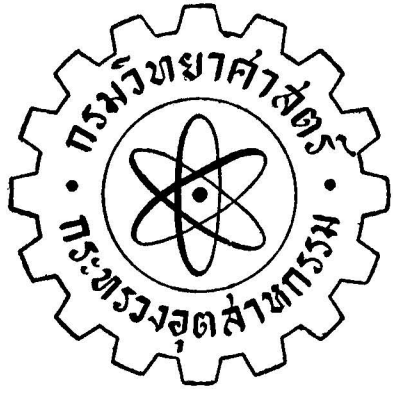

REPORT UPON THE WORK

OF THE

DEPARTMENT OF SCIENCE

Ministry of Industry

Bangkok, Thailand

No. 18

FOR THE YEAR 1955 (B.E. 2498)

FOREWORD

This 18th. report is the first that covers the work of only a single year. The change is intended to keep the report more up to date.

The work of the Department recorded herein is only representative of the nature and scope of its extensive duties carried out during this particular period. The Department of Science is the only non-profit-making scientific centre in the country that serves both public and governmental organizations in research, analysis, production, and other scientific and technical services as may be needed. Enquiry for further details may be made, during the office hours, to the Department of Science, Rama VI Road, Phya Thai, Bangkok, Thailand.

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

Department of Science
Ministry of Industry
Bangkok, Thailand

STAFF

1955

Position	Number of Positions	Vacant Positions
Director–General	1	–
Deputy Director–General	1	–
Director of Division	1	–
Principal Scientific Officer	1	–
Senior Scientific Officer		
Chief of Division	3	–
Senior Scientific Officer	3	2
Chief of the Division of Analytical–Chemistry Training	1	–
Secretary	1	–
Scientific Officer		
Chief of Section	13	1
Scientific Officer	13	3
Chief of Section	4	–
Assistant Scientific Officer	29	6
Assistant Technician	7	–
Section Staff	6	–
Laboratory Assistant	27	13
Clerk	7	–
Employee	62	–
TOTAL	180	25

OFFICER OF THE DEPARTMENT OF SCIENCE WAS CONFERRED THE MOST EXALTED ORDER OF THE WHITE ELEPHANT

First Class (Knight Grand Cross) Dr. Charng Ratanarat

SPECIAL DUTY

Dr. Charng Ratanarat, the Director–General, was invited 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, Chiengmai.

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

9) Member of the National Air Defence Committee.

10) Representative of the Ministry of Industry attending a meeting on the establishment of the Ministry of Defence's light ammunition factory.

11) Member and Secretary–General of the Thai Atomic Energy Commission for Peace.

12) Deputy Chairman of the Alum Plant Committee.

13) Member representing the Ministry of Industry in the Export Quality Control Committee, which was organized by the Ministry of Economic Affairs.

14) Member of the Committee to consider Thai Paper Project of the National Economic Development Corp. Ltd.

15) Secretary–General of the 9th Pacific Scientific Congress.

CERTIFICATION OF LOCALLY MANUFACTURED PRODUCTS

During the period under review, 27 locally manufactured products were sent in for approval. A total of 21 were approved. of which 19 were for renewal of certification, and only 2 were new products.

Merchandise	Number of articles	Certified	Not Certified
Cosmetics	15	13	2
Food	8	6	2
Distilled Water	1	1	–
Ink	1	1	–
Smelling Salt	1	–	1
Insecticide	1	–	1
TOTAL	27	21	6

PUBLIC DISSEMINATION OF SCIENCE

Apart from the monthly "Science for the People" programme and "News of the Department of Science", several broadcasts were made. Some of the more interesting subjects were:– "Well–water in the North – Eastern Provinces", "Thailand shall have a Nuclear Reactor" and "The Survey of Uranium Ore by Radioactivity Survey–Meter".

Scientific papers and texts of the broadcasts were almost invariably published in various magazines and newspapers to ensure a wider circulation among interested persons.

ASSISTANCE TO OTHER GOVERNMENTAL ORGANIZATIONS

There were miscellaneous assistance and cooperation rendered to other governmental departments apart from analyses and those specifically mentioned elsewhere in this report. They may be classified as follows:-

1) Giving advice and explanation on technical problems.

2) Repairing and constructing special scientific apparatus that could not be accomplished by other departments.

3) Making available the Department's technical facilities needed by other institutes for experimentation.

4) Permitting some of the staff of the Department to lecture or demonstrate at various Schools, Institutes and Universities on request.

GENERAL REVIEW

The total number of the staff of the Department of Science was decreased by seven through resignation, death and transfer. During the period covered by this report, 16 officers of the Department were abroad. Nevertheless the number of samples sent in for analysis showed an increase of 350 samples over that of the previous year. However, the present volume of work could be doubled, had there been more samples sent in and sufficient facilities made available.

The total number of research topics undertaken during the year 1955 was 26, most of which were in connection with

the utilization of natural resources, while a few were in connection with methods of analysis. Some of the more interesting topics will be briefly discussed in this report.

The Alum Plant, which was erected on the Department of Science's ground, had its opening ceremony performed on 8th. April, 1955. The Director – General was the General Manager and the Vice–Chairman of the Board. The Minister of Industry was the first Chairman, and the Chief of the Division of Research, Department of Science, was a member and the secretary of the Board.

In the year 1955, the Department of Science was granted a budget for the operation of two small pilot demonstration units on the production of shoe polish and adhesive paste. Since some equipment had to be ordered from abroad which took a considerable time, the projects were delayed accordingly. The production target was not attained until the following year.

Closer cooperations during the period of this report were extended to organizations and institutes both in this country and abroad. The Director–General was a member of an Industrial Mission, visiting various countries in Europe, Asia and America, to find the possibility of industrial development in Thailand. The Deputy Director – General and other senior officers of the Department attended three conferences abroad. Funds were made available for two officers to study and be trained oversea.

Internally, the Department of Science has always been giving full cooperation to the Science Society of Thailand. Many officers were invited or requested to become members of technical committees and special lecturers of various organizations, departments and institutes. Apart from those mentioned above, aids were given to, and analyses were made free of

charge for, the Department of Livestock Development, the Department of Public Health, the Department of Fisheries and various semi–governmental companies and organizations.

The public dissemination of science was continued through the usual channels, via broadcasting, televising, and publications on various occasions. Moreover, free advice and consultation were given to all requests.

It is noteworthy to mention here that the Director–General was appointed the Secretary – General and a member of the Thai Atomic Energy Commission for Peace and the Executive Secretary–General and a member of the 9th Pacific Science Congress Committee. Both organizations had their Secretariats at the Department of Science, whose staff were constantly called upon to render any assistance needed.

Administrative duties of the Department of Science were thereby considerably increased, which, in turn, imposed greatly upon the already heavy burden of the Office of the Secretary, which was narrowly limited by its small staff.

The Division of Analytical Chemistry Training had this year, its highest number of graduates, a total of nineteen, since the Second World War. Nevertheless they were still not sufficient to meet the demand. Apparently, the extension, from two–year to three – year course, was not sufficiently attractive as originally expected. Plans were, therefore, being made to extend its course further to four years, and a graduate would receive a Degree or Technical Diploma equivalent in status to a degree.

The Division of Biological Science was formed in 1953 to deal specifically with biological problems. The widened scope of the work performed had resulted in the establishment of a post of the Division Director to which its Chief was accordingly promoted. The work of the Division during the

period under review comprised the study on analytical methods for vitamin B_1 or Riboflavin, the study on nutritional values of fish sauce and some local foods for the purpose of future Food Control Programme, the study on analytical methods for trace elements in food, the study on milk subtitute for infant feeding, the study on natural dyes from local plants and the study on the preparation and the preservation methods of various foods. It ought to be mentioned that the adhesive paste pilot unit was also under the supervision of the Division of Biological Science.

The Division of Research was also formed in 1953. It had as its principal duties chief assignments on research and some problematic analyses which required special technique or are related to research problems. The Division also made analyses that required special handling, such as the analysis of counterfeit bank notes and coins. Analytical control of the Alum Plant, supervision of the shoe-polish, ink, table-salt, and perfume pilot units were also among the entrusted duties of the Division of Research. As for the research problems, water-bug extract, glutamate seasoning from bean and bean-cake, coconut oil from fresh coconut milk, and paper pulp from local bagasse, were studied in addition to the investigation on body and glaze for the Ceramic Plant, and many others. The study on waterbug extract resulted in a small scale production. The extract soon found great popularity. The demand was so heavy that, inspite of very much increased effort, the production was never able to satisfy it.

The Division of Physics and Engineering was formed at the same period as the above two divisions. Its intended function was the development of research work initiated by other divisions into a pilot plant scale, and, if proved feasible, into a full industrial production. Owing to the high cost of

equipment and the small fund available, progress was relatively slow. The majority of the work of the Division was, therefore, limited to physical tests and workshop routines, which included repairing and constructing of equipment and building; photographic work, and production of distilled water, ethyl alcohol of various grades and ammonia for the Department own uses were also its duties. As for research, study was made on the preparation of malt from Thai rice; and, in co-operation with the Department of Mines, its officers studied and analyzed ores and ore-tailings for radio-active elements or elements which might be used as nuclear materials. It might be of interest to note that the Division of Physics and Engineering, during the period of this report, analyzed and gave explanations of two natural phenomenae, both of which would be briefly discussed in this report. Lastly, the erection and the maintenance of the Alum Plant were mostly carried out by the Workshop Section of this Division.

The attempt to reorganize the Division of Chemistry and to form two separate divisions, namely the Inorganic and the Organic Chemistry Divisions, was not successful. The work of the Division of Chemistry concerns mostly with routine analyses of, e.g., water, opium, ores and fuel. In addition, the Division was experimenting on the use of a mixture of alcohol and gasoline as motor fuel.

Analytical statistics are given at the end of this report. Brief records of some of the more interesting work of each division during the year 1955 are as follows:-

SECRETARY'S OFFICE

Library

Since the transfer to the present office in 1953, the Library has been expanded and modernised. Miss Proesiri Bhekanandhana the Chief Librarian was granted a six-month scholarship to study in England by the British Council and later worked for her master degree in the Department of Library Science, Catholic University of America.

The Library still continued the exchange of its publications, the Report and Thai Science Bulletin, for publications of foreign scientific organizations, either directly or through the U.S.B.E.

Dr. P. Sheel, Head of the Indian National Scientific Documentation Centre (Insdoc), during his visit to the Library, was good enough to explain to the Secretary of the "Scientific and Technical Library Centre" the services rendered by Insdoc. List of References and List of Current Scientific Literature of Insdoc are to be exchanged in future with the Department's publications.

During the year 1955, there were 730 persons, excluding the Department's staff, requesting the use of the Library. The total number of books and periodicals was 10,890 bound and 8,600 unbound The current publications received were 25 from the United Kingdom and 40 from the United States of America.

As for the future, the Department of Science is organizing an Inter-library Association with a centre at either the Department's Library or the "Scientific & Technical Library Centre". Invitations to participate in the establishment of such an organ have already been sent to librarians of various departments, institutes and universities, thus ensuring better

and closer cooperation and coordination among interested circles.

DIVISION OF ANALYTICAL CHEMISTRY TRAINING

The School of Analytical Chemistry Training has as its main objective the training of students for work in the Department of Science and other governmental bodies. The courses of study include both Theoretical and Pratical Science, but more stress is placed on the latter. An applicant must have passed the pre - university (Science) standards or equivalent before being considered for admission by entrance examination.

During the period covered by this report, the School of Analytical Chemistry Training had 51 students and four trainees, of which 50 students and all the four trainees were eligible for their examinations. Of this total, 34 students and trainees passed, 19 students and trainees passed after re–examination and one failed. The number of Graduates this year was 19, including three trainees.

It was noticed that many students, who passed their first, and often second year examinations, left the School of Analytical Chemistry Training for the Universities. The number of graduates each year was, therefore, insufficient to meet the demand from other governmental and public bodies. As for future improvement, a proposal has been made to

1) extend the course of study so that graduates would receive a degree or a diploma equivalent to a degree, and

2) bind the student with a contract that either he must complete his study or if he leaves the School in the middle of his course he must pay a fine.

DIVISION OF BIOLOGICAL SCIENCE

The Division of Biological Science is divided into four sections, viz. Biochemistry, Plant Chemistry, Nutrition and Beverage, and Micro-biology sections. Its work covers biological research and analysis. The analysis statistics during the period under review was 491 samples or 1,362 analyses, which was approximately 14.0% less than the previous year. The Division conducted 12 topics of research, some of which will be discussed later in this report.

The Division encouraged its staff to send in articles for broadcast and publication in various magazines. In addition, its members gave lectures and demonstrated on various occasions on the methods of food preservation.

It should be mentioned here that, during the period under review, Dr. M. van Eekelen, the Director of the Food Research Centre of the Netherlands, was assigned the Food Technologist to help in the work of the Department, particularly in this Division, by the United Nations' Food and Agriculture organization. Dr. van Eekelen was working on the local food situations and the possibility of building up food industry in Thailand. He also helped in the training of the staff of the Division for future research work.

Biochemistry Section

Apart from analysis concerning vitamins in foods, biochemical research work is the main responsibility of the section. Some of the researches are briefly described below:-

1) Preparations of fish sauce and bean sauce by a quick process (Re. No. 90)

This was a continuation of the work previously reported. The aim was to find optimun temperature, digesting time, acid

concentration and quantity, and the protein content of the raw material used for preparing sauces. The sauce obtained from bean by this method was superior in flavour to that made by fermentation. The essence of the fish sauce produced was, however, not as good as in the sauces made by the conventional method. Means are being examined of producing, with the help of bacteria, an essence which can be used to flavour the quick–process sauce.

2) Consideration concerning control standards for fish-sauce

Data were collected to be used as a basis in the preparation of control standards for fish sauce. The aim of the project was to safeguard the public, and hence it was believed that it would receive full co–operation from all concerned.

3) Analysis of iodine present in small quantities in salt and water

A study was undertaken to find a suitable analytical method for determining minute quantities of Iodine present in salt and water, as requested by a consultant of the World Health Organization, Dr. V. Rama Linga Swami, who was investigating the goitre problem in this country. Samples collected by Dr. Swami during his trips to the North and North – Eastern province of Thailand were received, and analyses made by the Department of Science were conveyed to the Ministry of Public Health for further evaluation. Final results will be reported later.

4) Adhesive paste factory

A study on a preparatory method of adhesive paste suggested by the Ministry of Industry resulted in a grant to build an Adhesive Paste Factory. The plant was part of the Department's laboratory; the materials used were those easily obtainable in this country, and the paste was comparable with

imported products.

An adhesive paste for wood was also developed, and samples were tested in carpentry school of the Department of Vocational Education.

Plant Chemistry Section

The work of the section during the period covered by this report was mainly research. The followings were some of the more interesting topics.

1) Preservation of rice bran. (Re. No. 110)

Rice bran is one of the most important foodstuffs for domestic animals. Unfortunately its keeping quality is poor, owing to its oil content. The Division of Research succeeded in raising the keeping quality of the bran by extracting the oil with a solvent. However the process was expensive because of the high cost of imported solvents. Moreover the oil has no immediate worthwhile application and the food value of the bran was considerably reduced with the loss of the oil. The Plant Chemistry Section of the Division of Biological Science, in co-operation with Dr. van Eekelen, therefore investigated methods of preserving the bran complete with the oil. The methods include addition of anti-oxidants to prevent rancidity, application of heat to destroy the enzymes present, reduction of the moisture content, and combinations of these. It was found that anti-oxidants were not very effective and were probably unnecessary but an application of heat followed by a reduction of moisture content led to bran of good keeping quality. Further study was planned to investigate the changes in compositions and food values of bran preserved for various lengths of time, both with and without treatment.

2) Research on milk substitute for infant feeding (Re. No. 111)

It is accepted that for an infant there is nothing better than milk from its healthy mother. However, if it is not practicable to feed the infant naturally cow milk is usually used. Unfortunately fresh cow milk was not easily obtainable in this country. Dr. van Eekelen, who was attached to the Division of Biological Science, took interest in this problem, and co-operated with the Plant Chemistry Section, in a search for a milk substitute. Its preparation should be simple and the basic ingredients should be available in the country and cheap. After careful considerations, egg and banana (Namwa) were used, because egg has high food value although it lacks carbohydrate which however can be supplied by the banana. Sodium and Calcium, which are present in human milk, were also added. The composition of the milk substitute was carefully adjusted. The milk was tested on infants between the ages of 2 days and 4 months at the Hospital for Women and Children, with its Director's full co-operation. The results will be recorded in the next report.

3) A study on dyeing with natural colour from plant (Re. No. 92)

Synthetic dye is easy to use but may not be available in time of emergency. During the Second World War, the Division of Chemistry initiated a study on the use of natural dyes from plants. The Division of Biological Science continued the study but concentrated on a khaki dye from Hoo Kwang (Singapore almond) using various parts of the plant and various types of mordant. Various shades of khaki could be obtained. Futher study was planned to test the fastness of the dye against washing, light and wear.

Nutrition and Beverage Section

The work of this Section covered food and beverage researches and analyses. The Section was responsible for analyses of milk and milk products and alcoholic beverages for the assessment of duties by the Department of Customs, and analyses of foods for food control and for the certification of the locally manufactured products.

The following are some of the more interesting topics.

1) Analysis of Carbonated Non-alcoholic Beverages

The analyses made by the Section on samples sent over by the Ministry of Public Health and the Municipality of Bangkok resulted in the issue of the Ministry of Public Health Regulation No. 5, B.E. 2496, as previously reported. In order to keep this Regulation effectively enforced, staff of the Division of Biological Science were occasionally sent out to inspect bottling plants and collect samples for analysis. During the period covered by this report, 14 samples were obtained, of which eight samples satisfied the requirements of the Regulation and six failed.

It was observed that the above-mentioned work performed by the Division, resulted in a smaller number of plants being unconventionally operated and an increasing number of inquiries made to help in process development.

2) Preparation of Fruit Juices (Re. No. 93)

Small quantities of juices were successfully produced from fruits, as already recorded in the 17th Report. On various occasions officers of the Division were sent out to give lectures and demonstrations on the methods of preparation. Further studies were in progress on the variation in food value and colour of the juices with storage time.

3) Preparation of Jam from Thai Fruits (Re. No. 112)

Though jam was not much consumed in this country, many people were interested in jam making. Various kinds of jam were made from local fruits and their keeping qualities were studied.

4) Study on Preserved eggs (Re. No. 113)

Preserved eggs are popular among certain people. Usually they were imported from China, though some were known to be produced in this country by a process which was kept secret. The Nutrition and Beverage Section, therefore, investigated various possible methods and studied whether Salmonella or Paratyphoid viruses which might be present in duck eggs would be killed in the process without the egg being cooked. The finding will be valuable in the safeguarding of the consumers' health because the eggs are usually eaten uncooked.

5) Preparation of Vinegar by a Quick Process (Re. No. 114)

Analysis of vinegar samples sent in for certification and of those bought in the market showed that most of them were of poor quality. Some were even adulterated with mineral acid and were unfit for consumption. A laboratory-scale preparation of vinegar by a quick process was tried by the Section, and the vinegar obtained was of high quality though certain process developments were still necessary.

6) Study on Preservation of Lime Juice (Re. No. 115)

Lime is one of the most used ingredients in Thai diet. Various attempts had been made to prolong its storage life, unfortunately with little success. The Nutrition and Beverage Section, therefore, tried to preserve the fruit in the form of juice. The expressed juice was somewhat milky. Heating would

spoil its quality. Various preservatives were therefore used. The results will be given in a later Report.

7) Improvement of Lard's Quality (Re. No. 66)

In this country lard is used more than any other edible fats and oils for cooking purposes. A considerable amount is also exported.

From observations made by the staff of the Department during their visits to various factories, the production methods employed were not up to standard and the lard so produced had low keeping quality, i.e., the lard turns rancid after a short period of storage. In order to promote this type of industries, the Nutrition and Beverage Section, in co-operation with Dr. van Eekelen, made a study on lard preparation and preservation, using simple equipment easily obtainable. At this stage it may be reported that lard, produced at a constant temperature of about 120°C had a good colour and a total yield similar to those obtained at higher temperatures. Various proportions of anti-oxidants were added and rancidity did not occur even after eight months. Another problem which had to be solved was that with time the lard would separate into two layers, a solid and an oil. The problem never occurs in cold country because the lard solidifies. Dr. van Eekelen was kind enough to make an arrangement for a winterising equipment to be sent over from the FAO in Rome. It was hoped that separation of the two layers could be effected with the help of the equipment.

8) Compilation of Compositions of Thai Food Ingredients

In the past the Department of Science carried out many analyses of Thai foods. The work was taken over by the Division of Biological Science, with a view to publishing a handbook giving compositions of Thai food ingredients. Work

of similar nature was also undertaken by other departments. A meeting was therefore arranged between representatives of the departments concerned so that analytical data could be compiled and decisions made on a future course of investigation. The meeting decided that the matter should be under the responsibility of the Department of Science. The investigation was being undertaken by the Nutrition and Beverage Section.

Microbiology Section

This Section carried out analytical as well as research work. The analytical work was concerned mainly with bacteria in food and water, and the research work was mostly on fermentation. Some of the more interesting subjects are given below.

Preparation of Wine from Pineapple (Re. No. 97)

Pineapple being succulent should be suitable for wine making. The Microbiology Section had previously carried out tests but with inconsistent and unsatisfactory results. Further work was undertaken. Instead of the yeast previously cultured which gave the wine a slightly bitter taste, a new strain of yeast was obtained from pineapple juice left to ferment on its own. This yeast gave good wine with no bitter taste. However, there was another difficulty; the wine was usually too sour and if an alkali was used to eliminate the sour taste the quality of the wine was impaired. The problem was solved by an addition of molluse shells to the juice during the initial stage of fermentation; any acid formed was thus immediately neutralized. The result was satisfactory but further investigation was being undertaken to ensure consistency and quality which would be popularly accepted.

DIVISION OF RESEARCH

The work of the Division consists mainly of research, process testing and experimental production of goods for sale. The Division did not aim at producing the goods on a commercial scale but aimed at creating interest in the public mind and showing that not only could we produce various goods cheaply but also they were of high standard comparable with the best imported products. The Division hoped by so doing to persuade individuals or organisations who could raise enough capital to start manufacturing these goods on a commercial scale. The Division also undertook analytical work, including that on samples which presented special problems at the request of other government departments and private individuals.

Some of the more interesting items are given below.

1) Development of Alum Production Process

Experimental work concerning with the production of alum was continued. Modifications of the operating conditions of the reactor were made with a view to obtaining the product in liquid form while maintaining high efficiency. It was found that kaolin, which was one of the raw materials, had to be heated to a sufficiently high temperature. Otherwise the final product contains too high percentage of free acid for use in water works. Experiments were carried out to find optimum temperature and time for the roasting. Analysis was made on every batch of roasted kaolin before reaction with acid, and on every batch of alum so produced to control both the quality and the efficiency. Experiments were also carried out regarding the servicing and the suitability of the plant components; a suitable container was developed for the hot and acidic product.

2) Paper Pulp from Bagasse (Re. No. 100)

Bagasse was being burnt as fuel or as rubbish. The Division of Research tried it as a source of fibre for paper making and found that it yielded approximately 50 % of good-quality pulp.

3) Research on China Ware (Re. Nos. 104-109)

3.1 The Clay

Clay deposits of suitable quality for china ware were searched for. Unfortunately none was found suitable in quantity. Most clay samples investigated contained a certain amount of iron oxide making them unsuitable for porcelain. Earthenware could, however, be successfully produced by both the casting and the jiggering methods. The ware was pale yellow.

3.2 The Glaze

Successful methods were found to produce transparent glaze. Methods to produce opaque glaze still needed further inprovement.

3.3 Golden Tiles

Golden tiles were produced for decorating the Buddha's image in the commemoration of the auspicious occasion of the Twentyfifth Buddhist Century. The tiles were comparable to those imported. Unfortunately, its production was not encouraged further.

3.4 Electrical Insulator

Low-tension insulators were produced experimentally. Although not as white as imported products, they served the purpose satisfactorily.

3.5 Earthenware Factory

The Division of Research's data on china ware would be used as a basis in the production of earthenware articles in the Ministry of Industry's Earthenware Factory.

4) Water Bug's Extract (Re. No. 77)

The use of water bug's essence in a certain type of food is very popular among certain groups of people in Thailand and the Indochina. Since the water bug could not be easily obtained throughout the year an experiment was carried out to extract the essence in the male water bug with alcohol. The extract had a strong aroma, could be kept for a long period and could be conveniently added to the food to anyone's delight. The extract was put on sale experimentally. The production rate was soon overcome by the demand.

In addition the nature of the water bug itself was studied. The water bug is a Carnivorous insect and is a dangerous enemy to some animals such as small fish and tadpole; even a young water bug can perch itself on its prey and suck until the victim is dead.

The research would be continued both on the water bug itself and on its extract. At the same time, a study would be made on the synthesis of the extract.

5) Coconut Oil from Fresh Coconut Milk (Re. No. 78)

Coconut oil made by pressing copra needs purification, bleaching and deodorizing before it is edible. Experiment was therefore made to produce coconut oil from fresh coconut "meat" or kernel. First, the meat was pressed hydraulically to obtain the coconut milk, which was concentrated by centrifugation. The oil was then separated from the proteins and other components of the concentrated milk. The coconut oil obtained was colourless, of pleasant odour and contained only 0.2 per cent of free fatty acids. After the free fatty acids had been reduced to less than 0.05 per cent, further purification was not necessary. The oil was stored for over 6 months without its quality being impaired. Study was being made to

find a method which would give the highest yield and the most efficient process of separating the oil from the proteins and other components of the coconut milk. Analyses of the meat and the milk were also made for use in the above study.

Analytical Work

Though analysis was not a direct duty of the Division of Research, statistics indicated quite a number of analysis made by the Division during the year 1955. Most of the analytical work was in connection with the work of the Division, especially the supervision of the Alum Plant and the Earthenware Factory. Analysis that required special handling, such as an analysis of paper money and an analysis to determine the difference between artificial art paper and bond paper, were also made by the Division.

DIVISION OF PHYSICS AND ENGINEERING

The duty of this Division includes analysis, testing of materials and industrial processes, and providing engineering workshop services. During the period covered by this report, 1,839 analyses were made on 138 samples, 924 items of construction and repair work and 2,712 items of photographic work were carried out. Distilled water and some 50 litres of ammonia were produced for use in the Department and for sale. Lastly two pieces of research were carried out by the staff of the Division.

Physics Section

1) Identification of Ore Components

In co-operation with officers of the Department of Mines, investigations were made on by-products of tin mines

using a visual spectroscope. So far, Ilmenite, Monazite, Zircon, Columbium and Tantalum ores, all containing Uranium, were found.

The visual spectroscope was also used in the identification of elements in ore semples, sent in by public inquirers, before the samples were chemically analyzed.

2) Black-Smoke Phenomenon at Choompae Market

The Department of science received a report of Khonkaen Chief of Police submitted to the Director-General of the Police Department. The report stated that at approximately 2 p.m. on 14 June 1955, at the Choompae market, Khonkaen, while there was a light shower and a thunder-storm, a blackish smoky funnel was observed lasting approximately 10 minutes and stretching upward into the sky; this was followed by a bright light striking from the sky on to the earth and, to an observer at a distance, looking like something on fire and lasting over one minute.

It was surmised that the phenomenon was caused by a rapid convection of a cumulonimbus during the thunder-storm thus resulting in condensation over a small area. The phenomenon was generally known as "Funnel Cloud", and the bright light was believed to be caused by lightning.

Material Testing Section

Most the work of this Section was concerned with the testing of materials, e.g. the determination of tensile strength and compressive strength of test pieces made from samples of cement sent in by the Thai Cement Co. and of brick samples. The Section also carried out investigations to find the wood most suitable for destructive distillation.

1) Sand for Construction Purposes

Samples of Sand dug at various distances from the sea shore of the district of Banglamung, Cholburi were tested for their tensile strength and compressive strength in comparison with fresh-water sand from Rajaburi, and sieve-test curves were compared with the ideal curve. All the samples sent in conformed to the requirements for their proposed uses.

2) Destructive Distillation of Wood (Re. No. 48)

This was a continuation of the work reported in the previous issue. Pyroligneous acid for use in the rubber industry, acetic acid for cooking purposes and for use in the rubber industry, wood tar for the preservation of wood, methyl alcohol and other volatile products, and tannin from barks for use in tanning and for various pharmaceutical purposes were obtained from wood by destructive distillation.

The Othmer's Distillation Process was used. Among the various types of wood tried Kongkang (*Rhizophora candelaria*) gave the most attractive results, namely, the highest calorific value and the highest yields of by-products.

Chemical Engineering and Industrial Process Section

Most of the work of the Section concerned the culture of various strains of yeast for the ethanol production by fermentation. Other topics of investigation are summarized below.

1) Jelly-like Rain at the District of Payao, Chiengrai

A sample of jelly-like rain was received from the District Official at Payao for examination. Officers of the Department of Science were sent out to investigate the

phenomenon at the site. It was concluded that the mucus was caused by eggs of a kind of insect in the *Chironomidae* family (midges). The insect lays eggs in the air. The eggs are covered with a mucoprotein similar to fish's mucus. This is non-poisonous and can absorb water, which causes the eggs to swell and form a gel-like substance.

2) Experiment on Whisky Production by Fermentation of Thai Rice Malt

Whisky is usually prepared from malt of barley, a crop unsuited for the Thai climate. Attempt was therefore made to produce malt from various strains of Thai rice. The yields obtained were, however, not yet satisfactory. Further study was required.

3) Agar from Seaweed (Re. No.63)

Agar is usually imported. Apart from being used as human food, it is used for pharmaceutical purposes and in the growing of micro-organisms. It is usually prepared from *Grocilaria* or *Confervoides* seaweed. Many types of seaweed are found along the coast of this country. Preparation of agar from locally available seaweed was tried. The agar obtained was of the quality high above the accepted pharmaceutical standard. Improvement of the preparatory process was still necessary because the cost of refrigeration still prevented the process to be developed on a commercial scale.

Workshop Section

Most of the work of the Section concerned the making and repairing of laboratory instruments and office equipment. Distilled water and ammonia were prepared by the Section.

DIVISION OF CHEMISTRY

The work of the Division of Chemistry was mostly routine analysis of samples received from various Governmental departments and public organizations. The Division was composed of the following sections.

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

Opium Section

The opium analyzed by the Section may be classified into the following categories.

1) Boiled opium to be purchased by the Excise Department, Ministry of Finance
2) Boiled opium seized by the authority
3) Boiled opium from damaged tubes and miscellaneous sources
4) Raw opium seized by the authority
5) Mixed opium ready for filling opium tubes

Only in the sampling of the opium classified under category (1) was an officer from the Section present as a member of a buying committee of six or more. In this case the morphine content as found by analysis was used as a basis in the price adjustment. The morphine content of the samples analyzed during and a few months prior to the period covered

by this report are shown below. It may be noted that the morphine content steadily increases month by month until it is much higher than what it should be in natural opium.

Morphine Content of Boiled Opium Purchased by the Excise Department

Year	*Month*	*Maximum Percentage Morphine*	*Monthly Number of Samples (Can)*
1954	April	18.51	34
(124 Samples)	June	20.29	20
	July	20.66	34
	September	18.79	15
	October	17 34	13
	December	19.99	8
1955	January	16.67	33
(128 Samples)	February	25.29	8
	April	23.93	40
	May	27.68	17
	June	26.29	23
	July	29.70	44
	August	25.82	5
	September	20.08	4
	October	25.52	4
	November	25.80	24
	December	30.86	46

Minerals and Ores Section

During the year 1955, 171 samples of ores were analyzed as compared with 185 samples during the previous year. Most of the samples analyzed were tin and wolfram ores. Other ores analyzed included monazite, ilmenite and manganese, etc.

It should be mentioned here that columbium and tantalum were increasingly employed in the making of alloys for machineries and instruments designed for high temperature operation. It was therefore a duty of the Minerals and Ores Section, to pay attention to those two elements, which are normally present in our tin ores.

Metals and Alloys Section

The number of samples analyzed was increased from 273 in 1954 to 310 in 1955. During the period covered by this report, the Royal State Railway of Thailand, realizing the importance of the sampling method, invited the Department of Science to send representatives to be members of committees to receive purchased materials. Emphasis on the sampling method could benefitially be adopted by many Governmental departments and other organizations.

Fuel and Lubricant Section

The analytical work of the Section has been increased 40 % over the previous year. In addition, possibilities of developing local fuel resources were studied.

1) Crude Oil from the District of Fang, Chiengmai

The separation of various fractions in the crude oil from Fang by the usual distillation method was carried out in August 1954, vacuum distillation was employed in 1955, and the results from both methods were compared.

By using vacuum distillation method, the crude oil was found to contain no gasoline fraction, but to consist of 15 % of gas oil, 35 % of lubricating oil, and 50 % of asphalt. A certain fraction from the gas oil could be used in the diesel

engine with good result. The lubricating oil needed refinement to remove paraffins, and the asphalt was of low grade because of the high paraffin content.

In ordinary distillation, the oil was partly cracked. The yield contained 15 % of gasoline, 50 % of gas oil, 25 % of fuel oil and residue. Neither lubricating oil nor asphalt was found.

It was concluded that the best fractionating method was to apply both distillation processes, namely, the crude oil should be first distilled at high pressure (cracking distillation), when gasoline and gas oil would be produced. The distillation was then continued under reduced pressure (vacuum distillation), when certain amounts of lubricating oil and asphalt would be obtained.

2) Lignite from the Districts of Bhulanchang and Pa-angkob

Samples of lignite from the Districts of Bhulanchang and Pa-angkob were analyzed. The results are summarized below.

	Lignite	
	Bhulanchang	**Pa-angkob**
Moisture Content, %	6.5	17.8
Volatile Matter, %	40.7	32.2
Ash, %	2.0	0.6
Fixed Carbon, %	50.8	47.4
Sulphur, %	1.1	0.3
Calorific Value, Cal./g	7356	5483

It can be seen that the lignite could be used for raising steam in industrial boilers or in locomotives. The fixed carbon content was sufficiently high for the lignite to be used as coking coal. A process developed and used in certain for-

eign countries is to crush the lignite and to form briquettes which are used in destructive distillation. A certain quantity of gas produced is used for carbonization; the surplus is then used in raising steam or is sold to local residents for domestic purposes. The main product obtained is coke and the by-products are benzol, phenol, creosote, etc. Furthermore, the gas so produced may be used as a starting material in the synthesis of motor-gasoline, as successfully produced in Great Britain and Germany.

General Analysis Section

Apart from routine analysis the work of the Section included analysis of samples sent in by the Department of Customs for the purpose of tariff fixing, and from other Governmental departments for use as bases in the buying of materials and selling of Government's properties. Service was also specifically rendered to the Department of Industrial Promotion in the analysis and certification of products of various local factories. In addition, standard solutions of various concentrations were prepared for use in routine analysis carried out by other Governmental departments, factories, and commercial concerns.

Analysis statistics indicated a drop from 848 samples in 1954 to 653 samples in 1955. The decrease was believed to be a result of the temporary import control.

The following notes are of interest.

1) Problem of Paper and Pulp Classification

Imported paper was divided into three classes for the purpose of tariff fixing as follows:

a) Paper containing oil, wax, stearin or paraffin wax.

b) Wall paper, including enamelled, varnished, and painted paper.

c) Other types of paper not classified under the above two classes.

The art printing paper coated with china clay was analyzed and the Department of Customs was advised that it should not be included in class (b) with wall paper, etc., because its coating was not for decorative purpose.

Another problem involved paper pulp and cardboard, the tariff rates of which were considerably different. A certain consignment of bagasse pulp was inported in the form of pressed board, a sample of which was sent to the Department of Science for verification. After analysis it was decided that it was paper pulp which had been pressed into pulp board.

2) Analysis of Textiles

During the period covered by this report, more textile samples were submitted to the Department of Science than during any previous year. This resulted from an increase in the importation of textiles and fabrics and the development of synthetic fibres, e.g., rayon and nylon, etc. Compositions of various types of textile as specified were sometimes unreliable, and hence samples had to be sent to the Department of Science for analysis.

3) Raw Materials for the Manufacture of Paper

Analyses were made on various kinds of possible raw materials for paper-making, which has long been of interest to many industrialists. It was found that rice straw contained 38–54 % of cellulose, as compared with 57 % in bamboo. Unfortunately, the rice straw also contained 9 – 12 % of silica which was the highest percentage among the materials analyzed.

Water Section

During the year 1955, the Section analyzed 342 samples. The detail is shown below.

Item	1954		1955	
	Number of Samples	Number of Analyses	Number of Samples	Number of Analyses
Municipal water from various provinces	270	4,986	183	3,295
Well water	72	1,185	134	2,160
River and Canal Water, and Miscellaneous	23	336	25	460

Results from the analysis of municipal water were used in quality control. It was found that municipal water from various provinces might be classified according to their sources as follows:

1) Surface Water: Municipal water derived from river or canal, e.g. as used in Bangkok, Ayuthaya and Chiengmai, was low in dissolved solids and hardness, and of good chemical properties, but still contained much suspended solids as indicated by its turbidity, which was a result of insufficient filtration.

2) Ground Water: Municipal water derived from well, e g. as used in Nakornpathom, Samutsakhorn and Lopburi, was low in suspended solids but high in dissolved solids and hardness, which made it unsuitable for industrial uses but was pure enough for drinking purpose.

Apart from municipal water many samples of well water were submitted for analysis. It was of interest to note that more and more wells were being sunk and the public were more concerned about their own safety in using well water, as indicated by the following statistics.

Year	Number of Samples sent in for Analysis
1952	13
1953	45
1954	72
1955	134

It should be noted that among the 36 samples of drinking water sent to the Department of Science in 1954, three were unsuitable for consumption, and among 31 samples sent in during the year 1955, three were not safe to be used as drinking water.

Other kinds of surface water as well as sewage were also analyzed by the Water Section. The results were employed in deciding their uses, e.g. in steam boiler, in the starch industry, in dyeing, as cooling agent, etc. Apart from the analysis, the Water Section also gave advises and helps in solving various water problems. Inquiry concerning water for consumption or its suitability for any specific industrial utilization will be gladly answered.

ANALYSIS STATISTICS

From	Item	Number of Samples
Ministry of Defence	Well water	4
	Miscellaneous water	6
	Liquid fuel	32
	Lubricant	12
	Coal	4
	Metals and Alloys	1
	Miscellaneous ores	4
	Miscellaneous chemicals	8
	Fabrics	1
	Total	72
Ministry of Finance	Liquid fuel	3
	Boiled opium	436
	Raw opium	467
	Ferrous metals	1
	Tin	45
	Coinage Tin	70
	Lead	43
	Antimony	5
	Copper	1
	Metals and alloys	64
	Gold	2
	Silver	5
	Wolfram ore	116
	Miscellaneous ores	51
	Wood naphtha and pyridine	3

From	Item	Number of Samples
Ministry of Finance (cont'd)	Miscellaneous chemicals	7
	Edible oil	1
	Fresh milk	27
	Non-sweetened evaporated milk	79
	Sweetened condensed milk	164
	Milk powder	57
	White clay	1
	Miscellaneous food	1
	Textiles and Fabrics	64
	Damaged goods	5
	Dye	4
	Paint	11
	Writing and printing paper	5
	Pressed paper board	2
	Total	1,740
Ministry of Agriculture	Bangkok municipal water	2
	Well water	1
	Miscellaneous water	3
	Charcoal	53
	Fish sauce	1
	Miscellaneous foods	6
	Miscellaneous fodders	7
	Miscellaneous soil	1
	Total	74

From	Item	Number of Samples
Ministry of Communications	Lead	4
	Total	4
Ministry of Interior	Bangkok municipal water	6
	Provincial municipal water	175
	Well water	42
	Miscellaneous water	14
	Tin, or tin ore, court exhibit	1
	Miscellaneous court exhibits	7
	Detergent	1
	Sugar	1
	Miscellaneous fodders	3
	Sand	1
	Solvent	2
	Total	253
Ministry of Education	Well water	2
	Total	2
Ministry of Economic Affairs	Salt	1
	Miscellaneous chemicals	9
	Miscellaneous foods	2
	Total	12

From	Item	Number of Samples
Ministry of Co-operative	Fodders powdered fish	2
	Medicinal plants	2
	Total	4
Ministry of Public Health	Fresh milk	1
	Total	1
Ministry of Industry	Well water	27
	Miscellaneous water	2
	Charcoal	7
	Miscellaneous court exhibits	5
	Ferrous metals	1
	Copper	1
	Gold	2
	Acids	22
	Bases	9
	Salts	15
	Alum	64
	Hydrated lime and cement	2
	Wood naphtha and pyridine	1
	Glycerine	1
	Glue	4
	Detergent	3
	Miscellaneous chemicals	66
	Edible oil	3
	Miscellaneous oils	2
	Specially blended alcoholic beverages	10

From	Item	Number of Samples
Ministry of Industry (Cont'd)	Miscellaneous beverages	17
	Non-alcoholic beverages	5
	Flour	1
	Vegetables	7
	Fish sauce	18
	Miscellaneous foods	36
	Rice bran	2
	Medicinal plants	3
	White clay	191
	Clay and fire-bricks	4
	Miscellaneous soils	16
	Precious stone	1
	Miscellaneous rocks	1
	Wood	7
	Gum	1
	Tannin	2
	Writing and printing paper	4
	Miscellaneous	1
	Total	564
Banks and Governmental Organizations	Well water	3
	Miscellaneous water	5
	Sea water	510
	Liquid fuels	2
	Lubricant	1
	Coke	2
	Miscellaneous fuel	1
	Ferrous metals	23

From	Item	Number of Samples
Banks and Governmental Organizations (Cont'd)	Tin	13
	Lead	1
	Copper	5
	Metals and Alloys	3
	Tin ores	5
	Bases	1
	Salts	2
	Asphalt	1
	Total	578
Semi-Governmental Companies	Miscellaneous water	1
	Lubricant	1
	Asbestos	2
	Miscellaneous	5
	Total	9
Companies and the Public	Well water	36
	Miscellaneous water	17
	Liquid fuel	1
	Lubricants	10
	Coal	2
	Miscellaneous fuels	2
	Tin	2
	Metals and Alloys	1
	Silver	13
	Tin ore	2
	Wolfram ore	2
	Miscellaneous ores	1

From	Item	Number of Samples
Companies and the Public (Cont'd)	Acid	1
	Hydrated lime and cement	26
	Miscellaneous chemicals	19
	Butter	6
	Milk powder	1
	Rice	1
	Flour	2
	Molasses	2
	Fish sauce	1
	Miscellaneous fodders	5
	White clay	1
	Clay and fire-brick	1
	Miscellaneous soil	1
	Textiles and fabrics	15
	Damaged goods	2
	Edible dye	1
	Tannin	2
	Preparation of solvents	14
	Writing and printing paper	10
	Quality certification	21
	Miscellaneous	1
	Total	222
	Grand total	3,535

With the Compliments

of

Department of Science

Ministry of Industry

Bangkok, Thailand