NBSIR 76-1190

Report on an NBS/AID Survey of Standardization and Measurement Services in Thailand

Edited by: H. Steffen Peiser
Robert S. Marvin

Office of International Relations
National Bureau of Standards
Washington, D. C. 20234

Held May 22 to June 1, 1973
Issued February 1977

Survey Director: Dr. Charoen Vashrangsi
Department of Science, Ministry of Industry
Bangkok, Thailand

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A report of a Survey conducted jointly by the National Bureau of Standards and the Agency for International Development PASA TA(CE)5-71.

U.S. DEPARTMENT OF COMMERCE, Juanita M. Kreps, *Secretary*

Dr. Betsy Ancker-Johnson, *Assistant Secretary for Science and Technology*

NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Acting Director*

ACKNOWLEDGEMENTS

The Survey Team records its deep appreciation to the Royal Government of Thailand in affording all opportunities entailed in this study. The Team as a whole owes special gratitude to Thai members and their staffs for their constant availability and attention, their cheerful readiness to supply information and to discuss all relevant matters openly with the common objective of stimulating realistic, vigorous, forward looking technical ideas for the development of manufacturing and processing industries and organizations that serve these industries.

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This team was supported by an approximately equal number of professional Thai counterpart team members headed by the overall

Survey Director, Dr. Charoen Vashrangsi. Outstanding contributions to the team were made by the following Thai participants:

- Mrs. Phani Na Rangsi
- Miss Kanya Sinsakul
- Mr. Vichien Sakornmonkol
- Mr. Ong-Arj Kriengkripetch.

The last named is on the USAID staff in Bangkok.

INTRODUCTION

Following previous Surveys of Standardization and Measurement Services in Ecuador, Korea, and Turkey, the National Bureau of Standards was invited by the Government of Thailand and the USAID Mission in Bangkok to organize a similar survey in Thailand, a country which has chosen to introduce modern industrialization into an ancient culture.

Some months earlier H. S. Peiser had made a preliminary study and concluded that the conditions for such a survey were favorable. Initially it was to be held under the leadership of Dr. Prapit Na Nagara, Director General of the Department of Science in the Ministry of Industry. Unfortunately, when the team gathered in Bangkok on May 20, 1973, it was learned that Dr. Prapit had left the country on a special assignment. His place was capably taken by Dr. Chareon Vashrangsi, Physics and Engineering Division Chief in the Department of Science. He is familiar with the National Bureau of Standards and has taken part in other NBS/AID Surveys.

On May 21, the NBS/AID team with distinguished colleagues from Korea, Taiwan, and Turkey began its official schedule. The pre-arranged program of industry and government agency visits presented a major problem. The available time was insufficient even when the international team split up as much as possible. Cancellations, we were told, would offend our hosts. Thus the time for team discussions were very limited, and it was not possible to formulate a full set of conclusions and recommendations.

This report is, therefore, limited primarily to brief factual descriptions of the visits made. It should be noted, however, that the animated discussions covering a wide range of topics which were conducted during most of our visits, and informal suggestions offered our hosts during many of the visits, appeared to be greatly appreciated by those visited. It was clear that many of these discussions and suggestions were beneficial to the organizations visited.

On the first full day we were most generously received by General Krit Sivara, Minister of Industry and Commander-in-Chief. On several subsequent occasions he met with the team, discussed views and comments, and entertained the entire team at impressive functions. He charged his Ministry and all of industry to receive the team, show all the team wished to see, and follow up with positive programs in standardization and quality control. The team members were saddened to hear of the untimely death of Krit Sivara in 1975.

In one respect, Thailand cannot be directly compared with other LDC's. Third World countries often blame their struggles in development to

foreign exploitation and rule in the past. Thailand has never been subject to a foreign power for any length of time, and in its policies shows a high degree of self-reliance and fiscal soundness. Thus Thailand may be better prepared to plan a forward looking modern standardization system than other LDC's which have been accustomed to rely on plans imposed by a ruling foreign power.

An astonishing feat of programming and coordination was performed for the Survey Team by all the Thai team members who arranged more than 80 visits in less than two weeks, organized transportation and conducted the foreign participants in an ancient country that was to them new and lovely. Its history is marked by a spirit of independence coupled with a wish to adapt and honor foreign ideas.

Team Visits to Organizations in Thailand

Not every team member attended each of the 80 visits and meetings during twelve days in Thailand. Only on the first and last days did all team members stay together as one large group. On other days an average of a third of the members took part in any one visit. Choices were made by background and also by geographic and logistic restraints. Also, no attempt was made to explore all the technical standardization and measurement problems at any one of the institutions, companies and agencies. The aim was only to identify the types of relevant technical infrastructure services available and needed to support successful industrialization and development.

1. Visits of May 21

1.1 Department of Science

The tour of duty in Thailand began with a team meeting at the Amarin Hotel followed by an introductory get-acquainted session at the Department of Science. Dr. Chaloa Surasit, the Acting Deputy Director, presided since the Director General was abroad. Dr. Charoen Vashrangsi, Chief of the Division of Physics and Engineering, and Survey Director, led the discussion. Also attending were Mr. Chaiwai, Chief Engineer, Ministry of Industry, and Acting Director of the Thai Industrial Standards Institute (TISI), Dr. Kenneth Stephens, U.N. visiting expert in statistics and quality control, Mr. Rohn Hopper, U.N. visiting expert in public relations, Mr. Donald Marsden, Mr. Pat Johnson, and Mr. Ong-Arg Kringkripetch of USOM/AID, and varous aides.

It was explained that the Department of Science is a part of the Ministry of Industry where it is charged with providing scientific and technical services in support of industrial development. The Ministry operates under a five-year economic development plan of the

Government. The Department is organized into Divisions of Research, Physics and Engineering, Analytical Chemistry Training, Chemistry, and Bioscience. The Thai Industrial Standards Institute, which started in the Department as a project, is due to become an autonomous organization. Both the Department of Science and TISI are well documented organizations. No attempt is made to reproduce all the information here, even in summary.

The Department cooperates with Chulalongkorn University in operating a three-year training program leading to a certificate. Its purpose is to supply technicians, primarily to industry. However, more than 80% of the trainees go on for the B.S. degree.

Mr. Hopper's remarks should be specially noted. He felt that adequate advice on product standardization was already available from previous visits by experts and that this team should focus on how to bring calibration and measurement standards to the fore. He called attention to the proliferation of standards bodies in Thailand, and, in particular, to the Applied Science Research Corporation of Thailand (ASRCT) and the Royal Thai Air Force (RTAF), both of which have potential roles in calibration and measurement standards, if the RTAF has spare laboratory capacity. It has considerable competence.

Mr. Peiser stated that the team, after such a brief survey of a country that was virtually new to all foreign team members, could not be expected to present definite recommendations which could be adopted without critical evaluation followed by thoughtful implementation. The team aim was to listen to problems, throw out ideas for discussion, increase the awareness in Thailand of the technical infrastructure needs, and present choices for self-reliant Thai actions. As to Mr. Hopper's remarks on calibration and measurement standards, NBS would always wish to encourage such programs provided the widest possible use were made of standard reference materials and other means of self calibration.

The more traditional methods of sending instruments and physical standards of measurement to national or international standards laboratories were likely to decline in importance for several reasons including the fact that these techniques fail to assure that the measurement system is under control.

1.2 Department of Science Laboratories

The tour of the Department of Science Laboratories began in the area of bioscience under the leadership of Mr. Vichien Sakornmonkol. Trace analysis of food products for metals and insecticide residues is done by wet chemistry, gas chromatography and spectrophotometry following CODEX procedures of the Food and Agriculture Organization of the UN.

The testing is on a voluntary basis. (Certain mandatory testing and regulation are in the province of the Ministry of Public Health, see 5.2).

Alcohol content of spirits is determined and wines from the fermentation of various tropical fruits of Thailand are produced and evaluated in the hope of developing new product lines. (Grape wines are not successful in Thailand.)

Polarimetry, viscometry, and refractometry measurements are available, all of which pose recognized calibration problems which our hosts felt were not completely solved. Other topics mentioned were fat content of dairy products, preservation by drying (e.g. mushrooms, spices), canning of pineapple, fruit juices, tomato products, fish sauces, paper pulp from grasses as well as from woods, activated carbon from rice straw, and salt. Thai salt comes mainly from mines in the northeast and from the Gulf of Siam by evaporation of sea water. It is exported to Japan for production of caustic soda; the quality of the salt has not always satisfied the customers.

A scanning electron microscope and a Hitache-Perkin-Elmer molecular weight apparatus were examples of rather elaborate modern equipment. The availability of manufacturer's service is a critical element in the successful use of such equipment in Thailand. Relatively simple instruments are used in testing natural products.

In the Division of Physics and Engineering we were shown extensive equipment for mechanical testing (calibrated where appropriate with proving rings). There was testing of cables, chains, soil and some cement products. X-ray flaw detection equipment was out of order, an illustration of the critical importance of service availability for complex imported equipment. There were tensile tests of tire cord and abrasion tests and accelerated high temperature ageing tests of tires. We saw a 100 ton tension test machine, a home-made bend-test machine used to test pipe and roof panels, and battery test equipment. We saw results of experiments on the production of new ceramic wares and glazes.

Mr. Vichien, the Senior Scientific Officer at the Department of Science was our principal guide. He is a chemist from the Oregon State University and explained how the Ministry of Industry seeks to identify activities around which new industries may be built. For example, glutinous rice was being mixed with wheat to make a new food product that will be marketable in Thailand. Foods were inspected for trace elements. Paper chromotography techniques were used to evaluate the content of pesticides in food products. A Varian gas chromotography equipment, series 2800, was in use. It had been determined that the mercury content in fish caught in certain waters

was below accepted levels and, therefore, considered safe. They were also looking for traces of copper and other metals. In another inquiry they found that the lead content in raw and canned food was acceptable. It was below the maximum set up by the CODEX Alimentarius. If trace elements meet the standard, some foods can be given a Thai quality mark.

A health problem anywhere in the country is dealt with by the Public Health Department (see 5.2), which may pass on a problem to the Department of Science for testing. However, we were told that the Department of Science exists primarily to promote industry, whereas the Health Department exists primarily to protect the people. So, if the Health Department invites the Department of Science to carry out a test, it is done, provided it does not become a routine duty.

The food control committee also sets some standards. The Department of Science then checks the product of a given manufacturer to see if it meets the standard. The purpose of the alcoholic beverage laboratory is to encourage the birth of a new industry by experimenting with new wines that could be produced. Analyses are made for alcohol content, oils, etc. Reports on specific beverages are sent to the Ministry of Industry which deals with the manufacturer if there is a problem. We were given a sample of an interesting gooseberry wine.

The purpose of the nutrition laboratory is to do routine food analyses and to test for the nutritional value of plants that are indigenous to their region and that may be potential products. The new foods would be both for consumption in Thailand and for export. There has been a problem with contamination of some of the tapioca exported from Thailand. Tapioca is a principal export from Thailand. The problem is related to foreign materials contained in the shipped product. Every shipment is now checked for sand, crude starch, and moisture. The tapioca root comes from the tropical plant manihot (manioc or cassava are just other names). The roots are cut into slices called chips. The chips are dried and compressed into pellets, which are easier to ship. The Survey Team decided to study technical and standards aspects of this tapioca problem. The plan was to be alert throughout our stay in Thailand to any relevant observations and to report these findinzs with special emphasis. On the last day, however, it was found that a prior and superior investigation into the problem had been made at the request of the Government of Thailand by Cehave N. V. at the order of the International Technical Assistance Department of the Netherlands Ministry of Foreign Affairs. It covered the production and export control in Thailand, and the marketing in Europe, of tapioca pellets as a raw material for the production of compound animal feeds in the European Common Market. While the full report of that study was not available, an advance 22 page summary had

been circulated. Additional non-technical points of importance emerge which were not dealt with by the Survey Team. For example, it revealed that certain import regulations at the European port of entry are said to place a financial handicap on the use of superior pellets made from steam dried chips. This alleged difficulty is outside the scope of the Survey Team study and in no way negates our technical conclusions which were applicable at the time of the Survey.

The conclusions reached by the Survey Team were:

a. The quality of the tapioca roots is not in question.

b. The yield could be improved by better soil preparation, use of fertilizer, better weed control, and genetic experimentation.

c. Better mechanical cutting machinery to produce smaller chips might be introduced.

d. The cement floor, open air drying is objectionable. Steam drying and pressing into pellets is preferable.

e. The standards for permissible raw cellulose (5%) and sand (3%) are too high and encourage contamination due to poor handling or intentional admixture of the permitted amount. More than one of the several middlemen may be responsible for such contamination. Such permissive standards provide no, or even a negative, incentive for a quality product.

f. Sampling, test methods and the technical capability to enforce the standards are available. However, substandard lots are so frequently cleared for export that virtually all Thai tapioca shipped to Europe sells only at a discount.

g. Bilogical (bacterial and fungus) contamination is a major problem and could be reduced by temperature control. The temperature of the tapioca pellets at loading time often exceeds 50°C. Harbor water temperatures are always below 30°C, so that cooling should not involve a major expense.

h. A standard for meal (powdered tapioca) content might be introduced. The European animal feed manufacturer is said to have trouble from high "meal" content of Thai tapioca.

In the food preservation laboratory methods for preserving foods which might be commercially exploited were investigated. For example, we saw mushrooms that were being dehydrated. Convenience foods are becoming increasingly important in Thailand. Searches were conducted for new foods that could be made from indigenous plants. We tasted gooseberry and mango samples.

In the pulp research laboratory, tests were made to determine which of the various woods that grow in Thailand could be used to make pulp for paper. Short, medium, and long fiber woods are used to make paper. All over the world there is a shortage of long fiber woods. A grass grows all over Thailand that is a good source of the medium length fiber for making paper.

Another laboratory was looking into how to process barium from barytes deposits in Thailand. Presently barium is imported for making soda. A new industry would be created if a conversion process could be developed. Another laboratory was investigating the use of rice husks to produce activated carbon for filters. One laboratory was air conditioned. It housed a Cambridge scanning electron microscope used for studying wood fibers. A staff member commented that he needed to go abroad to learn how to repair instruments that are sold to Thailand. The Department of Science does not operate an instrument maintenance center. We were told that neither the Ministry of Industry nor the Thai Government elsewhere has a strong calibration center. Instruments must very often be sent back to the manufacturer.

We also went through the strength of materials and the cement testing laboratories. There was an impressive X-ray instrument used for phase identification using diffraction techniques. The chemistry section laboratory had a small stock of NBS standard reference materials supplied by NBS. The SRM's were kept for internal, not country-wide, use. There were many uncoordinated chemistry laboratories. The geological chemistry laboratory mostly analysed ground water for hardness. The ceramic research and development laboratory served a fledging Thai industry that was making rapid progress. The woman with whom we spoke received her preliminary training at Chulalongkorn University, then studied and worked in Japan and the Netherlands. It was interesting to note that most of the section and laboratory chiefs were women. Some had been trained in the U.S.

1.3 The Thai Industrial Standards Institute

The Thai Industrial Standards Institute (TISI) was headed by an Acting Director, Mr. Chaiwai Sangruji and included a technical staff headed by Mrs. Phani Na Rangsi, Miss Kanya Sinsakul and Mr. Vichit; consultants resident from UNIDO were Dr. Kenneth Stephens from the

U.S.A. and Mr. Rohn Hopper from the U.K. Right at the end of the team's stay in Thailand, Peiser revisited TISI for a half-day because he judged this Institution to hold the key to progress in Thai standardization services. It is also the institution, besides the Department of Science itself, with which NBS could organize the most constructively helpful follow-up activities in Thailand.

Implementing the Industrial Products Standards Act of 1968, TISI develops and disseminates standards, through operation of broadly based technical committees overseen by a high-level Standards Council. The executive secretariats of the technical committees are provided by TISI. Its staff provides information on existing national and international standards on any product, service or test methodology, so that the development work can be minimized. Adoption or at least adaptation of existing standards is correctly preferred, but even in such cases a consensus between all parties concerned is always obtained. Sampling procedures are an excellent feature of TISI standards. TISI staff are cautious in the use of mandatory requirements available to TISI by law. A preference, rare in LDC's, is shown for voluntary standards. However, where appropriate, compulsion is used, which affects both indigenous and imported products.

TISI has some of the usual administrative problems including especially those of a low salary scale, so that the most experienced staff are often attracted to industry. Imaginative public relations efforts of TISI are commendable.

One of TISI's potentially most effective programs is the operation of a quality marking scheme with clear guidelines to manufacturers on how to obtain a license to display the mark on a specific product line. The following steps are involved after an application is received by TISI:

1.) TISI inspects factory.

2.) Random samples are selected.

3.) A GOT or approved university laboratory tests the sample.

4.) Evaluation of test results is made with feedback to factory.

5.) Technical assistance to factory is given if needed.

6.) Report to Standards Council made.

7.) Preparation and acceptance of a surveillance plan.

8.) License is issued.

9.) Random surveillance and market sampling is continued.

10.) Routine tests based on standards are carried out by the factory in accordance with TISI requirements which may exceed those laid down in standard.

11.) Payments to TISI are made.

12.) Feedback to technical standards committees is encouraged.

The Survey Team members felt strongly that the achievements of TISI under given conditions were remarkable. A gradually increasing interaction with industry was foreshadowed with substantial benefits to Thailand. Undoubtedly TISI and UNIDO staff would look forward to any comment that the NBS/AID team had to make on the adequacy of the laboratory facilities in relation to its certification scheme. Unquestionably good test laboratory facilities would be one way of increasing acceptance by industry of the quality marking scheme. On the other side, TISI laboratories might take away or duplicate unnecessarily existing facilities at the Department of Science and at universities where the interaction with TISI has marked beneficial effects. It is unfortunate that the team never had a chance to discuss such issues in depth and consequently this report cannot include a strong recommendation. The only consensus seemed to be that if TISI establishes a laboratory it should be allowed to grow from very small beginnings step by step for specific and crucial tests.

If the TISI marking scheme grows greatly, TISI will either have to expand its staff or fail to fulfill its own standards of service. The danger is clearly that either the important extension services or the random inspections would be neglected.

1.4 Department of Industrial Works

We were received by Mr. Udomsak, head of the Department of Industrial Works. Through its Division of Factories, it operates an appreciable portion of Thailand's industry including the utilities, 10% of the sugar industry, 30% of the paper industry and 20% of the jute industry. The rice wine industry, however, is in the Ministry of Finance.

At the same time, the Department has regulatory functions over all industry, including vocational training, industrial safety, pollution control, etc. Throughout Thailand the relationship to labor is paternal; the union movement is in its infancy. Midiation is not

needed although Japanese and Chinese employers are said to be rather hard toward their workers on occasion.

The Department received instructions and guidelines from the National Economic Development Board, but did not send up recommendations for new policy initiatives. When technical problems arose the Department of Science was contacted, but this did not happen frequently.

The associated Thai Management Development and Productivity Center was impressive but its functions were considered mostly outside the scope of this Survey.

1.5 Department of Industrial Promotion

We were received by Group Captain Wimon Wiriyawit, Director General of the Department of Industrial Promotion and his Deputy Dr. Prabhas Chakkaphak and other senior staff. In the Economics and Information Division, the Department operates a progressive Small Industries Service Institute which has had UN support and is encouraged by the Thai Government. The principal function of this Department and topic for our discussion concern the Industrial Service Institute which we visited later (see 2.4 and 2.6 below).

1.6 Audience given by the Minister of Industry

An audience was given by General Krit Sivara, Minister of Industry who was also Commander-in-Chief of the Thai army and Secretary General of the National Executive Council. Present among others were Deputy Minister Sa-ard, Mr. Saman of the Mineral Resources Department, Group Captain Wimon of the Industrial Promotion Department, and Mr. Udomsak, Chief of the Industrial Works Department. Despite the formalities inherent in such an audience, a note of genuine welcome and encouragement was clearly evident. Mr. Peiser conveyed a message from the NBS Director, introduced the team, and described the limited goals of the Survey. Dr. Corruccini emphasized the great cost of basic metrology and the need to make choices based on the real needs of industry. It became clear there, and remained so throughtout our stay, that all doors would be opened to give the NBS/AID team the maximum opportunity to work for the benefit of the host country.

1.7 Department of Mineral Resources

Mr. Saman explained that his Department was originally the Royal Department of Mines, which was first moved to the Ministry of Natural Development. Only in the previous year was his organization moved to the Ministry of Industry. The major mineral resource of Thailand is in the alluvial deposits in the South, from which tin is dredged (see 11.1). Mr. Saman warmly acknowledged assistance from experts through

USOM (USAID). Scholarships are offered by Gulf Oil and Conoco. The geological survey of Thailand has been carried out on foot but the satellite program will have a major influence. Thailand had contracted with a German mission for a six year field study recently concluded. We were not told of its principal outcome and did not feel we should ask for such information.

Although as Peiser pointed out, NBS and this NBS/AID team had relatively little expertise in mineralogy and geology, Mr. Saman's group raised two relevant problems on which the team could throw some light. Both these turned out to be measurement problems throughout Thailand.

a.) The Division of Economic Geology needs time to 1/100 of a second in connection with its seismology work.

b.) The mineral industry has trouble weighing ores, especially on moving conveyors.

Among their laboratory equipment was atomic absorption spectroscopy, X-ray diffraction, and absorption spectroscopy. They said they were equipped for magnetic and seismic field exploration. Standard reference materials were in limited use.

1.8 Briefing by USAID (Bangkok)

On this day, and throughout the team's stay in Thailand, Mr. Donald C. Marsden advised the team. He gave basic briefings on Thailand, its people, its industries and agricultural products. Despite his many other commitments, Mr. Marsden seemed available whenever a critical question arose. The team on many occasions expressed well deserved appreciation for Mr. Marsden's guidance.

At the conclusion of the Survey, the Mission Director, Mr. Rey M. Hill gave a debriefing interview to Mr. H. S. Peiser as team leader in which he said that the interest shown by the highest levels of the government of Thailand indicated clearly that the team had discussed subjects of great importance and that the method of approach to many organizations had been found to have had beneficial effects. Mr. Hill for the future was hoping for follow-up activities by NBS especially in the computer field in which the GOT needed consultation for better utilization of existing facilities.

2. Visits of May 22

2.1 Ministry of Commerce, Office of Commodity Standards

The visit to the Office of Commodity Standards was most instructive because of the enthusiastic tutelage of the Director, Mr. Phot

Inganinanda. The OCS was established by the Export Commodity Standards Act of 1960. It deals with exports only. Its principal aim is to establish and maintain a good reputation for Thai products. The Ministry of Commerce determines what commodities must register for each shipment. The Ministry then details an inspection team which evaluates the prospective shipment by sampling and laboratory tests.

At present, ten products--mostly agricultural--are under such control: Keraf and jute, maize, castor beans, tapioca products other than flour, kapok, grain sorghum, silk fabric (yardage), silverware, teak "conversions" (i.e. sawed plank, but not logs, veneers, or furniture), and marina salt (crude). Examination methods may be instrumental (e.g. moisture content of sorghum and maize), wet chemical (e.g. silverware), or visual (teak conversions). The exporter bears the cost of the tests.

The OCS has prepared its own product standards for certain commodities (OCS predated TISI). These standards tend to be based on the requirements of the main customers. For example, the standard for castor beans is based on Japanese requirements, since Japan buys 90% of those exported. Similarly, the tapioca standard is based on EEC requirements since this product goes largely to West Germany, Holland, and Belgium. We noted that the Chief Chemist had been trained in Japan and Germany, these being the chief customer nations of Thailand.

In case of disagreement between the test results of OCS and those that may be obtained by the buyer, the purchase contract will usually provide for independent testing and arbitration--often in London. The terms of the contract are always the governing factor in settlements, once the character and quality of the shipment have been determined.

The necessity for the OCS program arose out of problems of the past, e.g., cheap substitutes being represented as teak and Kanaf, kapok seed waste furnished as paper pulp, and mislabelled silver and gold. However, gold has not been standardized and the Thai sterling silver standard if we understood correctly--does not meet highest assay standards in London. The OCS has authority to punish exporters for failure to meet export standards; the OCS can suspend or revoke export licenses. On the other hand, the Ministry sometimes is able to defend Thai exporters against unscrupulous or inaccurate claims of foreign buyers, such as those who try to recoup losses from market fluctuations by claiming short weight or poor quality. The work of the Office is made difficult by the government's otherwise laudable policy of favoring cottage industries in certain areas, such as textiles and silverware. Apparently the Office is adequately staffed and can respond quickly to requests for registration; there was no mention during the entire tour of economic loss due to delays for

testing or of any consequent need for regional test facilities, themes that loomed large in the corresponding Turkish Survey.

The OCS had a very small and congested wet chemistry laboratory with 12 people. Most wore the brown civil service uniforms.

2.2 Central Bureau of Weights and Measures

The Weights and Measures Act of 1923 (which incidentally specifies use of the metric system) is in force. It is apparently limited to the basic measures of mass, length, and volume. This Bureau with branches throughout Thailand and sections on a.) standardization, b.) qualifications, c.) inspection, and d.) administration, licenses Thai users and sellers of instruments and measures for these quantities and it certifies instrument types as well as each individual scale.

In the laboratory the team members saw one-meter and two-meter scales with verniers and Sauter balances of various sizes and ages. These, together with standard weights purchased from Germany, seemed to comprise the so-called secondary standards of the Bureau, but it proved difficult to ascertain just how or indeed the extent to which they were used, and the location of the primary standards. In a workshop of spartan simplicity we watched adjustment and verification of 7 1/2, 15, and 35 kg spring balances. About 500 were on hand. Galvanized dispensers for liquids or granular products and 10 liter to 40 liter wooden buckets for grains were also on view. We were unable to ascertain the accuracies required of any of these.

A petroleum testing laboratory in the Central Bureau of Weights and Measures was established under the "Oil Fuels Act". It is equipped to handle diesel fuel and lubricating oils. At present, research laboratories desiring to have measurement standards calibrated can request a calibration from the Department of Science, and the Department of Science is looking towards this Survey Team to recommend a simple formula for instituting a reliable national calibration service for which a desperate need is felt.

2.3 Chulalongkorn University (Bangkok)

Chalalongkorn University is reputed to be the one with the strongest science and engineering program in Thailand. The Faculty of Arts and Science was established in 1918 and benefited from grants from the Rockefeller Foundation.

Apparently, many members of the professional staff of the Department of Science received their undergraduate education there. Unfortunately, the Survey fell in the period between terms. Thus, laboratories and classrooms were empty, and but few staff members were

available. The following are some miscellaneous notes on a few of the departments visited:

a. Mechanical Engineering: There were 80 senior students, and a staff of 30. There were 12 MS candidates. The Department was just converting the teaching from British to SI units. One member of the staff served on a TISI committee. We saw a conventional engines laboratory.

b. Industrial Department: Students could choose between two options: Chemical Engineering and Industrial Management. There were 22 seniors in each. The Department had little equipment.

c. Civil Engineering: There were 400 students. The Department was well equipped for mechanical testing. They tested for TISI and charged fees. We also saw hydraulics and soil test equipment.

d. Sanitary Engineering: This Department had a four-year program with 100 students altogether.

e. Electrical Engineering: A total of 400 students were in this Department. There was a control systems laboratory and a modern analog computer (Japanese). Ballasts and lamps were tested for TISI.

f. Physics: The Physics Department had 40 undergraduate students and 12 MS candidates. Graduate laboratories included a nice-looking nuclear spin apparatus being applied to liquid crystal studies, and an X-ray diffraction apparatus. With the latter, structures of some pure macromolecular organic crystals supplied by the Chemistry Department had been determined. The outlook of the Department seemed to be to "do their thing" as pure physicists. Thus, there was no contract research or consultation in applied physics. The faculty was trained mostly in English-speaking countries. Laboratory technicians were plentiful. Typically they were recruited from among TV repairmen and given special training for scientific laboratory work. Regarding metrology and instrument calibration, the Department (and University) had no special facility for such services.

2.4 National Energy Authority Laboratory

This organization (NEA) tests products under a law which gives it responsibility for public safety related to power and energy. We saw testing of ballasts for flashover as a function of humidity, life

testing of switches, tests of wire and cable and switch housings. Typically, they would follow IEC test procedures. (Ballasts and incandescent lamps are manufactured in Thailand, but flourescent lamps are not. Wire and cable are also made in Thailand using imported copper and PVC.)

Their standards of resistance, voltage, and current were said to be referred to those of ASTRC (see 2.9). They have a GE "primary standard" watt-hour meter with certificate.

NEA performs some tests for TISI and it provides expert members of certain TISI committees. We were told that conflicts of interest have occurred between NEA and TISI, for example, regarding testing of ballasts. This type of problem is common to all countries and is inevitable. Any planner who writes that there should be just one responsible organization for all testing and regulatory control, fails to appreciate important realities.

2.5 Thailand Chamber of Commerce

Our visit to the Thailand Chamber of Commerce was brief. It could well be that we underestimated the technical and standards functions it fulfills. It did not provide a forum for professional technological and engineering discussion as do the corresponding chambers in Turkey. The Chamber resembles more closely the U.S. counterpart organization and thus falls outside the scope of this Survey.

2.6 The Industrial Service Institute (ISI)

The Industrial Service Institute which has a branch at Chiang Mai (5.5) assists entrepreneurs to develop and improve small businesses. The Institute is in the Department of Industrial Promotion (1.4) and was founded with much help from UNDP. Even now ISI welcomes foreign experts sent by UNIDO and the ILO. Although ISI provides many other services its technical aims are also extensive. It provides:

a. Seminars and Training Courses

b. Consultation and Technical Management

c. Cost and Productivity Studies

d. Factory Planning

e. Advice on Quality Control

f. Demonstrations on New Manufacturing Techniques

g. Advice on Raw Material Evaluation

h. Feasibility Studies

i. Market Surveys

j. Design Consultation

k. Packaging Design

l. Product Testing

In addition to an Administrative Division the principal units of ISI are:

a. Extension and Training

b. Economics and Information

c. Design Testing

d. Packaging

e. Workshop

f. Chiang Mai Branch

The strongest expertise of ISI is in the following areas:

a. Machine Shop Practice

b. Tool and Die Design

c. Heat Treatment

d. Electroplating

e. Sheet Metal Working

f. Welding

g. Forging

h. Foundry Technology

i. Plastics Fabrication

j. Woodworking

Special facilities in the ISI building include:

a. Library

b. Conference and Lecture Halls

c. Design and Drawing Offices

d. Machine Shops

e. Welding Shops

f. Forge

g. Electroplating Shop

h. Chemical Laboratory

i. Model Foundry

j. Pattern Shop

k. Woodworking Shop

l. Plastics Forming Shop

We talked chiefly to the following staff members who gladly answered our many questions:

° Mr. Ghamnu Vasinonta
Chief of Workshop

° Mr. Virot Vipa Tapaet
Senior Industrial Officer

° Mr. Manu Leopairote
Chief of Economics and Information

° Mr. Padetpai Meekun-iam
Chief of Design and Testing Division

° Mrs. Orapin Werawut
Chief of Administration

° Mrs. Nataya Chaiyarat
Designer in Packaging Division

The staff was very small compared with the tasks (about 20 with appreciable technical experience). All were enthusiastic and felt

convinced they provided a badly needed service. They had contacts mostly through UNIDO and AID with international organizations, but no strong linkage with the Department of Science, AIT, or ASRCT. Metal and plastics technology are to be priority areas, but detailed planning direction appeared not to be received from the Ministry of Industry or higher planning groups. Some staff members felt they were too busy to be responsive to other organizations in Thailand or higher Governmental policies. Contact with some small industrial and manufacturing units was good. However, ISI did not appear to be widely known to industrialists on small companies.

The services of ISI appear to be well conceived, but it seemed strange that even experts from abroad tend to work diligently within institutions like ISI without establishing strong links with other foreign experts in another like TISI. ISI and TISI would gain in many instances by cooperating as a pair of organizations delivering to industry distinct but related services.

2.7 Tanning Organization

The Tanning Organization is part of the Ministry of Defense but serves the civilian as well as the military market. We were welcomed most graciously by Major General Charoen Supapongse and Mr. Phon Chatura, Chief of the Pig Skin Department. Miss Sunantha Phut Inart is the Chief of the laboratory.

The Tanning Organization operates the biggest and most modern tannery in Thailand employing over 500 workers. It processes cattle and buffalo hides. The products are all kinds of leatherware. There is a severe quality problem due to lack of a refrigerated storage plant. The output is mostly for the home market. After severe rejection rates at several production stages, products appear attractive, are of very reasonable cost and are marketed through the Tanning Organization's own stores.

2.8 Ceramic Research and Development Center and Textile Testing Services

The Ceramic Research and Development Center was under a Japanese expert from the Tokyo Institute of Technology. He had designed and built several kilns and furnaces with his Thai trainees. Students were learning to handle raw materials and produce simple ceramic ware and refractories. Unfortunately the Japanese expert claimed to be unhappy with conditions and even with his Thai trainees. His preference was to guide applied scientific research and install elaborate instrumentation, and he was requesting funds for much state-of-the-art instrumentation. The perceptive guide from the Department of Science had notice from Peiser's questioning that he had come to

the conclusion that the kiln building and pilot ceramic production were more relevant here than the advanced research described. The guide felt that after that determination questions on the applied research, which the Japanese expert wanted to do, were irrelevant.

The Textile Testing Services, also under the Department of Industrial Promotion of the Ministry for Industry, were well explained in terms of Thai development needs. Here Mr. F. Massam from Lancashire, England, guided and trained enthusiastically 155 trainees studying for two years. All kinds of fibers including silk were processed. Spinning, dyeing, weaving, and finishing operations were learnt with simple machinery. Quality control and other tests methods were part of Mr. Massam's practical course.

2.9 Applied Scientific Research Corporation of Thailand

The Applied Scientific Research Corporation of Thailand (ASRCT) is a semi-independent non-profit confidential consulting organization to help industrial development, with a direct reporting line to the Prime Minister's Office. It had received support from UNESCO and the UN Special Fund. In addition to its laboratories ASRCT maintained a staff of economic, management and marketing consultants. ASRCT--so the slogan says--"can help you make money." It has indeed success stories to tell including those concerning:

a.) basil oil production

b.) tin plate production

c.) a ferro-cement grain storage silo.

ASRCT had an information service, printing capability, national measurements reference standards, the Center for Thai National Standard Specifications (CTNSS), and the Instrument Repair and Calibration Center (IRCC).

Our hosts described the IRCC first. It was said to be "ready to service (for nominal charges) any instrument or equipment rendered unusable because of faulty components, missing parts, inadequate or missing operating instructions, or inadequate calibration". Apparently IRCC was instituted to serve the Government for repair and calibration services of test instruments. However, it had not been fully utilized and at the time of our visit was not suitably equipped. We were told at the Department of Science that the Government does not have a strong instrument calibration center and that instruments must often be returned to manufacturers for repair or calibration.

An integral part of ASRCT was the Center for Thai National Standard Specifications (CTNSS). Although the team visted CTNSS, observations are now irrelevant because this unit has since been disbanded.

As long ago as in June 1969, Lal C. Verman, while ECAFE (Economic Commission for Asia and the Far East) Regional Adviser for Industrial Standardization, pointed to the disadvantages of proliferation of standardization organizations in Thailand in his Advisory Service Report on Standardization in Thailand. This problem remained essentially unchanged and it had evidently not been possible to implement the advice given by Verman. It might be well to quote Verman's principal conclusion:

"In conclusion it may briefly be stated that, after having studied the existing structure of standardization activity in Thailand, among the seven of its agencies created under seven different statutes, the author has found it necessary to recommend the ultimate creation of a truly national standards body, which would centralize all national activity, enlist the cooperation of all interests concerned, eliminate all duplication of effort, be able to project an authoritative image nationally and internationally, and above all provide conditions for the optimum utilization of the limited resources available in developing economy to the best advantage."

He also found that the time was not quite ripe for taking such a step immediately, but that the formation of a high-level consultative body of all the existing agencies to help achieve the ultimate goal within the next 7 or 8 years would be opportune. In the interim period this consultative body would guide the country to move in the direction of a central body and be entrusted with the responsibility for the coordination of all standards activities among the various agencies. He felt that this will prove a workable solution and help realize the ultimate aim.

The Survey Team tended to support Verman on the problem but would not feel qualified to press for the implied solution which looks so good and simple on paper but cannot in practice be realized in Thailand, India or anywhere. Besides one might well ask whether such an organization would not be so large that the problem of interdivisional relationships within the organization could just supersede the interorganizational problem. A more permanent system of cooperation between governmental standards writing authorities may be a more easily workable alternative and may serve Thailand better. In that mode CTNSS should, for example, make full use of available U.N. advisers in the country at other standards-writing organizations.

It should also be borne in mind that those who wrote the legislation for ASRCT had the national standards, instruments and calibration

center in mind just as Verman advocates. Yet in practice ASRCT could not by their services establish such a unique role. In practice and despite ASRCT's excellent legislative and administrative location, TISI and the Department of Science in their services to industry now seem to serve a more effective role.

2.10 Visit to Kasetsart University

The Survey Team was received by the Vice Director of Kasetsart University who was a member of the newly formed Committee of eight on Policy for Science and Technology attached to the National Executive Council in the Prime Minister's Office. Dr. Prapit Nanagara of the Department of Science was also a member. The communications with the Committee were being established, so that existing technical resources could be used, the Government could ask the right questions, and the technical community could listen to the issues and pass forward its relevant advice. This last point seems to be of great importance. The team had the impression that Thai professionals find it easier to be directed by authority than to give that authority the benefit of their advice. Good planning in science should go from bottom to the top as well as the other way round.

Dr. Yongyut Chiemchaisri, a senior professor in the Chemistry Department of the University, was not at all interested in any form of administration, in any coupling between his activities and national problems, or even in any cooperation with other professional chemists working in other institutions. Although Dr. Yongyut's views on these issues were extreme, they do point to a characteristic of Thai professional attitudes. Of course similar viewpoints are met in the U.S. and other countries, but rarely to the same extreme. To illustrate the existing national differences we give two illustrative examples:

We raised the subject of the extent to which the Kasetsart University advocated participation in professional technical societies in order to foster good communicationszamong working professionals. Dr. Yongyut startled us all with the statement that the people at Kasetsart have a great deal to do and that people, for instance, at the Department of Science also have a great deal to do, so why should they spend a lot of time talking to each other.

The second example is the following:

We wanted to obtain some additional insight into the reasons for the existing textbook shortage. Dr. Yongyut stated that in Thailand a university will use only textbooks that were written at the university! This surprising rule was confirmed at other universities.

It seems that the communication problems faced by standards organizations are not unique in Thailand.

2.11 Lever Brothers

At Lever Brothers (Thailand), Ltd., which manufactures Lever products according to the central company's specifications, we were graciously received by the Director, Mr. Tanee Intrasuit, and after a period of discussion, went on a detailed tour of the manufacturing and testing facilities. In the analytical laboratory, environmental control, safety procedures, test methods, and analyses were carried out according to the company book of procedures. The company specified standard materials and test methods in great detail plainly written. Government standards existed for soaps and were being developed for detergents. The company was confident it would easily meet such standards. Weighing scales were calibrated by a local engineering company and were also checked by the Government of Thailand.

2.12 Thailand Iron Works

Factory manager Mr. Vitoon Siriyakorn met the Survey Team. This Company galvanized and corrugated sheet iron which had been imported from Japan. There was little to observe in the way of test methods. Average thickness of the galvanizing layer was determined by average weight. There was also a visual inspection. A large weighing scale was calibrated occasionally by the Government.

2.13 Colgate - Palmolive (Thailand) Ltd.

At Colgate-Palmolive (Thailand) Ltd., we were received by the Australian Plant Manager, Mr. P. D. McLeod, who expressed the Company's interest in cooperating with government committees developing standards. A tour of the manufacturing and testing facilities was led by the Production Manager, Mr. Prasarn Luhkraisiddhi, and the Industrial Engineering Supervisor, Mr. Sukawat Smaksevi. As at Lever, everything was done according to the central company's specifications. Various instruments were calibrated by local engineering representatives. An interesting aspect of the standardization process was illustrated by the laboratory desire to have brightness testing included in Government specifications. This laboratory possessed an instrument for such testing but not all the soap companies did. Upon departure, we were presented with specimens of the Company products for all the team members and Thai associates.

2.14 Port Authority of Thailand in Bangkok

At the Port Authority of Thailand we had a pleasant discussion with Mr. Chit Chinphun, Mrs. Chunya Naksupa and Mr. Tavorn. The primary

measurements seemed to be of package dimensions (carried out with a tape measure) and of package weight (carried out with a scale sometimes taken by truck to and from some other site.) The means for recording temperature of biodegradable products and moisture content would find applications, for example, for tapioca. The visit concluded with a brief tour of the facilities.

2.15 Esso Standard Thailand Co., Ltd.

At the Esso Standard (Thailand) Company a number of laboratory measurements involving properties such as viscosity were carried out with instruments calibrated with standard reference materials. There were, of course, also field calibrations involving measurements of volume. The volume of incoming petroleum products was subject to three measurements which could be intercompared: at the refinery, by the tanker, and by this distribution center. All these were made and compared according to Company's specified procedure. Local volume calibration tanks were checked by the Government as well as by the Company. Many similar examples were found in Thailand where redundancy in measurements probably gives better compatibility and even accuracy than might be expected from the lack of calibration schedules or traceability to physical standards of high integrity.

3. Visits of May 23

3.1 Association of Thai Industries (ATI)

This Association has 300 member firms. They are predominantly small, but most of the large firms of Thailand are also members. At present there are no state industries in the Association, although there is nothing to prevent them from applying.

Economic development originally focused on agricultural products, but has been turning towards industrial products with export potential, e.g., cement, textiles, and beer. ATI recognized that this trend necessitates paying attention to the field of product standards. They admitted that the Government has an essential role in standardization but felt that the rate of progress of Governmental activity in this area was too slow. Criticism of TISI seemed rather severe. The example of the shrimp standard certainly was in part of doubtful validity because it is based on the Codex Alimentarius. For another example, ATI wondered why standards which have been developed by such bodies as ISO, DIN, ASTM, etc., could not be recognized. Surely they could be immediately adopted in translation, rather than developing special Thai standards with the time-consuming committee work and testing of products of local industry that this seems to necessitate. There is a valid answer to this criticism. Thai standards often are closely similar to other national or international standards. The

selection from alternative sources is often a worthwhile activity. Some adaptation to Thai conditions is rewarding besides introducing committee members to problems, opportunities and choices. Similarly trial tests have a strong and essential training function.

ATI put forward the view that a quasi-private status of the main standardization activity with government support might offer advantages. LDC's that have attempted such organizations (e.g., Brazil) are turning away from that kind of organization. At any rate, the budget of the GOT for standardization was seen as inadequate. Although there was no Thai patent or trademark law, trademarks were nevertheless administered by the Commerce Department.

Regarding testing facilities, producers were generally thought to have sufficient laboratory capabilities to assume control of their own products. Sophisticated methods were hardly ever required, given the nature of products manufactured in Thailand. Thai industry supports little or no R&D at its present stage.

ATI is ruled by a Board consisting of a President, three Vice Presidents, two Secretaries General, two Treasurers, two Legal Advisers, a Registrar, three Sergeants-at-Arms, and twelve ordinary members. By this distribution of functions a wide participation by many companies was assured.

3.2 The Coon Rawd Brewery Co. Ltd.

We were conducted by Mr. G. Glauninger, a German, who was the Company's head brewmaster. The excellence of this modern plant, its meticulous cleanliness, and the good quality of the product are a pleasure as much to behold as they are for the Company to show. Addition of a percentage of rice is permitted in Thailand in place of barley. This addition alters the taste perceptibly but not at all unpleasantly. The turbidity test was beautifully displayed to visitors but on questioning, Mr. Glauninger conceded that production control rested on faster tests. Most of the product could have been dispatched before the standard turbidity test would indicate certain bacteriological impurities. The description of a possible technique for curing a minor problem with a production control measurement may have compensated the Company for our gracious reception. The visit to this brewery was unique in the team's experience in that the tasting of its product was not part of the tour. In evenings spent in Thailand we had many other opportunities to enjoy that beer.

3.3 Siam Garment Ltd.

At the small Siam Garment Company we were received by the Manager, Mr. Tweesak Dhepnukul. This factory made cotton shirts, blouses and other

garments. It employed mostly women. Many women pretend to be single while they are actually married. In most companies married women are not eligible for employment but benevolent employers do not inquire too deeply.

Electric sewing machines are the only modern equipment. Work is done by copying submitted patterns. Mr. Tweesak had only one hope from our visit and that was that we would obtain orders for his Company for the U.S.A. Why else would we visit his plant? Our explanations were apparently considered polite rejections of his products. We tried to make him understand with the result, we fear, that he was left with the hope of receiving orders. He recognized that we had given no promises.

3.4 Thailand Carpet Manufacturing Co. Ltd.

The Thailand Carpet Manufacturing Co. Ltd. worked in conjunction with sister firms in Taiwan and elsewhere. Carpets were said not to be for export, yet are of high quality, hand knotted, and finished. The finest quality of silk carpets were not attempted. Appreciable technology transfer occurred through competitive British, German and Swiss firms supplying dyes. Production controls and inspection procedures were traditional. As no competition was feared and no competition for export was attempted, the Company was not open to much work on standardization or innovative ideas, yet gave the impression of a good organization with reasonable conditions for labor and an excellent product. Prices were less than half of those prevailing in the U.S.A.

3.5 Isuzu Motor Co. Ltd.

The Isuzu Company is a Japanese truck and bus manufacturer affiliated with Mitsubishi. The above plant, in the suburbs of Bangkok, assembled two models of truck chasses, a light truck and a heavy-duty truck. It turned out 500 per month, about 70% being heavy duty trucks. The Company claimed it sold 88% of all trucks and buses then being sold in Thailand. (However, one saw many Mercedes as well.) Its main customer problems arose from overloading of its vehicles. (The team noted many examples of this in its travels. As an example, the Datsun pickups commonly used as jitneys were usually "loaded to the gunwales" with passengers riding on benches in the five-foot long bed, their personal effects on the canopy. One which we saw smartly negotiating a mountain grade disgorged sixteen people!)

Most components used by Isuzu were imported from Japan, and were tested before shipping. Batteries, radiators, and paint were produced locally. However, the local sources were often Japanese affiliated or controlled. Production line controls included visual inspection of

paint and riveting, a brief driving test, checks of brakes, lights, speedometer, and wheel alignment. If engine adjustments were needed, they were performed at Mitsubishi in Bangkok. Measuring instruments included a master speedometer, a "standard torque wrench", an electronic paint thickness gage, and the brake dynamometer. We were unable to ascertain if the calibration of such devices was a concern.

The plant used less power handling equipment than its counterparts in Japan. The manual operations that we observed were highly specialized and unsophisticated. However, the workers' positions were constantly changed so that a worker could learn the entire assembly process within three to six months. They had two Japanese engineering advisers who were there on two-year assignments. Formerly there were as many as seven. The foremen were Thais. The labor force numbered 200. Our host was the Manager, Mr. Thavil Tandhapongse.

As in the case of Bangchun General Assembly Company (see below) the more sophisticated quality controls using physical instruments were being performed out of Thailand by the parent company. Isuzu appeared to be even more isolated than Bangchun from any dependence on Thai national production standardization requirements or instrument calibration facilities.

3.6 Bangchun General Assembly Co. Ltd.

This automobile assembly company, located outside Bangkok, was formed by a coalition which favors local assembly and penalizes importation of fully assembled cars. Individually they could not have justified acquisitions of assembly facilities, but the collective venture had proved successful. The cars were the GM Holden, Alfa-Romeo, and one other. One might suppose that difficulties would arise from the workers having to switch periodically from one assembly routine to another but such problems had not materialized. The company started with a nucleus of trained workers but most of the employees were trained on the job. The plant manager worked previously in Singapore and Manila, and he feels that Thai workers are superior.

The law required that domestic products should account for 25% of the value of the car. However, this was somewhat ambiguous and was flexibly interpreted. They used domestic paints, sealer, and greases. Domestic glass and rubber were in prospect, and perhaps later wiring and mufflers. However, the automobile market was too small and was shared among too many makes for domestic manufacturing of more sophisticated components to be economical. There would be advantages to limiting the market to about three lines only, as has been done by India and Korea.

Two problem areas were mentioned:

One was the variety of other national standards governing imported components, e.g., screw threads, dimensions of tubing and fittings, etc. The other was the unreliability of some domestic products. As an example, the Company had been supplied a lot of nice-looking bolts marked as high-tensile, which turned out to be made of an ordinary grade of steel. The manager felt that the TISI mark on such items would be a partial assurance, but that one would still fear unscrupulous and unauthorized copying of the mark. (The Act of 1968 provides rather severe penalties for improper use: confiscation, fines and imprisonment.)

There was little quality control to be seen here, since it was largely performed elsewhere, either at the source of major imported components (e.g., engine, drive train), or at the distributor's depot for completed vehicles. Bangchun did test the settings of its spot welding machines twice daily with visual, qualitative assessment of the results.

Thus, although every effort was made by our hosts to be helpful and informative, the visit was not very useful. It might have been better to have talked to the management level of users of Bangchun products.

The larger and very interesting question of whether the Government's policy on import taxation of automobiles is wise, is, of course, outside the scope of the Survey.

3.7 Telephone Organization of Thailand (TOT)

The Telephone Organization of Thailand provides domestic and international telephone, telegraph and telex services. Our visit was to the Test and Development Center. We were received by the Chief of the Center, Mr Olarn Phiendham.

The Center has been operated since 1964. It is a joint venture of the Thai Government, UNDP and the International Telecommunication Union, providing consulting, calibration and testing services, preparing engineering instructions, and drafting standard specifications. The Team believes that Thailand's communications industry can confidently build on the technical resources provided by this Center. An HP 107 oscillator was the frequency reference. A Tracor 599 VLF tracking receiver steered the oscillator to the 22.3 kHz Australian signal. There are three Rhode and Schwartz crystal standards. They also had a Rhode and Schwartz rubidium standard. They tracked Rugby (16 kHz) and Northwest Cape. They used a Fluke 207-1 VLF receiver on 22.3 kHz. They got only the skywave from Northwest Cape. It was very smooth.

The voltage standard was a 1.019 3-volt standard cell. The standard resistance box had 1, 10, 50, 100, 200, 500, 600, 1k, 5k, 10k, 50k, and 100kohm resistances. The capacitance standard had a range of 200 pF to 0.1μF. The inductance standard had a range of 1μH to 1H. These were all sent to Hawaii for calibration (USAR PAC Standards Laboratory).

The objectives of the Center included the following:

1.) Setting up of a calibration laboratory to provide the required services to all the telecommunication organizations

2.) Developing specificationzterials and equipment to suit local needs

3.) Acceptance testing of stores, equipment and installations in the different fields in the telecommunication organizations

4.) Issuing of engineering instructions in the various fields for adoption in the operating administrations.

Mr. Olarn explained that TOT prepares their own written standards. These standards are prepared following procedures used by many companies in Japan, U.S., England, and Europe. In some cases TOT works with contactors in preparing the standards.

The Repair and Calibration Section at TOT maintained primary standards for TOT. TOT had a mobile laboratory that travelled all over Thailand visiting the TOT offices to perform calibrations. Another mobile laboratory was to be acquired during the year following the Survey.

HF Time Signals: WWVH was received on 15 MHz and 20 MHz. Ordinarily they could get WWVH at any time of the day or night, and sometimes WWV. They could not receive JJY. WWVH was overlayed with BPV. We could hear BPV tick plus a female voice. The recording quality was fair. We were informed by laboratory personnel that we were in the middle of a 3-day sunspot maximum which started on the previous day at about 1400 hours. An additional recording of an HF time signal was made. They said it was RIP in Mainland, China.

We saw their repair facility and acceptance testing laboratory. The telephone cables they use are manufactured in Thailand. A local factory could manufacture up to 900 pairs of cable. One local branch was Phelps Dodge; the other was Yasiskee from Japan. About 80% of the cable used in Thailand was produced locally. We also saw their facility for type and acceptance testing of telephone hand sets. TOT supplied a few microwave links for the television network. TOT was supposed to supply and maintain all television links in Thailand.

There was a microwave link for television programs as far south as Hat Yai (close to Songkla) and as far morth as Chiang Mai. The next year there was to be a link up to Khon Kaen in the northeast. The TV network was used daily for newscasts. No circuit switching was involved.

The Public Relations Department of the Thai Government was directly responsible for policy concerning the nationwide television network. A police communication system was separate from all others, and came under the Interior Ministry. The Post and Telegraph Department, dealt with Intelsat. According to the Weights and Measures Act, the Department of Weights and Measures has responsibility for commercial standards of weights and measures as well as for maintenance of all primary standards of measurement. The collaborative links between these organizations was only loose. The NBS/AID team discussed on many occasions the benefits that Thailand would derive from closer cooperation or reallocation of technical responsibilities.

3.8 The Hydrographic Department

The Hydrographic Department of Thailand has responsibility for hydrography, geodesy, astromony, and time standards. We were received by Lt. Cmdr. Dr. Permsak Vijjanukroh, Mr. Pitayakorn Pinitpouvadol (Purdue MS) and Dr. Chawewan Koonkhamlert, who had recently received the first PhD degree to be awarded by a Thai University. Her accomplishment was being acknowledged by a display at the Rockefeller Center in New York.

We were told that the Hydrographic Department would shortly begin standard time broadcasts. One would employ frequency modulation at 104 MHz with 1 kW radiated power. Short-wave broadcasts at 1.2 MHz, 10 kW and an unspecified medium-wave broadcast were planned. The format included time, frequency, weather information and disaster warnings.

A single side band microwave link to EGAT was scheduled for implementation before the end of 1973 which would provide time in binary code once each second.

Dr Permsak had offered to conduct seminars for a number of agencies on the applications for standard time. EGAT was the only agency that had responded to his offer.

3.9 The Board of Trade of Thailand

The Board of Trade of Thailand is an independent organization formed essentially by representatives of the Chamber of Commerce, the Trade Association, State Enterprises, Cooperative Societies and Companies. Its Annual Report 1972/3 highlights some recent contracts with the

Peoples Republic of China, some resistance to Japanese goods, an anti-luxury campaign, and support for home-produced products. The Board had an excellent publication program including the weekly "Trade Bulletin" and advised the Government of Thailand on many trade and business problems.

Our host was Mr. Rangsan and the Deputy Secretary. The tapioca problem was again discussed from the viewpoint of the inspection procedures carried out by the Board of Trade which some say simply doubles the problem and expense of having consignments certified that do not meet the standard. Similar problems existed for rice and other processed agricultural produce.

3.10 Visit to Channels 4 and 9

We met with Mr. Tawat, head of the TV Technical Division, Thai TV Co., Ltd. It operates under the Department of Public Relations which has stations at Lampang, Khon Kaen, Songkla, and Surat Thani. In addition there are rebroadcast transmitters at some locations. Once each day a 15 minute newscast was broadcast live from Bangkok. The stations just mentioned carried the live newscasts with the synchronization information intact. The Federal Communications Commission (FCC) TV format was originally used in Thailand, but it caused trouble because Thailand has 50 cycle power. Thai TV had to use 50-60 cycle power conversion equipment at the transmitters, so they switched to the International Radio Consultative Committee (CCIR) format. They still had two stations that broadcast the FCC format, but all future stations were to be in the CCIR format.

Mr. Tawat explained that Thai TV was the only "private" television company in Thailand. The other television companies were owned and operated by Government agencies. The Thai TV Company is owned by "shareholders". The shareholders are the Thai Army, the Navy, the Air Force, the Police Department, the Ministry of Finance, the Lottery Bureau, the tobacco monopoly of Thailand, and the Government's Public Relations Department, which is the major shareholder. The Public Relations Department exercises very tight control over the Thai TV Company, which is independent in the sense that it receives no revenues from the Government. The advertisers who sponsor its programs are its only source of revenue.

The Thai TV Company owns and operates Channels 4 and 9 as well as a number of AM and FM radio stations. One of Thai TV's FM stations is piped into hotel rooms. It is known to Thai's by its call letters, Taw Taw Taw. Its carrier frequency is 99.5 MHz. That station carries the "early bird" program which appeared to be very popular in Thailand.

The Thai Army had both radio and television stations of its own. Their operation is entirely separate from Thai TV. The Government's Public Relations Department operates a number of television stations, most of which were up-country. These stations were known as the National Radio Network of Thailand. The Public Relations Department administers the broadcasting laws in Thailand. The Communications Law is administered separately by the Ministry of Communications. That organization has responsibilities which apparently include activities equivalent to those of the FCC in the U.S.A. All stations must register with the International Frequency Registration Board (IFRB) whose headquarters are at Geneva, Switzerland.

When a government agency operates a broadcasting station, its activities are not controlled by the broadcasting law. If the Public Relations Department wanted to use the NBS TV Time System and/or to caption on Thai TV, they would not have to obtain approval from any other authority.

The use of the TV Time System in Thailand would benefit the TV networks themselves. The clocks at the local stations around the country were not well coordinated at the time of the Survey. The only nationwide broadcast was a daily 15 minute newscast. Mr. Tawat said that they would like to have more network programs. One discouraging factor was that they lost about 5 minutes of program time every time they assembled the local stations into a network. Part of that time loss was related to adjustments that must be performed, but another part of it was because the clocks in the local stations did not all read the same.

Airline terminal clocks are already coordinated adequately. However, captioning carried additional interest for Thailand. There are a few minutes of programming that occur at 7 p.m., 8 p.m., and 9 p.m. each day with captioning. When queried as to whether this was partly aimed at improving literacy, Mr. Tawat said that it was. Some sponsors liked the captioning, but others did not. It was not done universally. Mr. Tawat was enthusiastic about the captioning opportunities associated with TV time.

3.11 The Provincial and Metropolitan Electricity Authorities (PEA) and MEA)

At the Provincial Electricity Authority one survey team member (Larry Gatterer) met Mr. Aroon, the manager of the engineering division, Mr. Boonlert, the Chief of Standards and Construction, and Mr. Som Chai, the Chief of the Technical Section.

The Yanhee Dam had been completed and was in operation. The largest generator at Yanhee is one megawatt. The Electricity Generating

Authority of Thailand (EGAT) takes care of the main power distribution network from Bangkok north to a place called Tak which is the location of the Yanhee dam site. EGAT is responsible for power generation at Yanhee and for taking care of the main transmission line down to Bangkok. PEA takes care of the local substations and the radials from the substations to the homes. EGAT's primary responsibility is with regard to the generation of electricity. PEA's primary responsibility is for distribution of electric power.

The Metropolitan Electricity Authority (MEA) generally has the same duties as does PEA except that MEA serves only Bangkok, Thon Buri Nonthaburi, and Samut Parkan. All the other provinces in Thailand were taken care of by PEA. EGAT will control the power to be generated by the many dams around Thailand.

The team did not obtain a clear picture of how electrical standardization was coordinated, for example, with TOT's Test and Development Center which had effective assistance from UNDP and ITU.

3.12 The Royal Thai Air Force Precision Measurement Electronics Laboratory (PMEL)

Mr. Gatterer went as the only NBS/AID team representative from abroad to visit the Royal Thai Air Force Precision Measurement Electronics Laboratory (PMEL) at Don Muang. He was accompanied by Ms. Kanya and Mr. Ari of the Department of Science.

The meeting was with Ruthstrom, Boonyamit, Suntus, and Papaat. The USAF advisor to PMEL is Senior M/Sgt. Carl R. Ruthstrom. He was previously stationed at Lowry and has visited NBS Boulder. He was to be leaving Thailand during July, 1974. Major Boonyamit is a member of RTAF and was the officer in charge at PMEL. Colonel Suntus was Chief of the Electronics Maintenance and Calibration depot at the PMEL. He was the prime mover here on maintenance calibration and he also had visited the NBS Boulder Labs. At the time PMEL was an RTAF facility but in a few years it was to become a tri-service facility. Thai Army and Navy do not have PMEL's of their own. They received services informally from this facility. The tri-service facility arrangement was in de facto existence, but it had not yet been funded as such.

This PMEL was set up under the Military Assistance Program (MAP). The new building will be roughly twice the width and about the same length as the present one. The facility will correspond roughly to a type 2A or 2B facility. It is working toward a 2A facility. Note that the Thai tri-service calibration center would then be removed from NBS by only one intervening level, provided by Newark AF Station.

Sgt. Ruthstrom and Dr. Stephens (Quality Control Expert at TISI) had already been in contact during the preceeding few months. Improved communication among standards groups was noted. Previously there was almost none between military and civilian authorities. Sgt. Ruthstrom suggested that if the Department of Science standards were controlled with regard to NBS standards then it would no longer be necessary to the tri-service calibration center to send its standards all the way back to Newark for calibration. The USAF has four PMEL's plus two transportable calibration units in Thailand. RTAF has this PMEL only.

The TOT people had suggested to Ms. Kanya (of TISI) that she should set up a technical committee for calibration and coordination standards. This committee would correspond in some ways to a professional technical association. Membership would be from TOT, Air Force, TISI, ASRCT, and other interested parties. The calibration and coordination people from these various organizations would also participate. However, she cannot set up this organization on her own because no committee may be set up without the permission of the Minister. Major Boonyamit's comment was that the committee may be a good idea but that he cannot accept the opinion of the civilian group unless his superior officer affirms that the advice is in accord with existing policy. The Thai's have very great respect for their elders and this respect carries over to their superiors. In Thailand people wait for instructions from their superiors. They wait and tend not to ask for permission.

The PMEL had standard resistors, capacitors, conductors, and saturated standard cells. All were to be calibrated at the center in Newark. They had a set of class S-1 weights. They used a John Fluke Model 207 MLF receiver and phase frequency comparator tuned to USN station at 22.3 kHz. They receive NWC from Northwest Cape. NWC uses a CS oscillator. They had trouble with HF, since the requirement here was for a stable frequency reference. Time (date) is provided by Royal Thai Navy, Hydrographic Department. No Loran-C receiver is at PMEL. They have a General Microwave Corporation Model 550 WWV receiver. Reception had never been good, probably due to an antenna problem.

The PMEL would like to have a catalog of NBS publications. In the past they had received and made good use of documents on microwave measurements. They received these documents when they attended NBS courses.

In private discussion Sgt. Ruthstrom had highest praise for the Thai experts at PMEL. He was then the only USAF advisor and felt he was no longer needed. Some parts of RTAF appreciated the vital need for good calibration services in advance of some other segments of the Thai technical community, where equipment was allowed to break down before thought was given to a calibration step. Survey team members in other

places, too, noted widespread lack of good preventive maintenance and care in securing compatibility at least in their measurements. The PMEL library was in English. Senior Thai staff could set up new laboratories for military use and carry their experience to civilian life. Trainees showed superior intelligence and motivation; they were carefully selected from volunteers.

4. Visits of May 24

4.1 Firestone Tyre and Rubber Co. (Thailand) Ltd.

Firestone is one of three major tire manufacturers in Thailand. The others are Goodyear and Bridgestone (Japanese). Firestone's output was all consumed domestically. We were received by Mr. Paul V. Johnson, the Technical Manager, and supporting staff. They purchased their materials on the world market wherever it was most advantageous, but required conformity to Company specifications which were uniform worldwide. They used nylon cord almost exclusively. This was bought in Japan. Their steel lead wire and carbon black were imported from India. They tried to use as much Thai natural rubber as possible as a social duty. Thai rubber was cheap in Thailand, though apparently it was not competitive in quality (cf. 8.6 and 8.7). They also found Thai rubber troublesome to use because the quality was variable, since it came from small plantations which lacked proper supervision and quality control. (There was no TISI standard on rubber.)

Regarding quality controls, they used standard reference materials and did tensile tests on the cord and wire. Occasional tires were sampled for effective body strength, tread quality, ply orientation, and bonding. Also they maintained records of the life history of selected tires in real-life use.

4.2 Glass Organization

The Glass Organization of the Ministry of Defense apparently expected us on another day and was not, therefore, really prepared to receive us. The first part of the visit was a tour of the manufacturing and testing facilities. The latter involved measurements of density, bubble content and residual stress. In all cases there was the appearance that perhaps these could be improved in terms of accuracy both by the use of better measurement techniques and by better calibration methods. During discussion after the tour it was brought out that there were fairly detailed government specifications as well as buyer specifications for many bottles.

It was noteworthy that the team was not shown temperature and refractive index measuring capabilities, nor chemical control of raw

materials and products. There appeared to be little interaction with the viewpoint of the consumer.

4.3 The Battery Organization

At the Battery Organization of the Ministry of Defense we had discussions with Mr. Ruenrom Khongsaisin, Chief of Quality Control Division and Mrs. Oratai Swamiwat, Chief of Research and Development Division, who gave us a rather extensive review of the materials and product testing in all phases of lead-acid battery manufacture. Among other things, it was brought out that the manufacturers' specifications were more rigid than the Government's specifications for batteries. This organization used Thai natural rubber in the manufacture of this product and did not encounter the difficulties with Thai rubber mentioned earlier at the Firestone Co. (4.1). After the discussions, there was a tour of the laboratory and manufacturing facilities. In all cases the test procedures and instrument calibration techniques seemed to be under good control.

This organization clearly appeared to be serving the country well with a widely used product line. Consultation by a highly experienced specialist would be needed to offer any further needed advice. The Survey Team did not and could not be expected to deliver such specialist advice in all fields covered.

4.4 Thai Plywood Co. Ltd.

At the Thai Plywood Co. we were taken on a tour by the very impressive Assistant Manager, Mr. Uthai Sintuprama, who showed us both the plywood assembly line and the pressed board mill. The mill was a highly automated plant which had been imported from Germany and the assembly line was a manual-labor oriented line. Continuing the use of the "manual" process was said to have the advantage of maintaining many jobs. Some quality control measurements were necessary and these appeared to be in proper operation. We were shown, for example, quality control records concerned with plywood sheet thickness.

The industry as a whole would appear to be capable of a great deal of expansion and diversification. Thailand has rich reserves of tropical hard woods. Their planned exploitation and conservation would appear to be economically and socially attractive. Many superior studies of this potential are available. By good standardization information, entrepreneurs in Thailand could be led into new markets without a need for much capital investment or large-scale manufacture. However, it should always be kept in mind that a natural resource can quickly be lost through indiscriminate exploitation and good forest management is a vital concern outside this Survey.

4.5 The Bangchark Oil Refinery

At the Bangchark Oil Refinery we were received by Refinery Manager Mr. P. V. Chang, and a group of his associates. This is a 65 000 BBL per day refinery which had been leased from the Ministry of Defense by Summit Industrial Corporation (Panama) since 1965. Under the numerous conditions of this lease and with U.S. know-how, Summit had greatly enlarged the capacity. The 1974 issue of "Investing in the Dynamic Growth of Thailand" published by the Board of Investment in Bangkok based on 1970 figures quoted only a 15 000 BBL capacity for this plant. Virtually all crude oil was imported but exploration continued. Oil shale found, notably 500 million tons in Mae Sot (about 50 gallons per ton), awaiting new technology before exploitation becomes economically feasible.

4.6 Thai Plastic and Chemical Co. Ltd.

The Thai Plastic and Chemical Co. Ltd. plant was managed by Mr. Samchai Kongsala. It is a German-made PVC plant for resin and pellet compound products. In the laboratory were many of the standard instruments used to characterize polymers. These appeared to be in appropriate and correct use. In the plant there was a small quality control facility involving test extrusion, etc. The quality control record was not explored.

4.7 Kimberley Clark Co. Ltd.

At the Kimberley Clark Co. of Thailand we were received by Dr. Kunjara who showed us the plant which conformed to Wisconsin standards. There was an attempt to use local talent and raw materials, but long cellulose fiber pulp had to be imported.

As for standardization, discussion centered on the use of metric sizes, the reliability of reagents supplied by Siam Science Services, and the calibration of weighing scales. To this competent Company staff there were really few unsolved technical problems. They were supported by a very willing, loyal and stable work force. Safety standards were Company, not labor, initiated and enforced with responsive labor participation. Inasmuch as these attitudes were typical of American firms policy, the acceptance and encouragement of American manfacturers in Thailand may well outlast those from some other nations.

In the time available it was not possible to discuss the progressively greater substitution of imported long fibers with medium length cellulose fibers from local grasses, if necessary reinforced with small amounts of other natural or synthetic high polymeric fibers. Such developmental initiatives may not seem attractive to a company

like Kimberley Clark even if they were to show technical and economic promise for Thailand. Support through the development of special national standards suited to products for local markets may commend itself.

4.8 Thai Textile Finishing Company, Ltd.

At the Thai Textile Finishing Company we were received by Mr. Sutchichai Stifuengfung a civil engineer, Mr. Hermann Schmidt, the thoroughly competent German technical advisor, and Mr. Yongyos Adireksarin.

This was a most unhappy plant heading for disaster mostly for reasons outside the scope of this Survey unless you include the need for market research before planning a manufacturing plant. The machinery was well suited to volume production. However, likely customers are small textile companies which whenever they have a relatively large order for dyeing or even printing carry it out in-house rather than subcontracting to a specialist company like the Thai Textile Finishing Co. Ltd.

Mr. Schmidt said he had a severe technical problem, in that all his factory hands came completely untrained, so that the factory became a school. While the large machines were largely idle or working on unsuitable and uneconomic runs, what better pastime than to train the young Thai staff; what better way to learn a useful highly skilled trade than from a meticulous task master? However, Mr. Schmidt was disillusioned and could hardly hide his disappointment with his pupils and so labor too was unhappy.

A final problem was the lack of protection in Thailand for industrial property. Mr. Schmidt prided himself with good justification for innovative contemporary pattern design. The "screens" were executed patiently with true craftsmanship. The new designs could be and often were imitated as soon as the first bolt hit the market.

4.9 The Thai Teijin Textiles Ltd.

At the Thai Teijin Textiles Ltd. we were received by Mr. T. Komolphan, a busy spinning, weaving and finishing plant. Our visit was too short for useful comment other than that it appeared to be well run, productive and profitable, employing a stable work force.

4.10 The Serm Suk Co. Ltd.

Mr. Chirdpan Bulsook, Director and Chief Engineer, received us at the Serm Suk Co. Ltd. producing Pepsi under license with considerable

autonomy. Product standards were strictly enforced from New York. Samples were also taken at random from the field. We were somewhat surprised that quality of product could in fact be assured without more impressive production and laboratory facilities than those available. However, the team enjoyed the taste of samples on a hot sticky day.

5. Visits of May 25

5.1 The Thai Asahi Glass Co.

At the Thai Asahi Glass Company, a subsidiary of the Japanese Asahi Company, we were received by Mr. Sombath Phanichewa, Director Factory Manager. The product of this plant is window glass made by the vertical draw method.

There were problems with a.) the raw materials (the sand was too coarse), b.) the electrical supply, c.) temperature and viscosity measurement, and d.) the lack of standardization in the Thai building industry. Nevertheless, the plant produced a well accepted product.

5.2 The Department of Medical Science

The Department of Medical Science operates a health laboratory, serving as a national food and drug testing facility and in support of medical research for diagnosis and prevention of diseases by all kinds of laboratory examinations. There are 42 subordinated provincial health laboratories, none of which the team visited. WHO has established an Aedes Research Unit for the control of the Aedes mosquito borne disease which has reached epidemic proportions (Dengue Haemorrhagic Fevers). Interest of USAID is strong in the analysis of narcotics, poisons and toxic substances. Bacteriological beverage analysis was another area of competence. Radiation protection services were rendered with the help of New Zealand and WHO. In the chemical services there was an overlap of facilities with the Department of Science, but little real exchange of equipment, staff and experience. For example, the NBS standard reference materials did not appear to be available readily to the Department of Medical Science. Few members from the Health Laboratory seemed to be available for work on the standards committees of TISI. One chemist felt he was too busy to consider such an assignment but would serve if so directed. Conversely at the Department of Science and TISI an attempt was made to distinguish sharply between the protection of the health of the public and the quality control of food products. Both might require identical tests. The situation was similar in the U.S.A. but activities of the professional societies facilitated a greater degree of cross-fertilization and interaction between specialists serving different agencies.

5.3 Food and Drug Control Division

By contrast with the Department of Medical Science, the Food and Drug Control Division is an administrative agency without in-house laboratory services. It reports to the Under Secretary of State for Public Health.

We were received by Mr. Panya Vanasatit, senior inspector; Mr. Tri Sangthongton, head of the Technical Section; and Mr. Theera Satasuk, head of the Registration Section. There are two Boards, one of Food Control with 16 committees, and the other of Drug Control with 21 committees. Both have wide statutary powers. Laboratory work was done by request to the Department of Medical Science. The standards activity of TISI was supported although the Food and Drug Control Division was proud to be much the senior agency. Occasionally use was made of the Laboratory of the Department of Science. It was here we found a real will to call on the best available competence. Mr. Panya actually encouraged laboratory personnel to describe new test methods that might be available for food and drug control. Mr. Panya thought a standard for maize (corn) should be given high priority. Food color standards were a problem. An attempt was made to use TISI standards. Mr. Panya deplored the huge number of organizations that claimed the authority to issue licences by their own standards.

5.4 Industrial Service Institute - Chiengmai Branch Office (see also 2.6)

A Survey Team group flew to Chiengmai, the second city of Thailand, located four hundred miles to the north of Bangkok in a pleasant wide valley at the elevation of about one thousand feet. Chiengmai is a center for tourism and cottage industries.

We were given a very effective briefing by Mr. Theodor W. Lomnicky, the UNIDO Project Manager attached to ISI in Chiengmai. The above office is the center for ISI activities in a northern area of sixteen provinces extending down to Nakhom Sawan. ISI was in the midst of a four-year project for laying the groundwork for the development of small industries in the north. The immediate goal was modest - to develop industries which are labor-intensive and which supply the market needs of the northern region. Exports to immediate neighbors such as Laos might be the next stage. The current activity consists of surveys, definition of needs, identification of problems and provision of services. ISI services consisted of management and technology seminars, consultations, and assistance in preparing applications for loans. The project was supported by allocations of 1 1/4 million bahts from the UN and 1 1/2 million bahts from the Royal Government of Thailand (20 baht equals about U.S. $1.00).

The industries currently being developed are typically non-interactive and involve "conversion" of materials, e.g., foundries and other metal working, wood-carving, etc. An example of a desirable product which could meet the above guidelines would be a water pump.

Regarding quality control, they were aware of its ultimate importance but feel that it was not a major concern at the present stage. They were aware of TISI and expect to call on it for appropriate assistance in due time. The earliest assistance needed might well be to provide seminars, for example, on packaging.

ISI very graciously provided transportation for the team during its stay in the Chiengmai region and also the services of a guide, Mr. Preecha Niyaboon, head of the Division of Extension and Training.

5.5 Chiengmai University

Chiengmai University had an enrollment of 7000, evenly divided between men and women. It was about to start a graduate studies program. Dr. Pimol Rienvatana, a young analytical chemist who had received his graduate training in Canada, was kind enough to show us through the Chemistry Department. Its size could be gaged from the first year class enrollment of sixty. Incidentally, it was remarked that there was an oversupply of chemists at that time in Thailand. We were especially impressed by a very well-equipped instrument laboratory for 3rd year students in physical chemistry. Among the more elaborate equipment of the department were an atomic absorption spectrophotometer, an ultraviolet spectrometer and a Perkin-Elmer infrared grating spectrometer. As an example of applied research by the staff, some work on trace contaminants in water supplies was mentioned.

In the Physics Department we saw a nice nuclear spectroscopy laboratory for 4th year students and for faculty research. There was a small neutron source and a modern multi-channel analyzer.

The School of Engineering was just being started and consisted only of a Civil Engineering Department at present. Industrial Chemistry was taught in the Chemistry Department.

Compared to Chulalongkorn University, the equipment that we saw at Chiengmai was newer and the spirit seemed more enthusiastic. The latter impression rests upon fleeting visits and exposure to very few members of the two faculties, so it must not be taken too seriously.

5.6 Cottage Industries

The best known cottage industries of the region were located in picturesque villages near Chiengmai. These were small establishments

each typically combining a showroom on the village's main street with workrooms in the rear. Among the products featured are silks, wood carving, umbrellas (bamboo frame), and lacquerware. The team had time for only a hurried look at these establishments as it was near their closing time when we arrived.

6. Visits of May 26

6.1 The Bangpa-In Paper Mill Factory

It is perhaps to be questioned whether we would have been given the opportunity to visit this plant had it not been in the close proximity of the famous and beautiful palace of a great liberal ruler, King Rama V, who freed slaves and founded Chulalongkorn University 100 years ago. Our hosts insisted we must visit that palace on Saturday afternoon. That visit taught us much of Thailand, its history and culture.

At the Bangpa-In paper factory, we were received by Mr. Somchit, the General Manager, and an enthusiastic staff. Three items stand out from diverse topics of discussion.

a.) Use of celulose fibers from local grasses.

b.) Management of paper stock.

c.) Lack of use even by Government of standard sizes of paper.

Evidently, TISI was not yet able to persuade various other Government departments to use the same sizes. Yet the factory did not want to give incentive price reduction for orders conforming to standard sizes. The competition was said to be too servere between different paper manufacturers. This argument may be false based on bad sales policy. The tougher the competition the more worthwhile to capture the orders for standard sizes with big runs and risk the loss of inconveniently small orders.

6.2 The Siam Cement Co. Ltd.

The Siam Cement Co. Ltd., operates thoroughly modern factories with some modern quality control facilities for raw materials and products using ASTM and other standards as well as some NBS standard reference materials. They earned the TISI quality mark. The confident and competent technical and other supervisory staff was given very fine housing and recreational facilities. The safety standards for the labor force did not appear to come up to American codes of good practice. The Company enjoyed good relations with Government

generally and TISI in particular. It was financially sound and could undertake some innovative development or research.

6.3 The Siam Iron and Steel Co. Ltd.

The Iron and Steel Company is associated with the Cement Company, and also technically comparable to Western Steel Works with widely diversified product lines such as existed in Pittsburg, Pa., until about 30 years ago and in Europe even at this time.

The melting shops, the forge, the alloy steel foundry, the continuous casting shop, the wire mill, the annealing bays, the pickling shop, the sheet rolling mill, the machine shops, all had their typical technical problems. The volume of any one product line was inadequate to support all the staff and modern control equipment that ideally would be desirable, a situation similar to that existing in some older European steel works. The team was interested to hear that this firm had retained as consultant Professor Robert Durrer, a Swiss steel expert whom Peiser knows quite well. He is now really too old for travel to Thailand and too much out of touch with current developments.

Thailand was procuring an integrated steel plant from Japan. The Siam Iron and Steel Company would then be able to cut down on its product lines which should make the management of this very interesting facility easier. In the meantime, Thailand should be proud that its steel making knowhow as vested in this firm is on a much higher level than commonly found in less industrialized countries. The Company generously entertained us at its own lovely guest house where we were privileged to spend Saturday night.

6.4 Chemical Fertilizer Co. Ltd.

Lampang is two hour's drive southeast of Chiengmai. The two towns are similarly situated in broad valleys which are separated by a range of hills. Lampang Province is somewhat more highly industrialized than Chiengmai. One of the factories in Lampang is that of the Fertilizer Company at Mae Moh.

At this plant we were hosted most hospitably by the manager, Mr. Somnuk Praditharany. This fertilizer factory produced ammonium sulfate and urea. It was the only fertilizer plant in Thailand at that time. However, a new factory was under construction in Bangkok to produce fertilizers containing phosphorus and potassium. At present such types must be imported. At the time of our visit Thailand had no standards for fertilizers but TISI has since produced one and a factory has been certified to that specification.

The Lampang plant is in an isolated rural location adjoining a lignite open-pit mine. The lignite was used to produce process hydrogen by the water gas reaction. (The CO_2 which also was produced was converted to CO_2, removed, and used with some of the product ammonia to produce urea.) The nitrogen was produced on site by air separation. The ammonia was produced from the nitrogen and hydrogen by direct synthesis. The sulfuric acid needed to produce ammonium sulfate was also made on the site, starting with elemental sulfur brought in from Bangkok and supplemented by sulfur recovered from the lignite, where its concentration is 1 to 1 1/2%. The plant was assembled by a German contractor, and much of the process equipment was of German manufacture. Lignite was unfortunately not common in Thailand; there was only one other site in the south. The lignite mine was under different management from the fertilizer plant.

Regarding process control, the lignite, sulfur, and feed water were analyzed by wet chemistry. Conventional manual Orsat apparatus was used for process gas analysis, and the Kjeldahl method was used to determine the nitrogen content. The reproducibility of the latter is about 1%. (The $[NH_4]_2SO_4$ contains 21% nitrogen.) We also noted a bomb calorimeter for determining the heating value of the lignite and a heated stage microscope for determining the melting behavior of slag. The chief chemist was a recent graduate of Chiengmai University. He had trained his own technican helper. He seemed to be cognizant of the possibility of checking his analyses by use of standardized reference materials, but this did not appear to be incorporated into the regular procedures. The plant was losing money, and this was said to be due to the fact that the Government fixed the prices of the products at artificially low levels. Unfortunately, it also had the appearance of a lackluster operation. Besides, such plants are rarely economic below a relatively large scale.

6.5 Ceramic Industry (Lampang Province)

At the Piyachai Ceramic Industry Ltd., in Lampang we had a translated interview with the manager who is of Chinese descent, but who has a Thai name. This factory which produced mostly mosaic tiles was based largely on hand labor including the hands of the rather young. Some measurements involved temperature, dimensions, and weight. They claimed to have no severe measurement problems. They had no government specification on their products.

6.6 Universal Food Co. Ltd.

This recently formed Thai-owned company located between Sampang and Chiengmai operated farms (pineapple, asparagus), and a canning factory managed by our host, Mr. Tsen. The plant, which the team toured, was two years old and was visited recently by the King. It processed and

attractively displayed 35 products including baby bananas, lychee, oranges, mango, sweet corn, water chestnuts, champignons, ketchup, bamboo shoots, attap fruit, guava juice, papaya juice, and staw mushrooms. The facility was clean, modern, and attractive. Three hundred workers gave the place a busy air, though the full utilization of the plant would only come in the following summer, when the staff would reach five hundred. The machinery was mostly built in Taiwan and appeared to be very modern. Although the plant was highly mechanized, there was necessarily much trimming and sorting done by hand. This was the only such factory in northern Thailand, though others existed in central and southern Thailand. 70% of the output was exported, 45% to the U.S., 18% to Japan, and the balance to Canada and Europe. The products for export were subject to Government inspection and control except that there was at the time of the Survey no control on canned pineapple. We understand that since that time the pineapple standard has become mandatory and that TISI operates very close control over the industry. Generally, Thailand met U.S. FDA requirements by controlling shape and color of fruit and the content of sugar and water. Some sugar which must meet company standards was purchased. They also performed microbiological testing of their products and the handling equipment. The only quality control problem mentioned was that the quality and ripeness of fruit received from private growers was too variable. The factory's laboratory was very clean and well-equipped, though apparently deserted. Plans included a pineapple washing plant to be installed within a year.

Regarding packaging, they used U.S. FDA can sizes and encountered little demand for other sizes. The can blanks were made in Bangkok by a company with British affiliation.

7. Visits of May 27

7.1 Siam City Cement Co, at Kang-Koy

Although it was Sunday morning we made a brief inspection of, and were graciously received at, another of the large Siam City cement plants, that at Kang-Koy. The raw material and product control were again of a high order. The management was competent and market acceptance of the product caused no problem, so we spent a little time examining the large weight scales. It would be rash to conclude that this important measurement could be as far out as it appeared at first sight, because the cross-check with the volume measure of the trucks delivering fuel was a significant means of ensuring compatibility, at least to a little better than 1/2%.

7.2 Ceramic Industry (Chiengmai)

The other half of the team on this Sunday continued its tour of Chiengmai Province and visited a factory producing as its main product

1 x 1 inch unglazed ceramic tiles. These were made from local clays but with imported pigments (Japan). The presses were made in Thailand and seemed excellent mechanically. Control of these machines was manual, and the absence of automated machinery generally was conspicuous. The tiles were fired in a tunnel kiln at 1200°C. The factory also produced some pottery, various slip-cast art ceramic forms, and fire bricks of various shapes. It exported some of its production to Laos and Viet Nam. We were told that TISI performs abrasion tests for this factory. Unfortunately, it was difficult to pursue such questions as quality control and standardization because of the heat and noise of the operation, language difficulties, and shortage of time.

8. Visits of May 28

8.1 An Audience by the Governor - Chon-Buri Province

Chon-Buri Province lies on the Gulf of Siam southeast of Bangkok. At the Governor's reception we were given an overview of the Province. Its economy is a mixture of agriculture, industry, and tourism, the latter two admittedly somewhat incompatible. Agricultural products include sugarcane, pineapples, and tapioca. Industrial development leans towards petrochemicals. A joint Japanese-Thai venture is to be producing petrochemicals for local plastics manufacturing and for bulk export. Two oil refineries already exist--one with a capacity over 60,000 BBL per day, and the other over 30,000 BBL (compare 4.5). The tourism focused on beach resorts such as Pattaya and was largely frequented by Thai's themselves.

Problem areas were:

1.) Moderating the use of beach front for recreation versus leaving space for refineries; and

2.) assuring an adequate water supply.

There was no major river in this Province. The Government was building a new reservoir. Wells had to be relied on in some places, e.g., at Pattaya. The effluent water from the tapioca and sugar mills was badly polluted. Generally such natural surface water as existed was of good quality. An exotic product for which water quality was said to be critical was orchids. They were successfully exported to Germany! Regarding technological assistance, the provincial authorities did make use of the Department of Science laboratories in Bangkok and felt that a local branch in Chon-Buri would be useful.

8.2 Tapioca Association (see also 1.2)

We met with the President and Vice President of the Tapioca Association of Chon-Buri in the store-front office of the Association.

This Association had existed for only 8 months, and was the only one in Thailand. It was an association of millers, not of growers. More than half of Thailand's production of tapioca was said to come from Chon-Buri Province. The production capacity was 400 tons/day. They shipped one million tons of pellets and chips per year worth 1 1/2 billion baht ($100 million) to western Europe and Japan. The Association was in the process of forming its own export company.

Tapioca comes from the root of the cassava plant and is essentially just a source of starch. It contains typically 62% or more of starch. The starch may be extracted for industrial use, or the tapioca may be used as a component of cattle feed (Europe). Tapioca for export was sampled for starch and silica content at loading ports to support export licensing by the Ministry of Commerce. The Association did not make these tests but it intended to establish a laboratory to do so. A silica content up to 3% was permitted as an allowance for incomplete scrubbing of the cassava roots, i.e., it was expected to be simply soil. However, it is widely believed that exporters add sand up to the 3% limit as an adulterant. The price of Thai Tapioca as quoted in, say Hamburg, is consistently a few percent less than that of Java or Taiwan chips, due undoubtedly to the quality factor.

The Association is concerned about quality and the Province industrial offices recently held a seminar for local producers on this subject. A related problem is the manner of drying the product. Traditionally, the chips are spread by hand on a concrete field to dry in the sun. In the wet season, drying may take as long as five days, during which time mildew may set in and adversely affect the color rating of the product. They would like technical help in analyzing if it would be economical to dry by artifical heat. Though costly, it would result in a cleaner, whiter product with better defined moisture content. They would also like R&D assistance in finding uses for the cassava tops, and in developing products from fermentation of surplus tapioca.

The discussion grew very animated on the part of the President and was directed mostly to our escorts from the Department of Science. Unfortunately not 10% of it reached us in translation. The President was a large man and, seemingly, a very angry one. Both of these attributes are rare in Thailand compared with executives in the U.S.A. It seemed that he was expressing his discontent with the Government on all issues affecting the Association with the nearest Government representatives who happened to be available as his American counterpart might be inclined to do. The main irritant seemed to be the price squeeze on producers. One may note that the Association's relations with the Government involve at least three Ministeries: Argiculture, Commerce, and Industry. A lack of coordination is one alleged failure.

We concluded this visit with a look at the process including washing, chopping, field drying, and pelletizing. (Compare relevant discussion in 1.2 and 8.3).

8.3 S. R. Co. Ltd.

The S. R. Company produces tapioca flour. The capacity was 30 tons/day of which 95% was exported. They produced to the buyers' specifications. Apparently there is no TISI standard. One such buyer for which marked bags were being loaded was the Staley Co., Illinois, U.S. The equipment was German, and the operation was highly mechanized. Hand labor appeared to be used only for in and out loading.

The laboratory looked simple but adequate. They determined starch and moisture content and reported the residue as pulp and fiber. A typical moisture content would be 11%. Their report also gave color estimated subjectively, a count of foreign matter appearing as specks, a sieve analysis, pH, and viscosity of dissolved starch.

The main world producer of tapioca flour is Brazil. (Compare 8.2 and relevant discussion in 1.2).

8.4 Fish Sauce Factory

At the same time as one team group was in the south of Thailand another was in the north in Rayong, Province. The company that latter group visited bottles an allegedly popular fish sauce derived from locally caught fish and sea salt. Because of increasing demand, the fishing fleet was having to extend its operations as far as the Cambodian offshore regions. Six grades of sauce were produced depending on the kind and quality of fish used. There was a TISI standard specifying protein content, kind of fish, etc., which was used as a guide but not followed fully. They did not think the TISI mark would be cost effective for them, as most people bought by price. This view seems to conflict, however, with TISI's experience in certifying a number of fish sauce manufacturers. The production rate at this plant was 200,000 to 300,000 liters/month with a value of 1 to 2 million baht ($50,000 to $140,000). The factory employed 100 workers. The bottling equipment was Japanese. There was no laboratory.

8.5 Ratcha-Buri Province

Part of the team flew down South to Hat-Yai and visited Ratcha-Buri Province where the Thai Government was having some problems in exerting its authority in the jungles off the main highways. The

NBS/AID Team was warmly received by Government and local officials with whom industrialization opportunities were discussed.

8.6 The Rubber Research Center (Songkhla Province)

Moving across the provincial border to the adjacent Songkhla Province, the team was conducted through the Rubber Research Center where new processes and products were developed and tested. Much effort had to be concentrated on processes by which dirt could be removed from sheet rubber.

Good innovative work was being carried out but the team was requested not to describe it in this report.

8.7 The Thai National Rubber Industry

Japanese buyers complain of the low grade of the Thai product although they only pay at the price of the lowest commercial grade product. Testing to be at all acceptable must be by a foreign expert--a British specialist fulfilled this function at that time. On careful inquiry it appeared that the small farmers typically were not rewarded for good quality. They sold to middlemen to whom they were obligated by debts and neither took enough care to prevent contamination in handling even though the removal of dirt from rubber is far more expensive than eliminating its introduction by proper handling. (It is understood that this simple quality problem has been successfully treated since the Survey took place.)

8.8 Prince Songklanakarin University (Songkhla Province)

Prince Songklanakarin University has some spectacular new architecturally innovative buildings. The large auditorium and the buildings for engineering and agriculture stand out. The student body and faculty were on the rise at the time of our visit. This generous project was designed by the Government to encourage the south of Thailand, connected to the rest of the country by sea or a very long narrow strip of land, to feel an integral part of the economic, political and cultural system.

9. Visits of May 29

9.1 Sam Hong Enterprise Ltd.

At Sam Hong Enterprise Ltd., we conducted a pleasant translated interview with the impressive Mr. Narong Viratyosin, who was of Chinese descent. This organization of 100 was managed technically by seven Taiwanese who controlled the plant and the Analysis Laboratory; the products were ferromanganese and borosilicon. Forty percent of

the production was exported, especially to Malaysia and Indonesia. There were no government specifications for either domestic or export use, but the company specified the range of Mn and the maximum contents of C, Si, P, and S in its products. These data were obtained through measurements on each lot. They were said to agree satisfactorily with the customers' own subsequent analyses. Measurements carried out on the raw material from Chiengmai agree with analyses which the supplier occasionally has made at a commercial laboratory. A building was being constructed to house more modern equipment.

9.2 Dole Thailand Ltd.

At Dole Thailand Ltd., a canner of pineapple, we had a friendly discussion with plant manager, Mr. Walter C. Light. The information obtained was similar to that for Universal Food Corporation. Dole had its own farms and grew pineapples which were suited by size and shape for canning. He only learned during our visit of TISI's pending activity in this field.

9.3 Siam Kraft Paper Co. Ltd.

Mr. S. C. Bhargara was the General Superintendent of the Siam Kraft Paper Mill at the time of our visit. A Company staff member was participating in the TISI program to establish government standards for domestic use of paper products. He felt the process of writing standards was too slow. There were at the time of the Survey no Thai Standards for export. The Company followed TAPPI standards and test methods. Some of the instruments required calibration by standard reference materials using, for example, those from the Pulp and Paper Institute of Canada. There was a large amount of effluent treatment equipment which was needed since the bagas used to make the fibers retains a substantial amount of sugar.

9.4 Thonburi Sugar Factory

Our translated discussions at the Thonburi Sugar Factory were with the owner, Mr. Kitti Chinthammit, who is of Chinese descent. The operation of this mill appeared to be somewhat of an art with machinery adjustments being made by eye and experience. Nevertheless, the product did meet specifications of the Ministry of Agriculture. Similary, molasses supplied to industry must be at least 50% sugar. Perhaps there was an effluent problem.

9.5 Thai Fermentation Industry Co. Ltd.

Our visit to Thai Fermentation Industry Co., Ltd. was shortened by scheduling problems. We were conducted by the plant manager from Taiwan and his associates requiring translations from Chinese to

Japanese to English to Thai. The Thai-China joint venture plant appears to be well organized and operated. There was a TISI standard which the Company has had translated into English. The tests were carried out according to these standard methods although we did not see the test results for lead and other heavy metals (possibly because of our limited time).

9.6 Preserved Food Organization

At the Preserved Food Organization, we were received by Mr. Prasant Komopis, Plant Manager, who explained the background of his organization which was founded in 1955 by a Royal Decree. There was a pilot plant at Kasetsart University. The large main plant was at Ban Pong. Much of the dried, frozen and canned products were exported and had to meet the appropriate customer standards such as those of FDA. The domestic products had to meet the requirements set by the University for Agriculture. The tests involved biochemical as well as chemical procedures. They concerned the raw materials, the processing, and the products. Combat Rations were among the range of products.

9.7 Fishmeal Factories (Songkhla Province)

Fishmeal is an important source of animal feed and is exported especially for poultry to Malaysia. The handling of this product even at the best of the factories was unsatisfactory and it was necessary to warn that dangerous bacteriological contamination could arise and have serious consequences. An expanded factory was being built and improvement of conditions was in sight.

9.8 Fishery Center, Songhkla Province

Good harbor facilities are available and a sizeable fishing fleet exploits some of the worlds finest fishing grounds.

10. Visits of May 30

10.1 Tanin Industrial Co. Ltd. (Bangkok)

The Tanin Industrial Company, which manufactured radios and television sets, was not typical of the many enterprises that the team visited, and yet it seemed to provide a most hopeful augury for the future of economic development in Thailand. It did so by demonstrating that a Thai-owned and managed company could successfully utilize relatively modern technology to produce consumer products that find acceptance in the face of massive Japanese competition. Tanin, now 9 years old, is the creation of two brothers, Mr. Udom Vidhayasirinun and Mr. Anek Vidhayasirinun. The Company had 500 employees and occupied a clean,

modern plant. It had set up 200 local service facilites with factory trained staff. They did not produce color TV. Most of the components were imported from Japan but some picture tubes came from Taiwan. The Company made its own printed circuit boards, labelled only in English, speakers, coils and inductors, and it was setting up a factory in Chengmai to produce electrolytic and air variable capacitors and transformers. Metallizing of knobs and escutcheons and electroplating of chassis, transformer shells, etc., also were done in the plant. Plans existed to export both their components and complete radios and television sets, initially aiming at Germany. They would make radios to sell under the well-known brand, Blaupunkt. The cheapness of Thai labor was clearly a factor. Assembly line girls earned 15 Baht per day ($0.75) or 400 baht per month ($20), plus their lunches and uniforms! This factor was drawing to Bangkok a new plant for National Semiconductors (U.S.), a company which was already established in Singapore for the same reason. In the Tanin plant, we saw lavish use of labor for hand-feeding of machines, hand painting of tuning dials, etc. Regarding quality control and standardization, the company had established their own procedures for stepwise checking during the assembly process. They provided TV circuitry to handle both 525 lines (U.S.-FCC) and 625 lines (CCIR), as both are transmitted in Thailand. They generated an in-house test pattern for adjusting the TV sets and used Japanese precision frequency generators for alignment. There appeared to be no government standards in their field.

Various problems were identified, largely political and economic rather than technical. The company was said to benefit from the duty on imported components being less than for complete sets (30% vs 50%). Japanese firms may dump sets on the Thai market at less than the local cost. There was said to be much evasion of import duties on sets, some smuggling, and much by-passing of duties via the U.S.-PX channels. Japanese advertising was persuasive and well-financed. Firms like Tanin had to buck the general public impression that Thai goods are inferior to foreign ones.

10.2 Sanyo Universal Electric Co. Ltd.

Sanyo Universal Electric Company is a joint venture between Sanyo of Japan (49%) and Universal of Thailand (51%). We were given a very informative tour by Mr. Maitri Mojdara, the Managing Director. The Company manufactured air conditioners, refrigerators, water coolers, fans, gas ranges, and television for the domestic Thai market only, though they had expectations of exporting to other parts of southeast Asia and the Middle East (Iran). They imported certain components, e.g., compressors, sealed refrigeration units, and controls. They were free to shop worldwide for these without necessarily having to buy in Japan. For example, some refrigeration units were obtained from Spanish affiliated Tecumseh (U.S.). Controls came from Sanyo

(Japan), Singer (U.S.), or Danfoss (Denmark). They assembled electric motors, using imported silicon sheet steel. Sheet metal for refrigerator shells was also imported, but forming was done locally. Plastic extrusions were also made locally.

The plant employed 600 persons. It produced 30,000 refrigerators, 30,000 fans and 45,000 television sets annually. These were their large-volume products.

Regarding quality control, they had assembled their own procedures to assure the adequacy of the plant operations and the performance of the fully assembled products, but these, though adequate, were somewhat unsophisticated compared to the technology involved in making some of the imported components. Thus they checked the on-off temperature limits of refrigerator controls and evaluated the capacity of refrigerators by taking temperature vs time data on cool down, but these were technically somewhat simpler observations than, say, controlling the metallurgy and dimensions of valve plates in the imported sealed refrigeration units. In these respects, their operations rather resembled the Insuzu Motor, Co. plant described earlier. We also saw some interesting statistical charts giving defect counts by sections of their TV sets and by origin (i.e., whether due to assembly workmanship or part failure) but were not sure what use was made of these data.

The company made use of various product standards for guidelines, e.g., those of Sanyo (Japan) and ASHRAE (U.S.). In the past, some of its engineers had served on TISI committees, but they had come to feel this was unproductive because progress was too slow and there was too much time spent on insignificant details.

10.3 Thai Lamps

The Thai Lamps Company is an affiliate of Philips of the Netherlands. It assembled incandescent lamp bulbs and imported fluorescent lamps. We were given a vigorous and effective briefing by Mr. H. H. M. Van Nieuwland, the Plant Manager.

The plant produced for domestic sale only. The sale of fluorescent lamps was increasing by 15% annually, of incandescent lamps by less than 10%. They had 30% of the domestic market for fluorescent lamps and 40% for incandescent lamps. All fluorescent lamps used in Thailand were imported. One of their problems was "dumping" in Thailand by Korea and Taiwan. The government permitted payment of import duties based on invoice value, which may be stated at an unrealistically low level so as to escape some of the tax.

The production line was surprisingly small and compact. The glass bulbs, coiled filament, and bases were imported from Europe. Bayonet bases are common in the Orient, but some screw bases are also used. The assembly line used somewhat more labor than would be typical in Europe. In fact, were it not for import duties, European machine-made bulbs would undersell the local product.

Regarding standards, Philips applied uniform standards to its more than forty factories around the world. These were based on IEC standards but may be more stringent in some respects. The Bangkok plant performed "complete" photometric, life, and mechanical tests. Their standard lamps were under the control of Eindhover which exchanged them periodically. They were calibrated at NPL of the U.K. The Philips certificates on these stated that the accuracy of the reference bank of lamps was 0.5% and that of a given standard lamp was 1.0% (in lumens). In their life testing, they controlled the voltage to 0.2%, which was equivalent to 1% in life. Their integrating "sphere" is actually an irregular hexadecahedron, developed by Philips for use in its various laboratories. In response to a query about possible specular effects, Mr. Van Nieuwland was emphatic, if not dogmatic, that this had been investigated and found to be no problem. The laboratory looked to be simple, adequate, and much used.

Incidentally, Philips sold standard lamps and photometric test equipment to all comers. The Division of Physics and Engineering of the Department of Science had purchased such equipment from Philips but had not put it into operation yet. The purpose of this equipment was not clear to the team, and there was some suggestion that the Department may be floundering here.

Mr. Van Nieuwland was, to be plain, scornful of TISI committee work. He had personally found it impossible to contribute, since all discussions and documentation was in Thai. Obviously the management of this company was confident that it can easily meet any reasonable standards and that it was presently far ahead of the state of the art in any locally operated testing and standardization laboratories.

10.4 La Petite (Thailand) Co. Ltd.

La Petite was a small company engaged in custom formulating and packaging of pharmaceuticals for foreign concerns using imported bulk components. Availability of women workers at low wage rates was undoubtedly a key factor in its viability. It was a clean well-organized plant.

The laboratory contained equipment for spectrophotometric, melting point, ash, water content, optical rotation, pH, etc., determinations and for wet chemistry--all rather simple and straightforward but

clean, neat and evidently much used. Bacteriological tests were also performed, as were tests for the presence of "pyrogens", i.e., fever-producing components such as killed viruses or bacteria. The test for pyrogens involved injecting a rabbit and monitoring its rectal temperature with a simple electronic probe.

The manager volunteered a comment that the team had heard elsewhere: Selling a product labelled "Made in Thailand" to Thais was difficult. Experience has led them to expect an inferior product.

11. Visits of May 31

11.1 Offshore Tin Mining (Phuket Province--a South-West Coast Island)

Before returning by air to Bangkok, the team was fortunate to be allowed to visit off-shore tin dredges, which differed little from Malaysian tin dredges on inland artificial lakes, except for the additional problems from sea water corrosion. (One dredge of newer design was very troublesome.) All dredges are owned by small companies but operated by Landon Tin. The local staff had no knowledge or interest in potential applications of the off-shore mining techniques to other ores under the sea.

The dredged mud and sand were washed back into the sea without apparent effect on the fish life.

The high density tin concentrate from conventional separators on the dredge was taken to shore where a smelter produced tin ingots of high purity. Some key products were recovered and sold. The remainder were stored in huge mounds. Niobium, tantalum, the rare earths and titanium might be recovered.

The quality of the tin is contolled by chemical analysis based on an NBS standard reference material, which is here believed to be "low" in the certified tin content. Some support from an Australian laboratory was claimed but later at NBS the discrepancy was discounted.

11.2 The Asian Institute of Technology

The brief team visit to the Asian Institute of Technology does not justify a description within this report. However, AIT appears as a major teaching institution and as a resource for applied science research and development. Its faculty is distinguished and drawn from all Asian countries with some U.S. and European members.

Such international or regional institutions tend to become most responsive to their local environment. AIT may be no exception and

thus have some problems in attaining its full anticipated impact in countries other than Thailand. AIT distributes good literature on its facilites, courses and services.

11.3 Far East Superintendence Co. Ltd.

We had a most informative discussion with Mr. W. C. J. Hermans, Chief Chemist. FESCO is an affiliate or branch of a worldwide commodity testing combine. This organization has representatives in major parts of the world under various names. The parent company is Societe General de Surveillance of Geneva. Their basic business is the independent determination and assurance of the quality and quantity of goods to be shipped. However, they are willing to undertake any kind of testing that falls within their competence. Procedures and equipment of the member companies are their local responsibility. There was some communication between the companies for mutual assistance, but no central source of standards, in contrast to the policy of Philips.

In Bangkok, FESCO undertook weight and quality examinations of such diverse products as mineral (wolframite, scheelite, fluorspar, barte), seed cakes, tapioca pellets, and pressure cylinders. Thai wolframite is free of molybdenum and could command a premium in the world market; however no premium was being realized at that time.

Regarding pressure vessels, they tried to follow U.S. DOT specifications, though they found them unintelligibly written. They used both X-radiography and ultrasonics for testing such vessels. They referred some tests to affiliates having special capability, e.g., X-ray fluorsence testing went to an Australian affiliate. In Thailand they used the facilities of the Department of Science, which they regarded as relatively well-equipped but slow. Unfortunately, the nature of FESCO's business was such that speed was essential; problems arose and were dealt with almost on a day-by-day basis.

The laboratory equipment included a Techtron grating instrument for atomic absorption spectrophotometry, a polarimeter, Mettler balances (good local service are available for these), and very busy wet chemistry facilities staffed with 5 women and 2 men. Mr. H. Erwans felt they had no significant calibration problems in their laboratory. In the field, however, large-scale weighing of goods in motion on conveyors and other loading equipment at the 1% accuracy level is not possible although such a capability would be very useful. On this visit, the final gaps were filled in the story of tapioca. Ninety percent of the tapioca pellets end in Holland via German traders as feed for cattle, pigs, and poultry. For this use only the starch content matters; here tapioca competes with corn. Discoloration is not an important factor. It is easy to produce tapioca with no more

than 1 1/2 to 2% of sand. However, adulteration up to the allowed 3% is widespread in Thailand and there is a tendency to overshoot the addition of dirt followed by extra-legal ways to evade rejection.

Government inspection was tried for one year but proved to be slow and inefficient. This brought private sampling and testing firms into the field. If a shipment passes inspection in Thailand, the foreign buyer pays 95% of the agreed billing, subject to reanalyses on unloading and possible further negotiation. The lower price that Thai tapioca commanded truly reflected its lower quality and is not artifical. The ultimate buyer seldom rejected on the basis of quality, because the lower price compensated him adequately. From this, it appears after much sound and fury that "the tapioca problem" has evaporated. The buyer is satisfied, and the seller has gotten what his product was worth. There would seem to be sensible reasons for dropping the 3% limit on silica and tailoring the price of each shipment to its starch content, but the benefits would be rather marginal (also see 1.2 and 8.3).

11.4 Weights and Measures Laboratories

It is usually considered an appropriate function of government to assure that equity prevails in the marketplace and to provide the necessary technical services to government, industry, and business so that commercial measurement losses are minimized.

To build effective programs of legal metrology, one prerequisite is to enact a modern, up-to-date law (general and broad in scope) and support this with regulations having the force and effect of law (i.e., specification and tolerances for weighing and measuring devices, requirements for packaging and labelling, etc.). Another requirement is to supply a legal metrology service with adequate physical standards (kilogram weights, volumetric test measures, and length measures) to adequately test scales, meters, tapes, and net content of packages. These field standards should be directly related to the nation's primary standards of mass, length, and volume with appropriate accuracy and legal certification. The government benefits from an effective program of legal metrology, for instance, as the largest single purchaser of commodities by reducing losses due to shortages and the public benefits from being given confidence in the government services as the "third man" in all commercial transactions. Individual industries, too, may realize sizeable savings in the purchase of raw materials and sale of goods produced.

The team, therefore, returned to the Central Bureau of Weights and Measures (see 2.2) to discuss the possible recommendations for revisions of the Thai Law of Weights and Measures BF2466 (1923). It recommends the Metric System but is tolerant on the use of some

customary units. There are problems with some definitions, at least in their translation into English, and with the approvals of weighing and measuring instruments. The verification of the meter standard at the International Bureau of Weights and Measures is an example of an unrealizable requirement. The penalties for lack of verification marks on many instruments throughout the country appear to make most traders liable to imprisonment. Revision of the law is, therefore, desirable prior to which action a careful study of corresponding laws of other countries should be made, discussed, and debated so that the important choices for a modern weights and measures law can be considered.

12. Minister of Industry's Council, Closing Session, May 31.

General Krit, Minister of Industry, convened his Council to meet the NBS/AID Team and to thank them. He listened to the summary statements of all team members. These statements are here reproduced in full:

12.1 H. Steffen Peiser, Chief, Office of International Relations, U.S. National Bureau of Standards

Your Excellency, General Krit, Gentlemen. The NBS/AID for the Survey Team of Standardization and Measurement Services in Thailand feels honored to meet with you once more. Split up into smaller groups, we have visited many manufacturing and related centers throughout your country. Team members have discussed problems and exchanged practical knowledge with your technical personnel. We, these team members, have become acquainted with a delightful land and a most charming people. Thailand has enormous potential due to its resources, natural and human. The technical training, knowledge and professional devotion of our Thai colleagues demand the highest respect and recognition. Your Ministry's officers have been wonderful hosts. The team feels deeply indebted.

Today we will give a tentative outline of the topics of our proposed report. You will detect among us a recurring conviction that it is not primarily a lack of technical know how or even of technical facilities that seems to slow progress in Thailand's industrialization. There does, however, appear to be a need for resolute from-the-top technical systems planning and inter-institutional coordination. Planning cannot be based on technical solutions alone. Implementation must always be coordinated with socio-economic goals and cultural background. The NBS/AID Team is in no position to make recommendations outside its technical competence. Yet, we will not evade issues. We will make observations which you can turn into vigorous actions that could have profound impact on industrial progress in Thailand.

Before we proceed with our technical presentations I call on Dr. R. J. Corruccini to perform an important and pleasant duty on behalf of NBS.

12.2 Presentation of Books by R. J. Corruccini, Former Deputy Director, Institute of Basic Standards

My own organization, the National Bureau of Standards, has put a collection of its best and most recent work in the field of measurement into a set of volumes which the survey team would now like to present to you for the Department of Science.

We also would like to present a copy of a study recently completed by NBS of all aspects of conversion of the U.S. from the so-called Customary British System to the metric system of measurements. Since in Thailand the metric system is already in wide use, as authorized by the Law of Weights and Measures of 1923, your country may reasonably feel a degree of detachment from this problem; even so we hope that this study may be interesting and illuminating as an example of one way to approach the analysis of a difficult national problem with a technical basis but having powerful social overtones.

Many quality judgments are subjective, e.g., the texture and appearance of fruit, or the handling and ride of an automobile.

However, the quality of modern industrial products is more likely to be measured quantitatively by a physical instrument, e.g., the size and shape of the internal parts of an engine, or the light output of an electric lamp.

In making instrumental measurements, one question should never be overlooked: is the instrument correct? If it is not, how can one find that out and how can one obtain correct results? Answering these questions is the job of national standards laboratories such as NBS.

Generally speaking we strive to assure correct results by:

1.) Maintaining accurate basic standards; length, mass, time, and temperature.

2.) Calibrating instruments for others by comparison with the basic standards.

3.) Furnishing devices or materials of accurately known characteristics (SRM's) which others may measure, thereby ascertaining the accuracy of their own instruments and the correctness of their experimental procedures.

These services support quality control in manufacturing, and the acceptance of goods in foreign countries. They are put on a uniform international basis by comparison measurements made at BIPM or directly between national laboratories.

They can be transmitted to laboratories even in countries which do not maintain basic standards by various channels: e.g., via instrument manufacturers with international distribution, private instrument calibration facilities, international navigational and radio timekeeping facilities, cooperation between national military services, and direct assistance from national laboratories of friendly countries.

The basic concept of assuring that measurements are meaningful should never be lost sight of, regardless of the level of sophistication involved. Otherwise the operation of measurement becomes empty of significance, and wasteful of time and resources.

12.3 Mr. Sang Sup Lee, Industrial Advancement Administration, Ministry of Commerce and Industry, Seoul, Korea

Your Excellency, Ladies and Gentlemen. It is certainly a great honor for us to have the opportunity of delivering, to you, some of the views we have formed during our short survey mission here in Thailand.

Since my friends here will bring out and discuss, with their expertise, various aspects related to our mission, please permit me to confine myself to making a few observations on the testing laboratory services, especially with reference to my own country, Korea.

Before embarking upon those prefessional matters, I wish to express my deep gratitude to all of you and others who are not here with us today, but who have kindly extended cordial hospitality and co-operation during our visits to various organizations here in Thailand. I have certainly learned a lot and benefitted greatly. The benefits will be well shared with people in my country.

All of us know that, despite certain differences between Thailand and Korea, there are quite a number of aspects which are common both to them and to many other countries which are in the process of laying the sound foundation needed for attaining rapid but healthy industrial development.

Accepting these assumptions, let me briefly refer to Korea's experiences in my field and the problems that have been confronting our country in recent years, as this may have some bearing on relevant institutions in Thailand.

Firstly, I feel that there is some overlapping and, on the other hand, too much diffusion of our standardization and research activities, perhaps in both our countries. Of course, it is desirable to have as many research and standardization activities as possible. However, I feel we must be careful to avoid much diffusion in a country where financial sources and experimental facilities are rather limited.

In the early part of this year the Republic of Korea took strong measures towards the rearrangement and consolidation of various organizations doing rather similar work. We have been striving to carry out standardization, quality control, weights and measures calibration and testing laboratory services in a much more systematic manner through a newly established organization.

Second, we have the problem of insufficiency of laboratory facilities, particularly in the provincial towns. The task which we have to tackle is the nation-wide improvement of the analytical and experimental laboratories. We feel this task must be urgently performed in order to keep pace with the nation's policy of decentralization of industries. We have been carrying out a study to find effective ways and means of making the best use of the very limited facilities available in the provincial towns. In this connection, I have been really impressed by the branch office of ISI located in Chiengmai. I have no doubt that it will continue to contribute greatly to the development of small and medium scale industries in that locality.

Our third serious problem is a shortage of skilled technicians. In Korea, even though we have been giving special allowances to those government officials who are engaged in technical, engineering and research work, there are still considerable differences between what they receive and what their counterparts in private enterprises receive. I feel that this is one of the common phenomena prevailing among the developing countries in Asia. If the quality of the officials with technical tasks is inferior to that of people working in private firms, it is not reasonable to expect the government officials to provide technical guidance and solve the problems of private firms. I feel strongly that a considerably greater number of competent engineers and technicians in the field of calibration is needed.

In this particular field, we are planning to recruit competent college graduates, to provide them with special training abroad, and to impose on them a duty to serve the Government on a contract basis. We are also considering means of curbing the outflow of competent specialists to private enterprises by providing them with sufficient incentives.

The final but the most important point which I wish to make is that top level officials should appreciate the urgent need to develop up-to-date technologies. I believe more importation of foreign plants and technologies will not be sufficient to attain industrial development in a real sense. Moreover, in many instances, I have observed that the top officials, even though they may fully realize the needs for such development, become rather reluctant once it comes to the stage of allocating funds. This may be owing for the fact that the effects of such inputs are not always immediate and clearly visible. It is my opinion that, in many instances, too low priority has been given to projects that will lay the foundation for healthy industrial development.

In Korea, we have been striving in every possible way to move away from the category of developing countries and achieve the status of a semi-advanced country during the second half of the 1970's. I am very glad to note that Korea is gradually giving higher priority to the development of this crucial area.

Please excuse me for saying so much on what has been happening and what is going to happen in Korea. I hope some of our experiences and some things we are planning to do will be of practical interest to you. I am eager to see all of us cooperating in a more effective manner to solve our common problems and bring prosperity to all our nations.

12.4 Werner Y. F. Ning, Director, National Bureau of Standards, Ministry of Economic Affairs, Taipei, Taiwan, Republic of China

It is my understanding that the protection of industrial property is essential to the industrialization process of a country. It is generally recognized that "Industrial Property" comprises primarily patents of invention, patents of industrial design, and trademarks. All of them are the results of creative activities. In the process of industrialization, the exploitation of natural resources and the utilization of human brain resources are equally important. When we speak of utilization of human brain resources, it is generally agreed and has been widely demonstrated that the protection of the results of the creative activities of the human brain is the best way to attract people to use their brains in the field of invention and design.

As an administrator of the patent system in a country similar to yours, I just like to draw your special attention to the following benefits you may enjoy if patent protection is available:

(1) Patent protection offers an incentive to the inventors. As you know, by definition, invention must be something new. In the

process of industrialization, a country needs both new products and new processes.

(2) Patent protection attracts foreign investors to bring new techniques and processes into your country. Patents must be considered as a kind of capital. Manufacturers of products protected abroad do not risk undue exposure to imitation by in-country manufacture if they also have in-country patent protection.

(3) Patents must be respected in connection with foreign trade. A patent is only protected within the jurisdiction of the country where the patent is granted. Imitation of patented products is not only morally wrong, but such a product will also be confiscated upon the entry into the country where it is patented. Home produced goods that do not respect patents are unsuited for export.

Trademarks are closely connected with quality control. A trademark has been considered by the trademark owner as an integral part of his assets. A trademark serves as a guarantee of the quality of the product. As a rule, a trademark owner does not just maintain the quality of his product, but also improves it willingly. The better the quality, the larger his market. The result of such a chain reaction is mutually beneficial to the trademark owner and the consumer.

For your reference, may I tell you very briefly about my experiences in the administration of industrial property in my country:

The total number of patent applications filed with the Bureau from 1950 to 1972 is more than 30,000 and the number approved is in the neighborhood of 12,000.

Based on nationalities, around 50% of the applicants are Chinese, 20% American, 19% Japanese, and 11% nationals from other countries. Among them, there are 38% from chemical industries, 4% in electrical engineering, and 6% in mechanical engineering.

From 1954 to 1972, the total number of trademark applications examined was more than 53,000, the number rejected was around 9,000, and the number registered was in the neighborhood of 44,000.

The statistics of the trademark applicants show that the first in number was Chinese, the second, Japanese and the third American, and that chemical products was the first, food products was the second, and textile products was the third in number of trademark applications.

In conclusion, even if you think that at the present time the implementation of a patent system is premature, it seems to me that it is already late to start training patent examiners. Normally, it takes at least four or five years. If I can be of any further assistance, please do not hesitate to let me know.

12.5 Fahrettin Can, Assistant Professor, Orta Dogu Teknik Universitesi, Middle East Technical University, Ankara, Turkey

I was very much impressed by the enthusiastic and cooperative attitude of the Thai people. They all appear to be hard working and willing to accomplish things, for others as well as for themselves.

On the other hand, I believe that modern technology requires specialization on the part of people, and use of sophisticated and very expensive equipment. Highly trained, specialized personnel and capital resources to purchase the costly equipment are usually scarce even in highly developed countries. It is more so in countries like Thailand and Turkey. We must, therefore, make the best use of such talent and equipment whenever we can have them available. This requires a systematic and conscientious cooperation among persons, departments, agencies, universities, ministries, companies and even among nations. This is the only way we can afford such personnel and equipment.

To serve the purpose, it would be very helpful if all organizations, big or small, government or private, would carefully reconsider their organizational structures, redefine their objectives, determine the functions that have to be performed, group the functions, and assign them along with proper authority by specifying the duties and responsibilities, and have all this followed up by the top management or high government officials and see to it that the organization is staffed with capable persons who can operate in harmony.

12.6 R. K. Eby, Chief, Polymers Division, U.S. National Bureau of Standards

Your Excellency, Ladies and Gentlemen.

I am honored to have an opportunity to present to the Ministry of Industry a summary of my observations during our survey of Thailand.

A necessary component of any standardization, quality control and testing program is the measurement of various properties of products. This, of course, must be accomplished with appropriate measuring instruments and the instruments must be calibrated so that the numbers which they yield have useful meaning. Now, most instruments are

calibrated originally by the manufacturer. However, it is incorrect to assume that this calibration will remain valid indefinitely independent of time and the conditions to which the instrument is exposed. Therefore, instruments require recalibration. Usually we accomplish this by measuring the appropriate property of a material of known stiffness, chemical composition, etc. Such materials are produced by the U. S. National Bureau of Standards and are known as Standard Reference Materials. A good example is the Light-Sensitive Paper used in the textile industry to calibrate the lamps with which the fading of dyes is measured. These are frequently carbon arcs for which the characteristics vary markedly from time to time in one fading lamp and from one fading lamp to another. If the buyer and seller of textile materials wish to specify fading properties in their contract and if they both wish to verify these in their laboratories, it is necessary that they calibrate their lamps with the same Standard Reference Material. This is the role played by the Light-Sensitive Paper which finds use not only in domestic trade but also in international trade in textiles. Indeed, such a material will probably become eventually an international Standard Reference Material.

There are very many standard materials and I have looked for the use of these in appropriate applications during my visits to laboratories in Thailand. I am happy to say that I have found many such materials in use to test, for example, rubber compounding procedures, the burst strength of paper, and in a number of applications in the Department of Science. However, I have not found them in use everywhere that they should have been. I have three observations that might be of some help in improving the situation:

a) An appropriate Department, such as the Department of Science, should take an active and central role in identifying the real needs for such materials in industry and encouraging their use.

b) To help in (a), the Department selected should send a representative to a Symposium, "Standard Reference Materials and Meaningful Measurements", which the National Bureau of Standards is holding this October to consider the needs for and roles of Standard Reference Materials in industrial technology. This person should also spend some time as a Guest Worker at the National Bureau of Standards learning about our Standard Reference Materials program.

c) When the real needs of industry for Standard Reference Materials have been identified, the National Bureau of Standards can help initiate a corrective program by providing, free, a reasonable amount of such materials.

In conclusion, it is my feeling that these three actions would contribute strongly to the filling of a need which I have observed for the wider use of the Standard Reference Materials in Thailand.

12.7 T. M. Stabler, Special Assistant for International Programs, Office of Engineering and Processing Standards, U.S. National Bureau of Standards

Among the fundamental considerations of any industrial or industrializing nation are programs of legal and scientific metrology basic to commerce at all levels: in production - in the purchase of raw materials; at the wholesale or distribution level - in the buying and selling of finished commodities in quantity lots; and at the retail marketplace - where the general public purchases products for personal consumption. Examples are food and clothing, gasoline and household fuels, and commodities for personal care, health and safety.

The basis for programs of legal metrology is the requirement for equity in trade, that the buyer and seller receive just compensation in pay and in commodities purchased. It is usually considered an appropriate function of government to assure that equity prevails in the marketplace and to provide the necessary technical service to government, industry, and business so that commercial measurement losses are minimized.

To build effective programs of legal metrology, the first step is to enact a modern, up-to-date law (general and broad in scope) and support this with regulations having the force and effect of law (e.g., specifications and tolerances for weighing and measuring devices, requirements for packaging and labeling, etc.). The second step is to supply the legal metrology service with adequate physical standards (kilogram weights, volumetric test measures, and length measures to adequately test scales, meters, lengths, and net content of packages). These field standards should be directly traceable to the nation's primary standards of mass, length, and volume for reasons of accuracy and legal certification. A laboratory or system of laboratories for scientific metrology should be considered for accurate industrial and commercial measurements, and should adequately support the needs of government, industry, universities, and legal metrology.

In addition to well-qualified, trained personnel, the program of legal metrology should be planned and administered by experienced officials to obtain the maximum benefits this program can provide.

The benefits may include significant savings to the nation's economy by controlling measurement of commodities at the export/import stations by promoting the use of international standards for

commodities introduced to foreign trade (participation in international standards organizations is recommended). The government can benefit from an effective program of legal metrology as the largest single purchaser of commodities by reducing losses due to shortages and by building confidence in the government service as the "third man" in all commercial transactions. Individual industries may realize sizeable savings in the purchase of raw materials and accurate measurement of goods produced. The general public - "consumers" - will benefit directly from effective weights and measures control. Only the use of approved (accurate) weighing and measuring instruments should be permitted in the marketplace. Only packages containing the correct net quantity should be sold.

On the international scene, it is in the nations where equity of commercial measurements is assumed to be accurate that the greatest shortages may occur. In the past, measurement surveys of certain marketplaces have indicated shortages in more than 50% of all devices tested and packages checked. Programs of legal metrology and international standards are of sufficient economic impact that consideration should be given to their early implementation.

12.8 L. E. Gatterer, Time and Frequency Division, U.S. National National Bureau of Standards

During my brief stay in Thailand I have attempted to survey resources and applications related to time standards. Before I discuss my impressions, perhaps I should define two terms that I must use, namely, frequency and date.

If the little hand on your wrist watch goes around once every twleve hours, then your watch is said to be on frequency. It runs at the correct rate. If the two hands point where they should, the date is accurate. That is, your watch reads the correct time. Frequency and date are two fundamental terms of timekeeping.

In Thailand, people need frequency standards (i.e., oscillators) to check the frequency of radio transmitters, electric power generators, and many electronic instruments. On the other hand, people who must coordinate activities at different locations need date standards (i.e., clocks). For example, if the people at Chiengmai and Songkla want to use seismic readings to measure the direction of travel and speed of the shock wave from an earthquake, then they must be able to make a very accurate determination of the dates at which the shock wave is detected at each of the two locations. The Department of Mineral Resources has informed us that the seismic people need to be able to date their measurements with an accuracy of 1/100 sec., and they don't know how to do it.

Another example of the need for date information in Thailand is related to nation-wide television broadcasting. I am told that some program time is lost each time that the local stations are connected into the nation-wide network hook-up, because the clocks by which the individual local stations schedule their programs do not all read the same date.

The seismic date problem involves the highest accuracy requirement I have encountered, but there may be many others that I did not discover. I have been able to identify a number of techniques that could satisfy this requirement. The careful use of HF time broadcasts from China and Hawaii stands out as one method that is relatively cheap and simple.

It appears that HF time signals are presently receivable at most locations in Thailand with reasonable reliability. I will be available to communicate with anyone having a special antenna problem or other difficulties.

From my extremely brief survey, it appears to me that careful use of HF time broadcasts will solve most existing needs for date information in Thailand. But it seems likely that in the not too distant future, Thailand may wish to acquire new electronic systems which will depend on more accurate date information for their day-to-day operation.

In the United States, for example, the electric power distribution people tell us that they could take advantage of millionth second date information to locate electrical faults in their networks. People interested in automatic vehicle location systems want accuracies even better than a millionth second.

NBS has been studying how to disseminate information from the time standard with such accuracies. One technique we have developed may be of great interest in Thailand. This technique takes advantage of the fact that television picture information is sent in bursts. In between the bursts there are very short time intervals during which the communication channel is empty. NBS has developed equipment that can inject time information into these empty spaces. The microwave networks that carry the TV signals and the time around the nation are very-stable, providing the basis for a very accurate and practical time dissemination system.

Anyone who has a specially equipped TV receiver can press a button and see the time displayed on his TV screen. Or the time signals can be channeled directly to the system that needs it.

But there is a side benefit of this technique that may be of special interest in Thailand. I learned that some TV programs in Thailand are

overlaid with subtitles or captions. The spoken words appear at the bottom of the TV screen in written form. These subtitles can be used with foreign language films of course, but they have other applications too. They open up a new world to deaf people, and they can be used to increase literacy or to teach a foreign language. But advertisers sometimes object to them, because the captions are distracting to some viewers. The captions are overlaid on the films prior to transmission, so everyone must see them.

An interesting aspect of the NBS TV Time system is that the equipment that must already be installed for the time signals can also be used for captioning. When captioning is done by this approach it is optional to each viewer whether the subtitles are displayed on his TV screen or not. He merely throws a switch if he wants to see the captions.

It would be possible to provide both sound and captions in more than one language if it should be desired to do so. At present the translated sound track is sometimes broadcast separately in Thai over FM radio. But it is perfectly possible, using the NBS technique, to broadcast both sound and captions in several languages, nation-wide, using the TV channel only. Each viewer could then select the language of his choice, and could have captions as well if he wanted. It would be a great satisfaction to be a part of opening up this new world to deaf people, whose greatest desire is to be able to communicate better with the rest of the world.

The main point though is that there are many interesting opportunities that depend on better time dissemination. I have two recommendations to make with regard to the organization of time standards in this country.

The first is that you give careful consideration to the organizational location of your date and frequency standards in this country before you modernize your timekeeping capabilities. The standards of length, voltage, and other physical units may in the near future become closely interrelated with frequency. So it will be beneficial to place your time standards physically close to your other primary physical standards.

The second recommendation is that you work with private concerns, or else you designate a group that will be responsible to help other agencies with time dissemination problems. You may not wish to make that the sole activity of a group, as the activity will probably not be large, unless Thailand acquires some new date dependent systems. But it might be useful to have a place where an agency like the Department of Mineral Resources can go for help when they need it. It might make sense to have the dissemination people physically close to

the time standard, and it would probably even be desirable to have the same people keep time and offer dissemination advice.

In closing I will mention that in order to satisfy its own needs, the United States is planning to begin maintaining extremely accurate date coordination between the bank of atomic clocks at the Loran C station at Sattahip and the principal clocks in the United States. So if Thailand should desire to coordinate its own time scale with the international time scale, the means will soon be at hand to do so.

Addendum: The television time dissemination technique described in this presentation is an experimental system. It has been tested extensively and successfully, but it is not an operational system in the United States.

The television format in use in Thailand is somewhat different than that in use in the United States. Therefore, modified equipment would have to be constructed before the television time dissemination system could be tested in Thailand.

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A survey of standardization and measurement services available in Thailand was carried out in May and June of 1973 as part of a National Bureau of Standards program sponsored by the Office of Science and Technology of the Agency for International Development. The Survey Team included five NBS staff members, three third-country participants, and an approximately equal number of professional Thai participants, headed by the overall Survey Director, Dr. Charoen Vashrangsi of the Department of Science in the Thai Ministry of Industry. A total of universities, government departments and private organizations were visited by some or all of the Team. The schedule of visits was so heavy that no time was available for discussion and formulation of formal recommendations. Thus the report is largely a brief factual account of the various visits, although a few comments and suggestions are included.

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