, the Thai Science Society and the Department of Science jointly arrange for the program "Science for the Public" to be broadcasted monthly.

In all, it can be said that the work of the Department of Science has steadily progressed, both in quality and quantity, yet it still hopes that it can render more service to the people and the nation in the future.

The following are summaries of the work of each division. Further details, if required, will be given on request at the Department of Science, Phya Thai, Bangkok.

OFFICE OF SECRETARY OF THE DEPARTMENT

Secretary — Siri Chuvidhya, B.S.C.

Registration Section

Chief of Section — Ong Thadasih

Besides routine correspondence, other duties may be summarised as follows:-

1) Technical Matters.

The Registration Section made available:-

a) Reports on analyses requested by other Governmental Departments, Organizations and Public.

b) Textbooks for students of the School of Analytical Chemistry Training.

c) Research papers on researches and material testings.

d) The Department's Reports, Bulletins, Articles for broadcast and answers to all inquirers.

The Section also published the reports of committees and societies, some of whose members were staff of the Department of Science.

2) Compilation of Statistics.

3) Registration of Officers of the Department.

4) Drawing and duplicating maps and plans.

5) Filing and classifying of technical papers.

Finance Section

Chief of Section — Mani Nutaman

Income and expenditure of the Department of Science during the years 1953 and 1954 are shown below:—

Expenditure

		1953	1954
Budget	Baht	2,565,696.00	6,575,560.00
Actual expenditures	Baht	2,535,328.67	6,240,527.86
Surplus	Baht	30,367.33	275,032.14

Income

The Department of Science received 64,763.22 Baht in 1953 and 101,304.94 Baht in 1954 as analytical and miscellaneous fees, and from the sale of the Department's experimental products.

Store Section

Chief of Section — Siri Suvanpathma

The Store Section purchased 132.114 kg. of chemicals and 6,087 pieces of equipment in 1953 and 466.044 kg. of chemicals and 1,746 pieces of equipment in 1954.

Library Section

Chief of Section — Miss Proesiri Bhekanandhana, B.A.

The Department's Library was reorganized in 1940. Its present collection includes 3,112 textbooks, 4,529 scientific papers and 1,490 bound and 6,654 unbound periodicals.

The publications were either purchased from the Department's fund or resulted from exchanging the Department's Reports through U.S.B.E. or directly with foreign scientific organizations. Some of the publications were gifts from individuals both in this country and abroad.

The Library also published the Department's "Thai Science Bulletin" Vol. 7, No. 1 for distribution, sale and exchange with publications of other organizations throughout the world.

Besides its own staff, the Department of Science's Library also rendered its service to members of other departments,

organizations, institutes and universities. Statistics of outside individuals requesting the use of the Department's Library shew an increase, i.e. from 650 in 1953 to 710 in 1954.

DIVISION OF CHEMISTRY

Senior Scientific Officer, Chief of Division	Luang Vichien Dhatukarn, L. ès Sc., I.C.
Senior Scientific Officer	Banbota Sudhikam, B.S. (Chem.)

Opium Section

Scientific Officer, Chief of Section	Surin Milindalekha, Dip. Pharm.

By law and by agreement, opium analysis is the duty of the Department of Science. The analysis is used in the control of opium quality and setting of the purchase price of opium. The Opium Section also helped in analysing exhibits used as evidence in prosecution. The number of samples sent in for analysis in 1953 and 1954 were 645 and 598 respectively.

Forensic Chemistry Section

Scientific Officer, Chief of Section	Vacant

Most of the work in this Section concerned exhibits sent over from the Police Department in connection with crimes committed. After obtaining the results, an officer from the Department had to be present as witness in court. Such samples comprised fire-arms, substances suspected of poisons, drugs, semen, and blood stains. The total samples analyzed in 1953 and 1954 were 210.

Water Section

Scientific Officer, Chief of Section — Pravat Isarankura Na Ayudhya, Dip. Ed. Sc.

It is understandable that water plays an important part in the progress of the modern world. Good potable water and water for industrial uses is increasingly on demand. It is one of the duties of the Department of Science to analyze water for such purposes. In 1953, 221 samples were sent in and 3,978 tests were made. This figure increases to 354 samples in 1954 when 6,372 analyses were made, representing an increase of more than 60% over the previous year.

	1953		1954	
	Number of Samples	*Number of Analyses*	*Number of Samples*	*Number of Analyses*
1) *From Governmental Institution*				
Well water	16	288	36	648
Pond water	7	126	12	216
Municipal water	157	2,826	235	4,230
Water Works	14	252	23	414
Mae Wang water	2	36	—	—
Sewage Effluent	1	18	—	—
Total	197	3,546	306	5,508
2) *From Private Concerns*				
Well water	23	414	27	486
Pond water	1	18	6	108
Water Works	—	—	15	270
Total	24	432	48	864
Grand total	221	3,978	354	6,372

Metals and Alloys Section

Scientific Officer,
Chief of Section — Vongse Naewbanij, A.A.

Apart from its legal duty of analyzing raw materials and coins for the Royal Mint, the Metals and Alloys Section analyzed materials for use in the evaluation of tariff for the Custom Department and in the purchases of the State Railway of Thailand, State Highways Department, Department of Interior and the Cane-Sugar Organization. The Metals and Alloys Section also helped in analyzing metal submitted by the Department of Mines, e.g., 4 gold samples were analyzed in 1954.

In 1953, 188 analyses were made on 141 samples sent in by governmental departments and public bodies. The figures increases to 240 samples and 378 analyses in 1954.

	1953		1954	
	Number of Samples	*Number of Analyses*	*Number of Samples*	*Number of Analyses*
1) *From the Royal Mint*				
Tin	38	38	75	83
Copper-Aluminium Alloy	—	—	30	48
Tin-Copper Alloy	—	—	4	8
Iron	7	7	—	—
Aluminium	4	4	13	23
Copper	15	15	7	7
Total	64	64	129	169

	1953		1954	
	Number of Samples	*Number of Analyses*	*Number of Samples*	*Number of Analyses*
2) *From other Governmental Bodies*				
Antimony	1	1	9	9
Tin	12	12	6	6
Lead - Copper Alloy	—	—	1	4
Lead	4	6	36	41
Iron and Steel	7	26	13	45
Ferro - Silicon	1	2	1	1
Aluminium	3	14	8	32
Magnesium oxide	—	—	3	15
Ferro - manganese	—	—	1	2
Copper	9	9	4	4
Silver	—	—	7	7
Zinc	6	6	4	5
Gold	—	—	4	4
Other Alloys	5	17	5	25
Total	48	93	102	200
3) *From Public Bodies*				
Lead	—	—	1	1
Zirconium	—	—	1	1
Copper	—	—	2	2
Silver	28	28	5	5
Other Alloys	1	3	—	—
Total	29	31	9	9
Grand total	141	188	240	378

Minerals and Ores Section

Scientific Officer,
Chief of Section — Miss Viyada Panyararjun, B.Sc.

For the exportation of national resources such as minerals, samples must be analyzed by the Department of Science for use as a basis in the tariffing of the Custom Department. The Minerals and Ores Section also helped in analyzing and giving advice requested by other departments and organizations as to the uses and properties of mineral and ores.

	1953		1954	
	Number of Samples	*Number of Analyses*	*Number of Samples*	*Number of Analyses*
1) *From Governmental Bodies*				
Wolfram ore	51	51	76	76
Antimony ore	6	6	8	8
Lead ore	28	28	43	45
Monazite Sand	1	1	—	—
Asbestos	—	—	1	1
Pyrite	—	—	1	1
Monasite	—	—	4	4
Calcite	—	—	1	1
Slate	—	—	1	1
Total	86	86	135	137
2) *From Public Bodies*				
Wolfram ore	15	21	18	18
Antimony ore	6	13	2	4
Ilmenite	2	4	—	—
Tin ore	2	2	13	13

	1953		1954	
	Number of Samples	*Number of Analyses*	*Number of Samples*	*Number of Analyses*
Lead ore	1	1	—	—
Monazite Sand	1	1	—	—
Asbestos	1	3	—	—
Iron ore	5	5	—	—
Mixed ores	1	2	—	—
Shelite	—	—	1	2
Total	34	52	34	37
Grand total	120	138	169	174

Fuel and Lubricant Section

Scientific Officer,
Chief of Section — Puan Proysuwana, Dip.Chem.

Fuels analyzed ranged from gaseous fuels such as oxygen and acetylene to solid fuels such as lignite, charcoal, wood etc. Lubricants included oils, greases and graphite. Other types of oil such as creosote and paint oils, were also analysed by this Section. Numbers of analyses made were 459 and 595 in 1953 and 1954 respectively.

	1953		1954	
	Number of Samples	*Number of Analyses*	*Number of Samples*	*Number of Analyses*
1) *From Governmental Bodies*				
Lubricant	18	167	28	194
Gasoline	—	—	6	26
Linseed oil	23	23	11	15

	1953		1954	
	Number of Samples	*Number of Analyses*	*Number of Samples*	*Number of Analyses*
Coke	12	57	16	39
Stand oil	—	—	1	1
Fuel oil	9	72	18	79
Diesel oil	6	60	13	79
Coal	1	2	—	—
Lignite	4	17	2	10
Chaff	1	2	—	—
Charcoal	6	12	50	100
Paint oil	1	1	—	—
Compressed air	2	3	—	—
Coconut oil	—	—	1	6
Petroleum	2	2	—	—
Compass fluid	1	1	—	—
Sand	1	1	—	—
Fire extinguisher chemical	1	1	—	—
Creosote	1	6	1	6
Graphite	—	—	4	4
Total	89	427	151	559

2) *From Public Bodies*

Lubricant	—	—	2	2
Pea-nut oil	—	—	1	1
Coke	—	—	2	7
Fuel oil	1	5	2	2
Coal	—	—	5	21
Lignite	1	6	—	—
Chaff	1	7	—	—
Charcoal	5	5	—	—
Coconut oil	—	—	1	2

	1953		1954	
	Number of Samples	*Number of Analyses*	*Number of Samples*	*Number of Analyses*
Carbondioxide	1	1	1	1
Agol oil	1	8	—	—
Total	10	32	14	36
Grand total	99	459	165	595

General Analysis Section

Scientific Officer, Chief of Section — Mrs. Boonlom Tevayananda, B.Sc.

Scientific Officer, — Chalad Virayodhin

The work of this Section is to analyse samples which cannot be classified in other sections. Such samples were coconut cakes, textiles and fabrics, insecticides, etc. Samples may be roughly divided into 2 groups according to source, namely, samples that were sent from governmental organizations and those whose analysis was requested by public organizations. The total analyses made were 1,146 in 1953 and 1,186 in the following year.

	1953		1954	
	Number of Samples	*Number of Analyses*	*Number of Samples*	*Number of Analyses*
1) *From Governmental Bodies*				
Unsweetened evaporated milk	11	22	—	—
Soap	1	1	33	213
Lime	—	—	1	7
Pyrethrum	—	—	4	4

	1953		1954	
	Number of Samples	*Number of Analyses*	*Number of Samples*	*Number of Analyses*
Shampoo and Permanent wave solution	—	—	10	10
Automatic lighter fluid	—	—	1	1
Sweetened condensed milk	17	17	—	—
Distilled water	—	—	1	1
Collodion	3	3	4	4
Vanoline	—	—	1	1
Milk powder	3	6	—	—
Pru (Scleria oryzoides, Presl.)	—	—	4	4
Hemostyl syrup	1	1	1	1
Synthetic oil	—	—	1	1
Sand	1	7	1	1
Plasticene	1	1	—	—
Castor-seed	—	—	7	7
Soda ash	2	5	—	—
Paper	2	2	13	13
Caustic soda	8	20	5	10
Brilliantine	9	9	6	6
Tiles	—	—	2	5
Boiled Tung oil	—	—	1	1
Ink	—	—	1	1
Eau de Quinine	2	2	—	—
Metal cleanser	1	1	—	—
White clay	4	12	8	20
Briquette	—	—	1	2
Son-dammar	2	2	—	—
Textile	6	7	20	20
Sulphuric acid	1	1	3	3
Sea water	285	855	174	522
Fertilizer	4	13	—	—
Detérgent	—	—	7	43
Sulphur	2	2	2	2

	1953		1954	
	Number of Samples	*Number of Analyses*	*Number of Samples*	*Number of Analyses*
Bitumen	—	—	1	1
Card board	2	2	2	2
KIK Insect repellant	1	2	1	1
Essence	—	—	2	2
Chemicals, unclassified	6	17	18	55
Limestone	—	—	2	10
Flour	—	—	3	6
Pigment (Red lead)	2	4	—	—
Semi-drying oil	—	—	1	2
Kirilac	1	1	3	3
Insecticides	1	1	5	5
Kapok seed	—	—	2	2
Face powder	4	4	4	4
Paint	8	8	27	27
Disinfectant	1	1	—	—
Cement	1	1	2	2
Rubber compound	—	—	3	3
Thinner	—	—	2	2
Dry cell	—	—	7	7
Iodizer	—	—	1	1
D.D.T. powder	14	56	—	—
Total	407	1,086	398	1,038

2) *From Public Bodies*

Standard solvent	21	21	18	18
White clay	1	3	1	2
Lithopone	—	—	2	4
Rotinone	1	1	—	—
Refined paraffin	2	2	—	—
Fertilizer	4	10	3	3
Detergent	1	3	1	1

	1953		1954	
	Number of Samples	*Number of Analyses*	*Number of Samples*	*Number of Analyses*
Chemicals	2	4	1	1
Damaged goods	6	6	4	4
Insecticide	—	—	2	2
Coconut cake	2	2	—	—
Cement	1	8	15	113
Total	41	60	47	148
Grand total	448	1,146	445	1,186

DIVISION OF BIOLOGICAL SCIENCE

Senior Scientific Officer — Pue Rochanapurananda, B.S. (Chem), Dip. Ind. Chem., Bachelor of Law.

The Division of Biological Science was established in 1953 and subdivided into 4 sections, namely Biochemistry, Plant Chemistry, Nutrition and Beverage, and Microbiology.

Its duties include research and routine analysis. Statistics of samples analyzed were 546 samples in 1953 and 592 samples in 1954.

The following is some of the more interesting work of this Division.

Biochemistry Section

Scientific Officer,
Chief of Section — Mrs. Phannipa Varavej, B.Sc.

1) *Rapid Process of Fish-Sauce Preparation* (*Re. No.* 90)

This was a continuation of the work started by the Division of Industrial Chemistry. The experiments were carried out with and without the fat being pre-extracted and at various pH values, by neutralizing hydrolyzed fishes with alkali. Results shew that fish, the fat of which had previously been extracted yielded higher quality fish sauce and that the suitable pH value should not be greater than 6.

Sauces from soy-bean and pea-nut cake were also produced by a similar method and found to give satisfactory results. Greengram cake from a vermicelli factory was also tried, but a good result was not obtained.

During the period of this report, certifications were requested for two samples of fish sauces, one of which was granted and the other which was turned down with the recommendation for further improvement.

2) *Vitamin B_1*

This work was supervised by Group Captain Dr. Swasdi Srisuk by kind permission of the Royal Thai Air Force. At this stage, work was aimed at determining the vitamin B_1 contents in different varieties of Thai rice before and after milling and polishing.

3) *Adhesive Paste*

Owing to the high price of imported adhesive paste, the Ministry of Industry suggested that the Department of Science produce the paste from raw materials available in this country. Experimental results were very satisfactory and production will be increased to commercial scale in the near future.

Plant Chemistry Section

Scientific Officer,
Chief of Section — Mrs. Vilai Devakul

Scientific Officer — Mrs. Anu Osathanonda, B.S. (Bot.)

1) *Borneol from Turpentine (Re. No. 91)*

Borneol is usually obtained from Dryobalanops camphora Colebr., a plant in Dipterocarpaceae family, found in Sumatra, Borneo and Malaya. Borneol might be synthesized from camphor which is, in turn, obtained from Laurus camphora or synthesized from turpentine. Since turpentine is abundant in this country, it was obvious, therefore, to use turpentine as a starting material in the synthesis of Borneol.

The turpentine used in this experiment was kindy given by Luang Samarnwanakij of Kasetrasart University, Bangkok. The procedure of the synthesis may be summarized as follows:-

The dried and fractionally distilled turpentine was esterified with oxalic acid in carbon tetrachloride, using aluminium chloride as catalyst. The ester was separated, dried and distilled. The Bornyl oxalate thus obtained was subjected to alkaline hydrolysis, and afterwards steam distilled. Crystallization was carried out in distilled water. Final purification was conducted by recrystallization from petroleum ether.

Another procedure was also tried using boron oxide as catalyst without carbon tetrachloride. The reaction was found to be as vigorous as in the case of using aluminium chloride.

Both methods gave satisfactory yields.

It should be acknowledged here that the entire project was carried out under a supervision of Dr. Satang Mongkolsuk, of the Department of Pharmaceutical Science, Medical University.

2) *Bark and Leaf from Singapore Almond (Terminalia catappa. Linn.) as Dyeing Agent (Re. No. 92)*

It has been long known that bark and leaf from Singapore Almond give kha-ki colour, which is becoming increasingly popular. Studies were made by the Division of Chemistry using alum and ferrous sulphate as mordant. The results obtained were quite satisfactory. The Plant Chemistry Section took this work over and tried to improve the fastness of the colour using both dry and fresh leaf and bark. As for mordant, a new method was tried using, successively, alum, tannic acid and potash alum, which resulted in a better colour and increased fastness.

Studies on this subject will be continued, and results will be published later.

3) *Properties of Lac (Re. No. 74)*

Studies on properties of various kinds of Lac received from the Royal Forest Department were made. Results, when completed, will be published in the next issue.

Nutrition and Beverage Section

1) *Composition of Thai Food*

Analyses on various kinds of Thai Food were previously published by the old Division of Industrial Chemistry. The work was continued by the Nutrition and Beverage Section. Additional results are shown below.

Composition of Thai Foods

Item	Ash %	Moisture %	Fat %	Protein (Nx6.25) %	Residue %	Carbohydrate (by Subtraction) %	Calories per 100 g.	Iron in mg. per 100 g.	Phosphorus in mg. per 100 g.	Calcium in mg. per 100 g.
Glutinous rice from mobile mill	0.7	10.9	0.6	7.1	0.4	80.3	355.0	—	121.2	28.8
Glutinous rice bran from mobile mill	15.6	7.7	5.5	6.6	27.0	37.6	226.3	—	612.1	74.0
Glutinous rice from large mill	0.5	10.4	0.9	7.4	0.2	80.6	360.1	—	114.4	18.7
Finely broken glutinous rice	1.6	10.1	3.2	9.1	0.7	75.3	366.4	—	338.5	15.2
Coarsely broken glutinous rice	0.6	11.1	1.1	6.7	0.3	80.2	357.5	—	134.9	14.1

Item	Ash %	Moisture %	Fat %	Protein (Nx6.25) %	Residue %	Carbohydrate (by Subtraction) %	Calories per 100 g.	Iron in mg. per 100 g.	Phosphorus in mg. per 100 g.	Calcium in mg. per 100 g.
Glutinous rice bran from large mill	10.2	9.6	18.5	3.7	7.9	50.1	381.7	—	2178.9	152.1
Black glutinous rice	1.5	13.8	2.9	9.0	1.0	71.8	349.3	49.1	284.9	—
Job's - tears	1.0	10.8	2.7	14.8	0.3	70.4	365.1	30.1	207.3	—
Bran powder	8.3	10.0	18.0	11.9	7.1	44.7	388.4	—	1800.0	90.0
Enriched rice	1.1	10.9	2.5	11.2	1.3	73.0	359.3	—	289.1	26.4
Rice flour	0.8	10.6	0.9	7.4	0.4	79.9	357.3	—	—	—
Sago	0.4	13.2	0.1	0.2	—	86.1	346.1	—	2.9	23.9
Black bean	3.5	9.3	0.3	23.8	4.6	58.5	331.9	16.5	479.1	56.9
Black sesame	4.5	5.3	46.3	21.9	9.9	12.1	552.7	45.3	662.3	178.0
Green onion	0.8	91.1	0.3	2.0	1.1	4.7	29.5	7.3	33.0	47.3
Tomato	0.7	93.2	0.3	1.1	1.2	3.5	21.1	4.9	31.4	2.3
Ma-khu'a-phuang (Solanum torvuna, Swartz)	1.4	77.6	0.4	0.1	8.3	12.2	52.8	7.5	84.7	77.6
Onion	0.5	91.8	0.1	1.4	0.6	5.6	28.9	8.0	26.6	8.4
Basil leaf	1.4	90.1	0.7	3.0	1.3	3.5	32.3	6.1	48.5	83.0
Buab-liam (Luffa acutangula, Roxb.)	0.4	95.4	0.2	0 7	0.3	3.0	16.6	0.7	23.8	4.7

Lettuce	1.1	92.7	0.4	2.0	0.8	3.0	23.6	4.9	39.3	16.4
Celery	1.5	93.3	0.5	1.6	0.9	2.2	19.7	13.7	40.1	92.5
Dried Chinese flower	3.5	17.7	1.3	11.0	5.6	60.9	229.3	32.6	250.7	49.9
Scallion	0.6	83.9	0.2	2.7	0.6	12.0	60.6	4.4	59.4	16.0
Coriander seed	6.4	13.1	0.6	13.6	39.7	26.6	166.2	63.0	495.3	512.2
Fennel	8.1	14.4	0.6	14.5	26.8*	35.6	205.8	26.8	471.8	607.6
Mace	2.7	19.6	15.4	14.2*	9.7	38.4	349.0	67.4	141.6	133.7
Nutmeg	2.2	13.7	35.1	7.5	3.3	38.2	498.7	25.5	215.3	1.6
Cardamom leaf	5.1	9.8	6.3	9.5	29.6*	39.7	253.5	125.5	23.4	16.3
Cinnamon	4.0	15.1	1.0*	3.3	15.4	61.2	267.0	22.2	46.3	16.6
Rhizome	1.3	86.2	0.8	1.3	1.2	9.2	49.2	23.1	71.4	80.1
Galanga	0.7	85.0	0.5	0.2	2.2	11.4	50.9	20.5	5.7	—
Het-hu-nu (Auricula judae, Fungi)	4.2	14.7	0.6	4.3	6.8	69.4	300.2	107.0	233.2	261.9
Bean Sprout	0.5	90.0	0.1	2.8	0.7	5.9	35.7	18.5	84.8	27.0
Garlic	1.2	63.1	0.1	5.6	0.9	29.1	139.1	5.4	140.3	4.9
Pepper	1.7	11.6	6.6	11.3	3.8	65.0	364.6	3.2	164.3	52.8
Tamarind	2.4	24.3	1.5*	0.2	4.2*	67.4	283.9	4.4	103.3	104.4
Tong-choy	17.4	57.4	0.8	4.7	3.7	16.0	90.0	44.9	79.9	21.4
Curry powder	25.8	81.1	7.0	7.1	6.3	45.7	274.2	—	72.1	7245.5
Palo powder	6.3	11.3	8.3	1.9	23.9	48.3	275.5	71.0	571.9	497.4
Mustard	3.8	4.0	28.4	31.0	1.5	31.3	504.8	26.1	900.5	3.4
Thai vermicelli	0.2	77.4	—	1.5	—	20.9	89.6	0.2	7.7	—

Item	Ash %	Moisture %	Fat %	Protein (Nx 6. 25) %	Residue %	Carbohydrate (by Subtraction %	Calories per 100 g.	Iron in mg. per 100 g.	Phosphorus fn mg. per 100 g.	Calcium in mg. per 100 g.
Pig—heart	0.8	65.3	17.0	13.9	0.1	2.9	220.2	2.5	150.2	5.1
Fresh duck	0.5	70.2	16.2	13.4	0.1	—	199.4	8.7	123.0	—
Fresh chicken	1.0	75.9	1.4	21.0	0.1	—	96.6	7.1	195.6	3.1
Fresh sea mussel	2.4	85.5	0.9	8.1	0.1	3.0	52.5	15.6	184.2	26.5
Dried Chinese cuttle fish	4.6	23.3	3.9	63.9	0.2	4.1	307.1	19.0	990.6	41.7
Fresh Serpent-head fish	1.2	73.1	3.8	20.5	0.1	—	116.2	5.8	218 2	30.7
Fresh Feather-back fish	1.4	75.4	4 7	19.1	—.	—	118.7	8.2	267.1	93 2
Sadine (Pla-Rang-Koey)	18.9	9.6	5.9	60.0	0.3	—	—	221.6	2.7	5.5
Dab	23.8	8.5	4.7	61.0	0.2	—	—	204.8	3.9	70.0
Sadine (Pla-Ok-ku-lae)	19.6	8.9	5.3	64.6	0.5	—	—	142.9	2.9	4.6
Non-salted Dab powder	19.0	10.6	5.9	64.4	nil	nil	310.7	370.0	3527.0	3479.4

Item	Ash %	Moisture %	Fat %	Protein (Nx 6.25) %	Residue %	Carbohydrate (by Subtraction) %	Calories per 100 g.	Iron in mg. per 100 g.	Phosphorus in mg. per 100 g.	Calcium in mg. per 100 g.
Salted Dab powder	41.69	16.1	4.7	37.7	nil	nil	193.1	258.0	2845.1	3443.5
Non-salted mixed fishes powder	21.9	12.7	10.1	55.3	0.9	—	312.1	—	2.6	4.5
Salted mixed fishes powder	23.4	28.4	8.7	28.5	1.4	—	192.3	—	1.3	2.3
Ground oyster shell	—	—	—	—	—	—	—	—	41.2	31.0
Tapioca dross	2.37	13.63	0.23	1.42	6.94	75.41	309.39	—	minute traces	370.0
Ground bone	58.8	6.9	3.3	27.8	0.6	2.6	151.3	—	10.5	21.9

Remarks: 1) All analys as made here were only on edible portions.

2) Doubtful figures due to insufficient quantity of samples analysed are shown with*.

2) *Animal Feeds*

Analyses were made in co-operation with the Department of Livestocks Development and Thai Fisheries Organization, whose factory is in Chumporn. Results are summarised below.

Composition of Animal Feeds

Item	Ash %	Moisture %	Fat %	Protein (Nx 6.25) %	Residue %	Carbohydrate (by Subtraction) %	Calories per 100 g.	Iron in mg. per 100 g.	Phosphorus in mg. per 100 g.	Calcium in mg. per 100 g.
Pea-nut dross	6.7	9.6	6.9	41.8	4.7	30.7	348.5	—	692.3	143.6
Coconut dross	5.7	9.4	12.8	20.8	10.4	41.5	363.2	—	527.3	94.2
Broken rice	1.9	9.3	6.9	10.4	0.8	70.7	386.5	—	362.2	306.2
Corn	1.3	9.6	4.6	10.2	2.5	71.8	369.4	—	308.6	41.3
Grass:										
Alabang x grass	4.4	59.6	1.8	1.5	22.2	10.5	64.2	—	86.6	traces
Molasses grass	4.6	65.1	1.8	1.3	17.2	10.0	60.4	—	78.9	traces
Sweet Sudan grass	4.0	80.4	0.6	1.3	5.7	8.0	42.6	—	148.1	53.9
Coated Burmuda grass	3.8	63.8	0.9	2.2	11.8	17.5	86.9	—	77.3	58.9
Alfalfa grass	5.9	67.1	0.7	3.0	7.9	15.4	79.9	—	166.6	125.7
Clover grass	3.1	68.8	0.5	3.4	8.4	15.8	81.3	—	188.2	138.6
Buffel grass	20.1	52.6	0.7	1.6	10.9	14.1	69.1	—	94.6	traces
Buffalo grass	3.4	69.2	0.6	1.5	12.5	12.8	62.6	—	129.4	78.2
Pappophomumbicula grass	3.6	46.4	1.1	2.5	15.7	13.1	72.3	—	149.2	26.7

3) *Fruit Juices (Re. No. 93)*

Fruits are plentiful in Thailand, both in variety and quantity. Experiments were made, therefore, to produce juices from fruits readily available. Juices prepared were in the form of concentrates, i.e., they had to be diluted with water before drinking. Satisfactory results were obtained with 'Som-Kliang' (Portugal Orange, *Citrus sinensis*, Osbeck.), 'Som-Khieo-Wan' (King Orange, *Citrus nobilis*, Lour.) and Pine-apple.

4) *Salad Cream (Re. No. 94)*

A survey of Thai diet shows that the people still consume too small a quantity of vegetables. Though vegetables are not kinds of food that will give high calorific value, they contain vitamins and salts necessary to human beings. One way of encouraging the people to eat more vegetables is to encourage them in the form of salads. Imported salad creams are often found to be rancid due probably to the fact that they have been kept at high temperature for too long a period. The Division of Biological Science, therefore, suggested that salad cream be homemade, since it could also be made-up to any desired taste. The right recipe was then published for distribution, and was found to have met with satisfactory reception by the public.

5) *Non-Alcoholic Beverages*

Soft drinks, both carbonated and non-carbonated were becoming increasingly popular in this country. New bottling plants rapidly increased in numbers. In order to safe-guard the health of the public, the Department of Science, therefore, analyzed 84 samples, submitted by the Ministry of Public Health and the Municipality of Bangkok in 1953. Of this total, 60 of

them used salicylic acid as preservative, and saccharine for sweetening. As a result of these findings, a Ministerial Regulation was issued by the Ministry of Public Health in 1953 for the Control of Soft drinks.

In 1954, officers of the Division of Biological Science were sent out to inspect bottling plants and took samples for analysis. Twenty samples still did not conform with the Regulation. The matter was reported to the Ministry of Public Health and fines were imposed accordingly.

6) *Milk*

During the period of this report, the Division of Biological Science analyzed 567 samples of milk, of which 16 samples did not pass the Ministry of Public Health's specifications.

7) *Food Prepared from Fish Powder (Re. No. 95)*

In order to encourage people to consume more fish, methods of preparing foods from fish powder were experimented. The powder was provided by the Department of Fisheries. The flavour was not yet quite satisfactory, however, a slight improvement was gained by using fish powder, newly prepared by the staff of the Nutrition and Beverage Section.

8) *Alcoholic Beverages from the Bang-Yikhan Government Distillery*

There was a rumour that alcoholic beverages of the Bang-Yikhan Distillery contained certain poisonous compounds. The liquors were, therefore, sent to the Department of Science for analysis. The results shown below clearly indicated the presence of neither poisonous matters nor drugs.

	White Whisky	Phya Khang Whisky	Krung-Thon Whisky	Narai Whisky	Me-Khong Whisky	Bangkok-96 Whisky
Alcohol, % by vol.	28.2	28.2	28.5	30.0	35.0	43.0
Methyl alcohol	None	None	None	None	None	None
Fusel oil, %	0.04	0.06	0.03	0.03	0.02	0.01
Lead, Arsenic, Copper	None	None	None	None	None	None
Alkaloids	None	None	None	None	None	None
pH	5.0	5.7	6.5	6.4	4.6	4.7
Sp. gr. at room temperature	0.96	0.96	0.96	0.96	0.95	0.94
Residue, % wt./vol.	0.07	0.87	0.63	0.61	1.58	0.44

9) *Food Values of Glutinous Rices from Small Mobile and Large Mills (Re. No. 96)*

On an official visit to the Northern Provinces of Thailand in 1954, H.E. Lieutenant General Banyad Devahasadin Na Ayuthaya noticed that an increasing numbers of people were suffering from beri beri. The Department of Industrial Promotion's Director-General, who was in the same party confirmed that there was the same situation in the North-eastern part of the country. It was believed that the cause of this illness was probably due to the fact that increasing numbers of people were consuming glutinous rice from small mobile mills instead of domestically milled rice. Samples from various mills were, therefore, sent to the Department of Science for investigation.

The analyses showed that the amount of vitamin B_1 in glutinous rice from amall mobile mills was less than that from large mills, which was, however, still lower than the standard requirements, (i.e. 0.045 mg. of vitamin B_1 per 100 Calories of Proteins and Carbohydrates). Quantities of vitamin B_1 in glutinous rice bran and in broken glutinous rice containing bran were higher than standard value, but, unfortunately, they were not suitable for human consumption.

Since the domestically milled glutinous rice was unpolished, most of the vitamin B_1 was retained, and hence less proportion of consumers were suffering from beri-beri.

Details of this study were published in the August issue of the Science Magazine Volume 8, 1954.

Microbiology Section

Scientific Officer, Chief of Section — Miss Charungchantana Phalajivin, B.S. (Pharm.)

Apart from bacteriological examination of water, the duties of the Microbiology Section may be summarised as follows:-

1. *Experiments on the Culture of Yeast for Alcoholic Liquor* (*Re. No.* 97)

This was a continuation of the work of the Division of Industrial Chemistry. The additional work included the fermentations of alcoholic beverages from ginger, 'Som-Kliang' and 'Som-Khieo-Wan.'

2. *Preservation of Bamboo* (*Re. No.* 98)

In one of the meetings of the National Committee for the UNESCO, it was suggested by a representative of the Women Culture Organization that the use of bamboo should be encouraged if an efficient method of preservation could be found. The matter was delegated to the Microbiology Section who investigated the problem and reported its successful finding to the Women Culture Organization.

3. *Fermentation of Alcoholic Beverage from Broken Rice* (*Re. No.* 65)

A committee was appointed by the Minister of Industry to investigate the possibility of using broken rice instead of high grade rice in the fermentation of alcoholic beverage of the Bang-Yikhan Government Distillery. Experiments were undertaken jointly by the Division of Biological Science and the Division of Physics and Engineering, in conjunction with the staff of the Distillery, using various grades of broken rice and glutinous rice. Results are summarized below:-

a) Using natural ferments, glutinous rice yielded higher percentage of alcohol than non-glutinous white rice.

b) Different grades of rice and glutinous rice give different yields of alcohol.

c) Fermentation of white rice using pure cultured yeasts and moulds gave higher percentages of alcohol than using natural ferments.

The same was not true for the glutinous rice.

Moulds and yeasts used in the above experiments were *Rhizopus* and *Saccharomyces cerevisae* No. 9, respectively.

It was concluded that in the usual fermentative process, high grade broken rice might be used instead of unbroken rice. By using a steam heated closed fermentation pot, provided with stirrer, lower grade broken rice may also give satisfactory results; however, an economic appraisal should firstly be made before venturing into actual production.

Lastly it should be noted, that infested broken rice will never yield high quality beverage, unless methods are found for the elimination of the infestation.

DIVISION OF PHYSICS AND ENGINEERING

Senior Scientific Officer, Chief of Division — Riddhi Subhanka, B.Sc., B.Chem.Eng., M.S. (Chem.Eng.)

The work of the Division of Physics and Engineering include research, testings, and analysis, both routine and general. The work also includes pilot plant operations; photographic services; installation and maintenance of the Department's equipment. The Department's Workshop is also under this Division.

The number of samples analyzed was 95 in 1953 and 250 in the following year. The installed and repaired items were 317 and 1,426 in 1953 and 1954, respectively, and the total number of films developed, printed and enlarged were 945. Apart from work mentioned above, answers were also given to 8 problems.

The following is typical of the work done in each section.

Physics Section

Scientific Officer, Chief of Section. — Chong Bunnag

Apart from routine material testing, the following tests and analyses were made:—

1) Testing of counterfeit Zeiss Umbral eye-glasses.

2) Testing and cleaning of 95 aiming-lenses for artillery.

3) Analysis of tin-ore tailings for Columbium and Tantalum, using Spectrometer, in co-operation with the Department of Mines.

Strength of Material Testing Section

Scientific Officer,
Chief of Section — Vichien Sakoramonkol, Dip.Chem.

The Section has the monthly routine work of testing cement sent over by the Bang-Sue and Ta-Luang factory.

As for research, wood destructive distillations of 'Kong-kang,' 'Sa-mae-tha-le,' 'Ka-thin,' 'Pha yung' and 'Son-tha-le,' were studied with the following results.

Products from Destructive Distillation of Wood

Name	Acid %	Methanol %	Charcoal %	Settled Tar %	Soluble Tar %	Colorific Value Calories per gramme
'Kong-kang' (*Rhizophora candelaria*)	1.5—2.1	1.5—2.1	38.0—42.9	—	—	7,400
'Sa-mae-tha-le' (*Avicennia officinalis*, Linn.)	2.7—2.9	2.7—2.9	37.2—42.9	2.9—4.4	3.1—4.5	6,000—6,700
'Pha-yung' (*Dalbergia cochinchinensis*, Pierre.)	1.8—2.1	1.8—2.1	37.5—41.8	7.1—8.2	4.0—5.0	7,262—7,829
'Ka-thin' (*Leucaena glauca*, Benth.)	1.3—2.1	1.3—2.1	40.0—43.6	3.7—4.3	4.0—4.8	7,200—7,800
'Son-tha-le' (*Casuarina equisetifolia*, Linn.)	1.7—1.9	1.7—1.9	35.0—39.6	5.4—6.8	5.4—7.2	7,330—7,456

Best result was obtained with 'Kong-kang.' 'Kong-kang' and 'Sa-mae-tha-le' are grown along the coastal areas, others may be found elsewhere. After 3-4 years, they can be used for destructive distillation.

Chemical Engineering and Industrial Process Section

Scientific Officer,
Chief of Section — Miss Rungtavan Bunnag, B.S.(Phar.)

In addition to the section's routine analytical work, analyses of coconut and palm sugar for harmful bleaching agents, of leather for lead oxide and sugar, and of nylon for nitrogen were made.

For departmental uses, the Chemical Engineering and Industrial Process Section produced high grade alcohol, using a closely controlled process. The fermentation was made under a definite range of pH value. The sugar content was measured every 24 hours. It was found that the minimum amount of sugar remained after fermentation ended was approximately 2.0% of the total invert sugar. The production of yeast, it was found, could be considerably increased by using purified mould-saccharified glutinous rice water extractive.

By this method the yeast count was found to be much greater than grown under ordinary nutrients.

Research work may be summarized as follows: —

1) In co-operation with the Bang-Yikhan Government Distillery, 84 experiments were made on fermentation of alcohol using broken rice. The results were favourable.

2) Research on Malting of Rice carried out with the Division of Biological Science, to jointly determine a maximum diastatic power in relation to germination.

3) Preparation of Agar-agar from Thai sea-weed (Rayong Province coastal areas). The Agar-agar obtained was white in colour and had no odour, but economic evaluation is still under way.

Work Shop Section

Scientific Officer, Chief of Section	Amara Prachankadee, Bachelor of Law, B.S. (Chem. Tech.)

The work of this section during the period of this report is summarized below:—

1) Supervising the construction of the Department's new building and residences. Moving of all equipment from the old office and decorating all ministerial and departmental exhibiting sites.

2) Repair of more than 190 pieces of instruments and furnitures.

3) Installation of instruments, such as an alcohol still, a wood distiller and an opium shaker, transferred from the old office.

4) Supervising the construction and erection of the Government Alum Plant.

5) Supervising the construction of the Department's fence.

6) Preparing 200 litres of liquid ammonia and 4,248 litres of distilled water for the departmental uses, and 270 litres of distilled water for other governmental institutions.

DIVISION OF RESEARCH

Senior Scientific Officer, Chief of Division	Yos Bunnag, M.Sc.(Lond.), A.R.C.S., D.I.C.
Senior Scientific Officer	Manoon Prachankadee, B.Sc. Chem.
Scientific Officer	Mrs. Sakuntala Bhodhiprasat, B.Sc.
Scientific Officer	Mrs. Rabieb Prachankadee, M.Sc.
Scientific Officer	Miss Priya Chandravekin, B.Sc.
Scientific Officer	Mrs. Nidnoi Sucharitakul, B.Sc.
Scientific Officer	Miss Suradee Bubphaves. B.Sc.

The majority of the work of this Division is applied research. Other types of work include analyses and controls, providing data for enquirers on technical problems. Work done by this Division during this period included 39 research topics, analyses of 246 samples and answering 12 enquiries. Five officers of the Division was appointed lecturers of the School of Analytical Chemistry Training, and staff of the Division were appointed to be members of 36 different technical committees.

Some of the more interesting work can be summarized below.

1) *Fusel Oil (Re. No. 79)*

Fusel oil used was a by-product from the Government Alcohol Plant in Ayuthya. The amyl alcohol, isobutyl alcohol, and normal propyl alcohol fractions were separated from fusel oil, and after esterification to acetate esters could be used in the preparation of high quality stencil correcting fluid and solvent for nail's enamel.

2) *Rice Bran Oil (Re. No. 37)*

Good keeping rice bran oil could be obtained by extracting freshly milled bran (4 hours after milling) with commercial hexane. The yield was approximately 15-20%, included 4% wax. The oil contained about 5-7% of free fatty acids. Its application may be summarized as follows:—

a. Crude oil may be used in soap industry, in the preparation of shampoo, sulphonated oil or Turkey red oil. The last two mentioned are used in the leather printing, and dyeing industries.

b. The bran oil may be purified by alkali refining to eliminate free fatty acids. After bleaching and deodorizing by steam distillation under reduced pressure, the oil may be used for cooking purposes.

c. Hydrogenated rice bran oil may be kept for at least

6 months without losing its good quality.

d. The wax, which is ten times more valuable than the oil itself, may be used in place of carnauba wax for certain purposes, namely, shoe and floor polishing.

It should be noted that, two officers of the Division of Research were trained at the Southern Regional Research Laboratory, U.S.A., and their experiments on a method of decreasing losses in the purification of bran oil by adding ethanol, amines, diamines and polyhydroxy compounds were accepted by the Patent Office of the United States.

3) *Keeping Quality of Coconut and Palm Sugar* (*Re. No.* 55)

Experiments were made and the conclusion could be drawn that coconut and palm sugar with good keeping quality must have low moisture content. A preservative should also be added and its surface coated with paraffin wax.

4) *Separation of Salts from Spent Brine* (*Re. Nos.* 51-52)

With simple equipments easily obtainable, the following salts might be produced.

1) Pure Epsome salt, used as laxative.

2) Magnesium chloride for the preparation of Sorel cement, used in rice polishing stone.

3) Pure, high grade table salt.

5) *Hydrogenations of Vegetable and Animal Oils* (*Re No.* 11)

A. COCONUT OIL.

Both old and freshly prepared coconut oil, singly or mixed with various amounts of other vegetable or animal oils were hydrogenated. Results may be summarized as follows:—

1. With old coconut oil, the hydrogenated oil was not as hard and as white as the freshly made oil.

2. Hydrogenated coconut oil mixed with 10% lard had typical lard odour, was slightly softer than pure hydrogenated coconut oil and could be kept for 5 months before rancidity started.

3. Hydrogenation of a mixture of 10% lard and 90% coconut oil yielded harder product with no lard odour.

4. Hydrogenated coconut oil mixed with 10, 20 and 30% hydrogenated cotton-seed oil gave very much harder products than pure hydrogenated coconut oil, however, increase in quantity of hydrogenated cotton-seed oil did not increase the hardness of the products.

5. Hydrogenation of coconut oil at elevated pressure yielded the same results as those at ordinary pressure.

B. COTTON-SEED OIL.

1. Old and rancid hydrogenated cotton-seed oil could be rehydrogenated. The product obtained was generally harder, but the rancid odour still remained.

2. Cotton-seed oil containing anti-oxidant required longer time of hydrogenation.

C. RICE BRAN OIL.

Impure rice bran oil had longer time of hydrogenation than the pure one. This was due to the poisoning of catalyst by the impurities. Hydrogenation at elevated pressure gave white, odourless product within a short period ($1\frac{1}{2}$ hours).

d. Hydrogenation of lard at normal pressure for 10 hours yielded white, hard and odourless product.

e. Hydrogenation of pea-nut oil for 10 hours, yielded white, hard and odourless product.

f. Hydrogenation of olive oil for 5 hours, yielded hard, yellowish-white product with agreeable odour.

g. Hydrogenation of sesame oil for 5 hours, yielded hard, yellowish-white product with pleasant characteristic odour.

h. Hydrogenation of fish-liver oil for 10 hours yielded hard, yellowish-white product without any odour.

6) *Hydrogenation of Para-Rubber Oil (Re. No. 46)*

Seventeen hydrogenations totalling 750 hours were made on a condensate of Para-Rubber smoked sheet destructive distillation. The hydrogenated oil was then redistilled, yielding 65% diesel oil and approximately 35% gasoline. The gasoline, it was found, could be used satisfactorily when tested on the Department's water pumping engine.

7) *Hydrogenation of Oil Obtained from Yang Oil Distillation (Re. No. 45)*

Single hydrogenation on distillate yielded oil which polymerized in less than a year. Six further hydrogenations total 122 hours gave lighter product with superior general properties and might be kept without polymerization for more than 5 months. The oil might satisfactorily be used in diesel engine.

8) *Destructive Distillation of Lignite (Re. No. 81)*

Percentages of coke, tar, moisture and volatile gases obtained were recorded. The coke still contained a certain amount of volatile gases due to insufficiently high coking temperature. The volatile gases contained approximately 10% SO_2 and 12% CO_2, which after proper scrubbing with alkali solution, could be used in Bunsen burners. The tar content was approximately 2%, similar to that obtained from other foreign lignites.

9) *Yeast for Use as Animal Feed (Re. No. 53)*

Dry compressed yeast, with moisture content less than 12%, contained no harmful substances and could be used for feeding animal. Its analysis on food values is as follows:—

Moisture content	11.7 %
Crude fibre	3.2 %
Carbohydrate	70.9 %
Protein	3.4 %
Fat	2.7 %
Ash	8.1 %

CaO	0.26 %
P_2O_5	0.29 %
Fe_2O_3	0.26 %

10) *Cellulose from Rice Straw* (*Re. No.* 83)

Crushed rice straw was digested with alkali salt solution. It was then washed with sulphite and bicarbonate of soda, and bleached with sodium hypochlorite containing 4% available chlorine. It was again washed with several reagents and dried under reduced pressure at 50°C. The yield was approximately 54% of the total straw.

The cellulose thus obtained is under further study with a view to finding applications in industry.

11) *Paper Board from Jute Waste* (*Re. No.* 62)

Jute waste was bleached and made into paper board. The pulp content was approximately 50% and the paper obtained was white and strong, having favourable properties comparable to other types of fibres.

12) *Experiments on Manufacturing Process of Alum Used in Water Works* (*Re. Nos.* 70-71)

White clay, calcined at 500°-700°C, was heated with 75-80% of 50°-60° Be′ sulphuric acid at 100°-110°C for three hours. The yield of aluminium sulphate was almost 100% and containing less than 1% of free acid. The process was suitable for full scale industrial development.

13) *Rice malt* (*Re. No.* 84)

A study was made on the preparation of malt from various kinds of rice, namely, 'Sai-Boua-wi,' 'Poung-Madeor,' 'Karb-Dum,' 'Bang-Pra,' 'Kao-laung,' 'Kao-proa,' and 'Sampour-tong.' The results may be summarized as follows:—

1. Rates of growth were not the same, the 'Poung-Madeor' rice, having largest grain, grew fastest.

2. The longer, the sprout, the higher the enzyme α-amylase value (in contrast with the barley which is richest in enzyme when the grain starts to grow). This enzyme value depended on the length of the sprout and the time of germination.

Apart from the research work, analyses were made on the following samples:—

	No. of Samples
1) Determination of fastness of grey garberdines	3
2) Clothes	4
3) Napalm	1
4) Fertosan Compost Accelerator	1
5) Fertosan Poultry Land Cleanser	1
6) Dye	1
7) Tin ore	1
8) Determination of Tar content in Lignite	2
9) Salt-Lick Soil	3
10) Wolfram ore	1
11) White clay	47
12) Tin and coins	4
13) Sulphuric acid	3
14) Paint	4
15) Corn flour, Tapioca flour	3
16) Straw	2
17) Rock	2
18) Rice hull	1
19) Alum	120
20) Enzyme in various kinds of Rice Malt	40
21) Fire brick	1
22) Sugar	1

Most of the analyses had certain connections with the research work. The rest of them, by their nature, required special handling by experienced analysts of this Division.

DIVISION OF ANALYTICAL CHEMISTRY TRAINING

Director of the School of Analytical Chemistry Training,

Singto Ratanakasikara, B.Sc. (Inter.)

Chief of Division of Analytical Chemistry Training

School of Analytical Chemistry Training

In the year 1953, 11 students passed the entrance examination. The first year class started on the 15th. June 1953, consisted of 10 new students and 2 repeaters. The second year class began on 8th. June 1953 and was composed of 5 students.

At the end of the academic year, only 8 first year and 4 second year students were eligible for their final examination. The results were 4 (absolute) passes, 3 passes after re-examination and 1 fail for the first year students, and 4 (absolute) passes for the second year students.

In 1954, the curriculum was extended to 3 years instead of 2 years in order to raise the standard of the school's graduates.

The first year class consisted of 31 new students and 1 trainee from the State Railway of Thailand. The second year class was composed of 5 students. The third year students were those who had previously passed the second year course. The total number of the third year attendance was 16 students and 3 officers from the Department.

At the end of the academic year, 1 trainee and 31 first year students were eligible for the final examination. Of the above total, 22 students (absolutely) passed and the remainder passed after re-examination. Four students of the second year class were eligible for their final examinations. Only 2 students (absolutely) passed and 1 student passed after re-examination.

The fourth student obtained less than 60% in organic chemistry, but highest total marks, and his class attendance was regular. He was, therefore, allowed to take the third year course under the condition that he must secure not less than 60% in applied organic chemistry in the first and second term examination before he could take his final third year examination. Ten of the 3 officers and 16 third year students (absolutely) passed their final examinations and the rest passed after re-examination.

Class Schedule

1) *Lectures*:

First year;	11 hours per week for 34 weeks
Second year;	11 hours per week for 34 weeks
Third year;	7 hours per week for 23 weeks during the first two terms and 10 hours per week for the 11 weeks of the last term.

2) *Laboratory*:

First year;	18 hours per week for 34 weeks
Second year;	20 hours per week for 34 weeks
Third year;	21 hours per week for 34 weeks

ANALYSIS STATISTICS

Source Classification

Source	Item	Number of Samples	
		1953	1954
Ministry of Defense	Well Water	1	3
	Fuel Oil	26	17
	Lubricants	6	10
	Coal	—	1
	Coke	—	11
	Miscellaneous fuels	—	5
	Ferrous metal	1	1
	Lead	—	1
	Copper	—	1
	Other metals and alloys	2	5
	Chemicals	3	17
	Edible oil	1	—
	Rice	—	1
	Soil	—	3
	Sand	1	—
	Textiles and Fabrics	—	8
	Miscellaneous	1	1
	total	42	85
Ministry of Finance	Fuel oil	2	4
	Lubricants	—	6
	Coke	1	—
	Miscellaneous fuels	—	3
	Morphine dross suspects	1	—
	Opium exhibit	228	64
	Raw Opium exhibit	415	298
	Other suspected exhibits	—	3
	Ferrous metals	10	5
	Tin	42	40

Source	Item	Number of Samples	
		1953	1954
Ministry of Finance (Continued)	Tin for coinage	12	36
	Lead	3	37
	Antimony	1	3
	Copper	7	8
	Other metals and Alloys	10	70
	Tin ore	—	3
	Wolfram	61	86
	Asbestos	—	1
	Miscellaneous ores	35	58
	Soap	1	—
	Fertilizer	3	—
	Alkali	—	1
	Lime and Cement	—	2
	Detergent	—	2
	Miscellaneous Chemicals	3	11
	Raw Opium	—	37
	Opium	91	181
	Edible oil	—	1
	Miscellaneous oils	23	14
	Cattle's fat	—	9
	Miscellaneous fats	1	—
	Alcoholic beverages	18	4
	Miscellaneous beverages	2	—
	Fresh milk	20	17
	Non-sweetened evaporated milk	61	93
	Sweetened condensed milk	130	172
	Milk Powder	41	44
	Flour	—	1
	Miscellaneous foods	—	4
	Medical supplies	2	1
	Insecticides	3	5

Source	Item	Number of Samples	
		1953	1954
Ministry of Finance (Continued)	Textiles and Fabrics	10	13
	Hemp and Fibres	3	—
	Sealing wax	2	3
	Para-rubber	—	3
	Dyes	—	5
	Paint	9	20
	Writing and printing paper	—	6
	Card board	3	1
	Miscellaneous	2	2
	total	1,256	1,377
Ministry of Agriculture	Miscellaneous waters	3	—
	Coke	7	—
	Wood charcoal	—	27
	Other metals and alloys	1	—
	Food	—	1
	Rice bran	4	—
	Fish powder	5	—
	Miscellaneous animal feeds	15	4
	Miscellaneous	—	8
	total	35	40
Ministry of Communi-cation	Coke	2	—
	Tin	3	—
	Copper	6	—
	Other metals and Alloys	2	—
	Acid	1	—
	Salt	1	—
	Miscellaneous oils	3	—
	Asphalt	2	—
	total	20	—

Source	Item	Number of Samples	
		1953	1954
Ministry of Interior	Provincial water supply	150	189
	Well water	19	64
	Miscellaneous waters	25	25
	Blood stains	172	9
	Fire-arms and Ammunition	2	1
	Morphine dross suspects	1	—
	Seminal stain	—	1
	Miscellaneous suspected exhibits	31	3
	Bank notes	—	5
	Alum	3	—
	Miscellaneous chemicals	3	—
	Miscellaneous sugars	2	—
	Miscellaneous animal feeds	18	—
	Insecticides	—	4
	Miscellaneous	—	1
	total	426	302
Ministry of Education	Miscellaneous waters	—	2
	total	—	2
Ministry of Economic Affairs	Coke	1	—
	Miscellaneous ores	1	—
	Detergent	1	—
	Specially blended alcoholic beverage	1	—
	Rice	—	1
	total	4	1

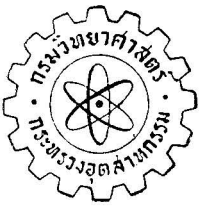
Source	Item	Number of Samples	
		1953	1954
Ministry of Co-operatives	Fish Powder	3	—
	Textiles and Fabrics	—	2
	total	3	2
Ministry of Public Health	Well water	—	1
	Miscellaneous water	2	5
	Non-alcoholic beverages	75	7
	total	77	13
Ministry of Industry	Well water	—	1
	Miscellaneous waters	2	3
	Fuel oil	—	1
	Coal	6	7
	Coke	2	—
	Charcoal	4	14
	Miscellaneous fuels	1	7
	Phosphorus	1	1
	Tin	1	—
	Copper	1	2
	Gold	—	5
	Tin ore	—	2
	Acids	15	23
	Alkalis	13	4
	Salts	3	1
	Alum	—	119
	Lime and Cement	2	1
	Vinegar	17	1
	Wood naptha and Pyridine	1	—
	Glue	2	—
	Detergent	1	—
	Sulphur	2	1
	Miscellaneous chemicals	2	40
	Edible oil	—	1
	Miscellaneous oils	—	4

Source	Item	Number of Samples	
		1953	1954
Ministry of Industry (Continued)	Specially blended alcoholic beverages	13	26
	Alcoholic beverages	2	—
	Miscellaneous beverages	—	53
	Miscellaneous non-alcoholic beverages	13	46
	Rice	10	56
	Flour	—	5
	Sugar	1	—
	Fish sauces	7	2
	Miscellaneous foods	2	2
	Rice bran	—	8
	Fish powder	1	—
	Miscellaneous animal feeds	—	3
	White clay	5	43
	Clay and Fire-brick	—	2
	Miscellaneous clays	2	2
	Miscellaneous rocks	—	1
	Sand	1	2
	Wood	25	9
	Gum from tree	2	—
	Tannin	23	2
	Miscellaneous	2	35
	total	185	535
Banks and Governmental Departments	Well water	2	1
	Miscellaneous water	25	9
	Sea water	174	285
	Fuel oils	1	5
	Lubricants	10	12
	Coal	2	—
	Coke	1	5
	Miscellaneous fuels	1	—
	Ferrous metals	3	9

Source	Item	Number of Samples	
		1953	1954
Banks and Governmental Departments (Continued)	Tin	1	3
	Lead	—	1
	Antimony	—	1
	Copper	2	2
	Other metals and alloys	—	1
	Gold	—	1
	Tin ore	1	1
	Miscellaneous ores	1	2
	Alum	—	2
	Sulphur	—	1
	Miscellaneous oils	1	1
	Writing and Printing papers	—	6
	total	225	348
Semi-Governmental Organizations	Lead	1	—
	Lime and Cement	2	—
	total	3	—
Private and Public	Well water	22	52
	Miscellaneous waters	2	9
	Fuel oil	2	2
	Lubricants	1	2
	Coal	2	4
	Coke	1	1
	Charcoal	3	—
	Miscellaneous fuels	1	—
	Ferrous metals	1	2
	Copper	—	2
	Other metals and alloys	1	1
	Silver	23	12
	Tin ore	3	10
	Wolfram ore	30	24
	Asbestos	2	—
	Miscellaneous ores	20	6

Source	Item	Number of Samples	
		1953	1954
Private and Public (Continued)	Fertilizer	—	1
	Acid	—	1
	Lime and Cement	—	23
	Detergent	1	—
	Miscellaneous chemicals	6	4
	Edible oil	—	5
	Non-alcoholic beverages	—	2
	Evaporated milk	—	1
	Condensed milk	—	1
	Milk powder	—	1
	Rice	1	—
	Flour	4	7
	Miscellaneous sugars	2	1
	Fruit	—	1
	Vegetable	1	—
	Fish sauce	—	1
	Miscellaneous foods	—	2
	Fish powder	2	2
	Miscellaneous animal feeds	3	1
	Medical supplies	—	1
	Insecticides	—	2
	Plant in the crude form	1	—
	White clay	1	2
	Clay and Fire-brick	—	1
	Miscellaneous rocks	—	2
	Textiles and Fabrics	3	—
	Damaged substances and goods	10	2
	Asphalt	1	—
	Preparations of soluble substances	24	19
	Writing and printing papers	—	2
	Certification of locally manufactured products	17	25
	Miscellaneous	1	1
	Total	192	238
	Grand total	2,468	2,943

The total number of analyses made in 1954 was 13,926.



With the Compliments

of

Department of Science

Ministry of Industry

Bangkok, Thailand