NATIONAL BUREAU OF STANDARDS REPORT

9811 [illegible] 2 ?

A REPORT TO THE AGENCY FOR INTERNATIONAL DEVELOPMENT ON A VISIT TO KOREA BY A NATIONAL BUREAU OF STANDARDS TEAM UNDER AID SPONSORSHIP

NBS

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards[1] was established by an act of Congress March 3, 1901. Today, in addition to serving as the Nation's central measurement laboratory, the Bureau is a principal focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. To this end the Bureau conducts research and provides central national services in three broad program areas and provides central national services in a fourth. These are: (1) basic measurements and standards, (2) materials measurements and standards, (3) technological measurements and standards, and (4) transfer of technology.

The Bureau comprises the Institute for Basic Standards, the Institute for Materials Research, the Institute for Applied Technology, and the Center for Radiation Research.

THE INSTITUTE FOR BASIC STANDARDS provides the central basis within the United States of a complete and consistent system of physical measurement, coordinates that system with the measurement systems of other nations, and furnishes essential services leading to accurate and uniform physical measurements throughout the Nation's scientific community, industry, and commerce. The Institute consists of an Office of Standard Reference Data and a group of divisions organized by the following areas of science and engineering:

Applied Mathematics—Electricity—Metrology—Mechanics—Heat—Atomic Physics—Cryogenics[2]—Radio Physics[2]—Radio Engineering[2]—Astrophysics[2]—Time and Frequency.[2]

THE INSTITUTE FOR MATERIALS RESEARCH conducts materials research leading to methods, standards of measurement, and data needed by industry, commerce, educational institutions, and government. The Institute also provides advisory and research services to other government agencies. The Institute consists of an Office of Standard Reference Materials and a group of divisions organized by the following areas of materials research:

Analytical Chemistry—Polymers—Metallurgy — Inorganic Materials — Physical Chemistry.

THE INSTITUTE FOR APPLIED TECHNOLOGY provides for the creation of appropriate opportunities for the use and application of technology within the Federal Government and within the civilian sector of American industry. The primary functions of the Institute may be broadly classified as programs relating to technological measurements and standards and techniques for the transfer of technology. The Institute consists of a Clearinghouse for Scientific and Technical Information,[3] a Center for Computer Sciences and Technology, and a group of technical divisions and offices organized by the following fields of technology:

Building Research—Electronic Instrumentation — Technical Analysis — Product Evaluation—Invention and Innovation— Weights and Measures — Engineering Standards—Vehicle Systems Research.

THE CENTER FOR RADIATION RESEARCH engages in research, measurement, and application of radiation to the solution of Bureau mission problems and the problems of other agencies and institutions. The Center for Radiation Research consists of the following divisions:

Reactor Radiation—Linac Radiation—Applied Radiation—Nuclear Radiation.

---

[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D. C. 20234.

[2] Located at Boulder, Colorado 80302.

[3] Located at 5285 Port Royal Road, Springfield, Virginia 22151.

NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT		NBS REPORT
1400640	March 1968	9811

A REPORT TO THE AGENCY FOR INTERNATIONAL DEVELOPMENT ON A VISIT TO KOREA BY A NATIONAL BUREAU OF STANDARDS TEAM UNDER AID SPONSORSHIP

Forest K. Harris
Ronald K. Eby
H. Steffen Peiser

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

Index

Abstract

A review of visits by an NBS team to about 50 Korean research, testing, and standards laboratories and government offices is presented together with the conclusions and recommendations of that team.

The amount and complexity of Korean industry based on modern technology is increasing and apparently will continue to increase. Also, the volume of exports is increasing. Both of these factors create needs for more sophisticated physical standards, quality control, and calibrated testing systems within the country. However, most of the present system of standards and calibration is inadequate for the demands of modern technology. The responsibility for physical standards is diffuse, many of the reference standards themselves are inadequate, and are housed in laboratories which are not suited for good measurements. As a consequence, a number of companies are forced to go outside of Korea to obtain calibration of their instruments and reference standards. Similarly, the responsibility for testing and applied research (that of a nature to be supported within the government) is somewhat diffuse and many of the facilities are inadequate for the work.

It is concluded that to change this situation there should be a number of changes made in the present systems of testing, standards, and research. These should include: a combination of some government agencies; some changes in responsibilities and guidance; some changes in the salary structure; and new grounds, buildings and library. To assist the development of the combined agencies, a "sister relationship" with NBS could include: training of key personnel at NBS; visits by NBS staff to the new Agency; and NBS advice and assistance with planning physical standards, new laboratories, and a new library. NBS training assistance presupposes that funding from some source can be arranged, since NBS has no funds available for this purpose. The NBS team is convinced that these changes, etc., should be made quickly in order that the new Agency be able to meet the demands which Korean industry will soon place upon it. It is our belief and hope that the recommendations in this report will be of assistance to the technology of Korea.

1. Introduction

Any survey and assessment of technology in the Republic of Korea must be made with the historical background of the country in mind. Korean history reaches back through four millenia, much of the time as an independent kingdom with a feudal system. Modern Korea was under Japanese domination during half a century and was under colonial rule during the final 37 years of this period, ending in 1945 with the partition of the country into a northern half, rich in mineral resources and under communist domination, and a southern half with a largely agricultural economy, in which a republican form of government was organized. In the 1950-53 war, this Republic was almost completely overrun by the invaders from the North; and the armistice of 1953 left the nation partitioned, with the resources of the northern half firmly behind the Iron Curtain. The struggle of the Republic of Korea toward a viable industrial economy is being made under the continuing threat of a neighbor whose rulers are militant; and the defense posture of ROK, which requires an 600,000-man army and absorbs 30% of the national budget, is a basic consideration.

Under these handicaps a 5-year plan of economic development was initiated in 1962, and saw exports grow from $M55 in 1962 to $M256 in 1966, with manufactured goods accounting for 68% of the final figure. A second 5-year plan was begun in 1967 with its principal emphasis on industrialization and export expansion. Export volume is expected to reach $M350 in 1967, and it has been predicted that electronics alone will account for a figure between $M100 and $M200 of the national product by 1971.

Because of its situation with respect to natural resources, but with a reservoir of literate, intelligent and hard working people, the Republic of Korea must depend largely on processing and manufacturing for an export market in order to sustain a viable economy. Thus the problems of quality assurance, particularly for export items, are of paramount importance. It was in connection with these problems and with the testing programs that implement quality assurance that the visit of our NBS team to Korea was sponsored by AID. Our program of visits was arranged in collaboration with the US Operations Mission/Korea by the National Industrial Research Institute (NIRI) which has the ultimate responsibility for tests of export items to assure acceptable quality in foreign markets. The program was enlarged at our request to include some additional visits.

The text of our report is divided into sections: (1) Introduction; (2) General observations and conclusions that are the basis of our recommendations to AID in the areas studied; (3) Recommendations that we wish to submit for discussion and action; (4) Elements of a "sister relationship" which could be realized between our NBS and an ROK organization having a mission and objectives similar to ours, if funds were

made available from some appropriate source; (5) A diary of our day-to-day activities together with some comments on the individual visits; (6) Appendices listing abbreviations used in the text, stating the formal agreement reached between the NBS team and NIRI at the conclusion of our study, and presenting information about ROK government employees salary scale.

2. General Observations and Conclusions

2.1 Need for a National System of Physical Standards

In a technological economy good measurements are essential to quality control and to equitable trade. These measurements must be based on a national system of physical standards which should be in agreement with the International System if it is to serve trade between nations.

Authorities in ROK have developed an extensive system of written standards which specify attributes and performance of products and materials--drawn largely from U.S., Japanese, British, and German specification standards with modifications to meet local conditions--which have gained substantial manufacturer and consumer acceptance, and whose provisions form the basis of export product inspection. To be effective, the control of manufacturing operations and the evaluation of product quality must be backed by measurements coordinated through calibrations based on a national system of physical standards.

2.2 Deficiencies in Present System

While there are Korean laws defining many of the units of measure in accord with the International System, a national measurement system is not yet realized in practice. The responsibility for the basic standards is fragmented; the reference units which exist are improperly housed and are not generally used effectively. There is in fact no extensive interface between the national standards and the calibration services that should be available to technology and science. In many of the laboratories and test facilities we visited, the original factory calibration of measuring equipment is used and no procedure exists for periodic calibration checks. The "Fine Instrument Center" (FIC) has a temporary arrangement with the 8th Army Calibration Laboratory for checking FIC reference standards; but this is on a time-available basis and is purely an interim understanding. FIC can probably provide some part of Korea's technology with secondary level calibrations which would be useful as a stop-gap measure until the Korean system is properly organized. The "Gold-Star Electronic Company" sends its company standards to Germany for calibration checks. There are a few additional instances in which progressive companies make use of the measurement systems of other countries to provide needed calibration services.

2.3 Government Responsibility

It is clearly a responsibility of central government to provide and properly maintain reference standards adequate to form the basis of a national measurement system in essential agreement with the International System, and to make these standards available to science and technology through appropriate calibration services and consultation. This responsibility cannot be delegated if the national system is to be kept in agreement with the International System.

2.4 Review of Existing Organizations

A brief examination of a few ROK organizations is pertinent at this point. The Fine Instrument Center (FIC) has within its mission (a) the training of instrument technicians, (b) the recalibration, repair and maintenance of instruments, (c) engineering and consulting services to industry in instrumentation, and (d) prototype development of instruments. Thus, while FIC obviously must maintain a standards laboratory and can provide a calibration service, it is dependent on a higher echelon standards laboratory (preferably, directly on the national laboratory) for assignment and calibration checks on its reference standards. The Korea Institute of Science and Technology (KIST) was organized in 1966 as an independent agency to carry out research in the sciences, engineering, and economics. It aims at "utilizing science and technology to support and encourage the economic development of the nation. Preservation of autonomy and independence is considered of the greatest importance. Financial support is furnished by the governments of ROK and USA under a long range program of assistance which helps insure stability. However, it is intended that the Institute will ultimately become self-sufficient through provision of its services to industry on a cost-incurred basis." It aims to attract Korean scientists and engineers presently working both in and out of the country and is in a position to offer salaries and working conditions that are very much more attractive than those of government laboratories. Here also it may be assumed that a standards laboratory will be needed to meet the needs of the Institute; and it may be that calibration services can be extended to industrial firms on a "cost-incurred" basis; but it is not within the charter of the Institute to set up and maintain the national measurement system nor does it wish to carry out the public obligations incident to custody of the national reference standards. The National Industrial Research Institute (NIRI) is organized for industrial research as well as being assigned the ultimate responsibility for export product inspection. Its mission statement includes the following: "...to carry out investigations of domestic resources...development of production, training of technicians and engineers, application of modern technology to industry.... An important activity is research directly concerned with industrial production which manufacturers cannot do because of lack of facilities and equipment. The Institute is also concerned with improving the quality of industrial products and the development of new industrial fields."

While there is apparently some overlap in the stated missions of KIST and NIRI, we do not believe that there need be any significant duplication of effort. KIST aims at research that will be supported by industry on a contract basis. Industrial research of NIRI may well be limited to areas of technology which must be supported by government, where industry is unable or unwilling to provide the funding needed. Certainly there are areas of applied research that match with NIRI's obligations in supervising product evaluation. It is, however, quite clear that in competition for technical talent, KIST has an enormous advantage over NIRI since it is not limited to government salary scales

and offers substantial fringe benefits. Also, the element of NIRI's mission concerned with export quality assurance may well suffer since "research" activity commands a substantial bonus above the normal salary scale. Thus, senior staff understandably tend to concentrate their efforts in "industrial research" and to emphasize the research aspect of their activities. Something should be done to bring salaries and working conditions of senior scientists and engineers in government organizations more nearly into line with the outside opportunities that are available.

There are a number of inspection of institutes in various technical areas which are under the general supervision of NIRI. In addition, there are provincial laboratories (with inspection functions) which are under the immediate supervision of the provincial governments, and ultimately answerable to the Ministry of Home Affairs. Thus the responsibility for quality assurance is diffuse, and technical communication could be handicapped by the need to proceed through channels between two ministries.

In the area of responsibility for the national reference standards, the Bureau of Weights and Measures (in MCI) has custody of such metrology standards as there are; the Electrical and Communications Institute (in MOC) has custody of the electrical standards; the Atomic Energy Institute (in MOST) no doubt has the competence to establish radiation standards of intensity and exposure needed in industry and medicine, but as yet has done nothing in this field. Thus in the field of the national reference standards of measurement, organizations in a number of ministries are involved, and this seems to us an undesirable complication.

3. Recommendations

From our observations during visits to industrial research and testing institutes, government bureaus, testing and product control facilities, and manufacturing plants, we have concluded that the following recommendations are worthy of consideration.

3.1 Reorganization

The organizations now concerned with domestic and export standards, supervision of quality control testing, industrial research, and responsibility for the national reference standards should be united as branches of a single organization similar to the US National Bureau of Standards. Within the Ministry of Commerce and Industry (MCI), these organizations are:

a. National Industrial Research Institute (NIRI)
b. Bureau of Weights and Measures
c. Korea Bureau of Standards [NBS(ROK)].

As noted below (See 3.2) there are other organizations that should be included.

3.2 Responsibilities

The new organization (for the purposes of this report called the Institute of Metrology, Standards, and Related Research - IMSRR) should be responsible for:

a) The duties of the present organizations--specifications, quality control and industrial testing, calibration services, reference standards, training in measurement techniques and good laboratory practices, measurement-related research, industrial research of a nature that is not carried out by KIST or in industrial laboratories;

   Note: Responsibility for quality control testing and industrial research is now somewhat diffuse and consideration should be given to central coordination of the Provincial Industrial Research Institutes which have duties similar to those of NIRI. They are presently responsible to the Ministry of Home Affairs through local government channels.

b) the electrical standards;

   Note: These are now maintained in the Ministry of Communications (MOC). In taking over the basic electrical standards

IMSRR would assume the responsibility of providing MOC with the calibration of electrical standards needed by MOC. At the same time MOC should be relieved of the task of testing watthourmeters--a job it performs now only because it has custody of the basic electrical standards.

c) radiation and radioactivity standards needed for medical and industrial applications, including nuclear power;

Note: In this one area, consideration should be given to the possibility of delegating the establishment and maintenance of these standards to the Office of Atomic Energy.

d) establishment and maintenance of temperature standards for the entire range needed by industry;

e) providing standard reference materials needed for calibration of instruments and checking the procedures used in the analysis of products and materials;

Note: The standard reference materials program should be correlated with those now in existence in other countries. Correspondence with the Office of Standard Reference Materials
National Bureau of Standards
Washington, D.C. 20234
could be useful in planning a program. It may be in the future that some standard reference materials could be obtained on an exchange basis, with ROK providing other materials needed in the international program. Existing talent in NIRI and elsewhere in research and testing organizations of ROK could be utilized for this purpose.

f) establishment of industrial safety standards;

g) maintenance of a nationwide inventory of special testing equipment and measurement competence.

Note: We do not know if it is feasible to make FIC an arm of IMSRR, but from the point of view of economy of effort, of equipment, and of training measurement specialists (desired by FIC as well as IMSRR), and in view of the desirability of unifying responsibility for the measurement system and the essential calibration services needed by technology, the inclusion of FIC in the new organization would have decided advantages.

3.3 Advisory Panel

To achieve the closest possible ties with the technical and scientific needs of the nation, an advisory panel should periodically review the activities and plans of IMSRR and make recommendations based on its findings. Such a panel should be selected from leading scientists and engineers in universities, industry, and other technical areas such as KIST and FIC.

We would also urge that the industrial research program of NIRI be reviewed in the light of programs now under way or planned in KIST, so that duplication of effort may be minimized. NIRI talent thus freed could be made available for the equally important tasks of assisting in the establishment of an effective national measurement system and in its application to the problems of product quality assurance so vital to the industrial economy of ROK.

3.4 Competitive Salaries

There is presently a substantial salary differential in favor of individuals engaged in "research" (Appendix 3). We believe that in IMSRR this should be extended to those who are responsible for:

a) maintenance and use of the nation's reference standards;
b) planning and directing of the calibration services of the Institute;
c) planning and directing of product testing.

We understand that pay scales of NIRI and other technical services of the national and provincial governments are far below those of industry and KIST. This leads to the loss of the best talent in the technical staff of the government. A reasonable differential is perhaps useful since a limited movement of personnel is healthy but the discrepancy here is far too great. The government could easily lose the technical leaders it has and not be able to make the staff improvements needed to assume the responsibilities described above. This situation should be corrected, perhaps in steps during a period of several years.

3.5 New Grounds and Buildings

The present facilities and site of NIRI are needed and wanted by adjacent Seoul National University (SNU) to consolidate its colleges. Also, the present plant of the Bureau of Weights and Measures is not suited to good measurements and its grounds are not adequate for the combined organizations. Hence, a new site should be selected. It is suggested that ground on the undeveloped part of the Export Industrial Estate in Yongdeungpo be considered for this site. The Bureau of Weights and Measures is planning a new laboratory building and we understand that some funds are set aside for this. It is suggested that these funds, if available, should be applied toward building at the new site. Moreover, valuable properties would be freed by the contemplated moves.

This suggested location would facilitate liaison and close cooperation between IMSRR and FIC; indeed there could even be sharing of some laboratory equipment and reference standards in areas of common concern, with a substantial reduction in cost to each organization.

3.6 New Library

Library facilities of the present organizations are wholly inadequate in some technical areas. A really good National Technical Library would be of great benefit to Korean technology and therefore, a central library on the new site of the combined organizations is suggested. This library should take into account resources which might be available to it on an inter-library loan basis from other institutions both public and private (e.g., universities, industry, KIST).

Note: It would be advantageous for the Patent Office to share the site and to have immediate access to the central library of IMSRR, but we are not suggesting that the Patent Office itself necessarily be incorporated into IMSRR. Similarly, there might be a number of advantages in having the Korean Standards Association share the site.

3.7 Miscellaneous

a) A statistical engineer with training in the design and analysis of experiments and quality control tests would be extremely useful to IMSRR.

b) In addition to other gains, a unified organization should achieve conservation of management talent and of equipment. Thus, there should be more time for planning in areas not covered thoroughly now. For example, decisions to buy expensive equipment (infrared spectrometers, x-ray diffraction apparatus, etc.) should be made taking into account availability of such equipment in other institutions to which IMSRR might have access, and if purchased, should be accompanied by a decision (and evaluation of fund availability) to provide a continuing supply of relatively inexpensive replacement parts. This should be especially true for parts of known limited life such as sources of illumination.

3.8 Timing and Need for Action

We would point out that the recommendations above are listed in a sequence which might correspond approximately to a reasonable sequence of implementation. However, it is our feeling that rapid implementation of all the recommendations is necessary for the attainment of a national institution adequate to meet the growing needs of Korean Technology.

4. Sister Relationship with NBS

We assume the establishment of a unified institution (IMSRR) with the responsibilities described in Section 3 together with needed funding. The "sister relationship" between NBS and the proposed institution could include any or all of the following features.

4.1 Training at NBS

a) Training of Koreans in various fields of testing has been active for some time. This can be continued in areas where it would be of further assistance if a source of funding can be found.

b) If 4 or 5 engineers or scientists were trained in appropriate measurement fields, they could be expected to assume responsibility for the national standards of measurement. They could also train the technicians who would carry out under their direction the essential calibration services of IMSRR.

Note: It may be pointed out that NBS and the George Washington University cooperate in a graduate curriculum of Engineering Metrology leading to MS and D.Sc. degrees. Koreans could enter this program upon acceptance by GWU. Thus broad training in a variety of measurement disciplines is available in the cooperative program. Specialized training at NBS only would require much less time and expense.

c) Training of scientists in research areas appropriate to the mission of IMSRR could be carried out at NBS. To be effective, these visits would have to be at least six months, but one year would be better.

d) NBS could also assist in arranging training periods for IMSRR personnel in State Offices of Weights and Measures when this seems more appropriate than a training program at NBS or is considered to be helpful as a supplement to NBS training.

4.2 NBS Visits to IMSRR

Experts in various fields of research, standards, and testing, might be made available to IMSRR for periods of a few months or longer. This form of assistance would be quite costly in terms of the specialist's absence from his own work for an extended period and should not be undertaken unless there is good reason to believe that his services will be efficiently used.

4.3 Physical Standards

NBS could advise and assist in planning and acquiring physical standards and reference materials and the instrumentation essential to their proper use. NBS could also provide initial calibrations (in terms of the International System) of reference standards that would become the basis of a national measurement system.

4.4 Laboratories

NBS could advise and assist in planning the laboratories and controlled environment needed for proper work in standards, research, and testing. NBS could also give advice concerning instrumentation for those fields of work.

4.5 Library

NBS could advise in planning the IMSRR central library and could contribute substantially with NBS publications on an exchange basis.

4.6 Need for Action

In conclusion, we would like to emphasize our feeling that the rapid development of all these aspects of the "sister relationship" with NBS (or other national laboratories) is necessary to prepare IMSRR for the demands which we believe Korea's technology will place on it in the near future.

5. Diary

5.1 Interviews in the U.S.

Before our departure for our tasks in Korea, we succeeded in obtaining a good deal of reading material partly with the help of the Embassy of Korea. At the US National Bureau of Standards we profited from advice given by our staff member, Dr. Chong Kuk Kim, and a consultant to the Polymer Division, Dr. Hyuk Yu, whose brother, Professor Hoon Yu, of the Seoul Graduate School of Public Administration, we met later in Korea. We talked to Dr. Harvey L. Goering of the Battelle Memorial Institute (BMI) about the sister relationship set up between BMI and the Korea Institute of Science and Technology (KIST). That relationship included training programs of senior KIST staff members, two of whom visited us at NBS before our departure. One of them, Dr. Young Ku Yoon, a competent X-ray crystallographer with experience at Brown University, Brooklyn Polytechnic Institute, US Steel and Argonne National Laboratory, was shortly returning to Korea. We were also fortunate to have private briefings from US Commerce Department economists who had considerable experience of the Korean scene.

Just before departure from NBS we met Mr. Sung Hwan Kim, an NBS guest worker for some months from the National Industrial Research Institute (NIRI).

Most important, probably, was our meeting with members of the Korean Industrial Development Observation Team led by Assistant Ministers, Woo Ryong Lee, Ministry of Commerce and Industry (MCI), and Moon Taik Lee, Economic Planning Board (EPB). We obtained valuable information from that team of twelve senior executives especially as a result of an evening discussion meeting convened by Assistant Minister, Woo Ryong Lee, in which we were given an excellent introduction to the Korean government's encouragement and interest in the field of our mission.

5.2 Interviews in Japan

Thursday, September 28

One of us arrived in Japan and visited the production, testing, and development facilities at the Haijima Plant of Rigaku Denki Co., Ltd. Useful discussions concerning a number of instruments were held with Superintendent Yokoyama and Research Department Manager, Dr. Yoshimatsu. The subject of government export regulations was discussed with T. Yamada of the Export Dept. I, Overseas Division.

Saturday, September 30

The remainder of the team arrived in Tokyo, Japan, and were met by Dr. Isao Oyama, second division chief of the National Research Laboratory

for Metrology, Mr. Masanao Morimura, physicist at the same laboratory, and others. An opportunity presented itself to discuss the relation of standards laboratories to Japanese test laboratories engaged in industrial product characterization and quality control.

Sunday, October 1

During informal meetings with Professors Teiichi Ito, R. Sadanaga, and M. Nakanira, all of Tokyo University, we discussed standard reference material development in Japan, the possibility of encouraging Korean participation in the program which is unique in the Far East, and Japanese success in the continuing supply of qualified graduates to industry and government institutes concerned with inspection, testing and quality control.

Monday, October 2

We called on Dr. Robert T. Webber, Scientific Attaché, Far East Embassies of the US, to discuss the background of Korean science and technology as it relates to our mission.

We also met Dr. Walter H. Hodge, US National Science Foundation, Chief of Far East Office, and his deputy, Dr. Richard R. Ries, to discuss the impact of the US/Japan Cooperation in Science Program on standards, quality control, and inspection procedures in Japan. The US Embassy staff also assisted in obtaining at short notice appointments with responsible government officials to give insight into regulatory control in Japan of inspection and testing procedures for export goods. The acceptance of Japanese products abroad is known to have depended on effective government-industry collaboration in quality control.

In particular, a visit was made to the Ministry of International Trade and Industry where we were received by the Chief of the Section for Inspection and Industrial Design, Mr. Iwaki Iwashiro and arrangements were made for further visits to illustrate Japanese inspection systems.

The evening was spent with Dr. P. J. Frank, General Electric, scientific representative in the Far East, for us to obtain an impression of the extent of difficulties in maintenance and servicing complex American scientific equipment in the field.

Tuesday, October 3

A thorough inspection was made of production and testing at Nippon Kogaku KK, manufacturers of the renowned range of Nikon Cameras and optical instruments. Accompanied by Mr. Masanao Morimura of the National Research Laboratory of Metrology we were guided throughout by Mr. Keizo Shiomi, Manager of the Nikon Research Laboratory.

We visited the Science and Technology Agency in the Prime Minister's Office of Science and Technology. The Director General of the Agency, Dr. Y. Tomonaga, is well known to us as former Director of the National Research Laboratory of Metrology. Interesting discussions were held with Dr. Kumiomi Umerzawa, Director of the Agency's Planning Bureau.

Wednesday, October 4

Further informative discussions at the US Embassy were followed by a visit to the office of the Japan Machinery and Metals Inspection Institute where President Isamu Hishinuma was the principal host. This was followed by a visit to the Setagaya Laboratory of JMMI where most of the discussions were held with Director Hideo Goto and the Acting Head of the Measuring Instrument Testing Section, Mr. Masato Kawarai. Advanced techniques were used to excellent effect. Collaboration with industry worked smoothly.

At Tokyo University a visit to Professor Shizuo Fujiwara, a well-known nuclear chemist, proved to be not directly relevant to our Korean mission.

Thursday, October 5

A visit was made to Tonuku University, Sendai Institute of Scientific Measurement where Professor Tadatoshi Hibi is director of a fundamental research institute in metrology without regulatory or direct teaching responsibilities and without accepting contract research from industry. Dr. Hibi and his staff were very helpful and would welcome cooperation with Korean specialists in metrology.

An extensive tour was made of the Sanjo Works of Shimadzu Seisakusho Ltd. We were accompanied by Professor Keinosuke Kobayashi of Kyoto University and guided by the Manager of the Scientific Instrument Works Dr. Shichibei Kozawa and the Sub Chief of the Engineering Section Mr. Masaya Iwanoga. Shimadzu manufactures a very large range of scientific instruments for research, industrial, and medical applications. It exports many of its products and also has concluded technical cooperation agreements with foreign companies to permit manufacture of their products in Japan. An opportunity arose for a comparative discussion of the situation in the U.S., Japan, and Korea.

Friday, October 6

We visited Professor T. Horie at Osaka University, a renowned physical chemist, who formerly taught at Seoul National University as Associate Professor. His experiences and impressions are probably somewhat outdated. Our discussions with Professor Syuzo Seke were more profitable but only from a purely scientific viewpoint.

We visited Professor Keinosuke Kobayashi of the Institute for Chemical Research at Kyoto University. In addition to presenting a lecture about our research, we had interesting discussions with Professors Kobayashi and Yasunori Nishijima of Kyoto and Professor Hiroyuki Tadokoro, Department of Polymer Science, Osaka University, who came from Osaka to see us. Professor Kobayashi and his postdoctoral student Dr. Toshio Nagasawa are continuing their work on the effects of point defects (induced by electron irradiation) on the crystals of polyethylene.

Saturday, October 7

We visited Kogyo Denchi Cooperative Industrial Park situated in Kusei, a district of S. Kyoto. Mr. Toshio Chyo, President of a member firm, the Chyo Balance Corporation, was our principal host. The range of balances and differential thermo-gravimetric instruments range from among the world's most precise to diverse equipments used for routine testing. The company has considerable experience in the Korean market and has received contracts under a system of Japanese aid with preference for Japanese products.

Also visited were Asahi Roentgen Company, the Sera Company, specializing in injection moulding, the Torii Winding Maching Company (textile machinery), the Yamashiro Company (metal sheet press and welding), the Sugawa Company (truck bodies), the Yamashiro Company (electrical measuring instruments), and an example of Japanese cottage industries. Finally, a discussion took place with a representative of Yanagimoto Manufacturing Company, a major supplier also to Korea of chemical analysis instruments for product characterization.

5.3 Interviews in Korea

Sunday, October 8

At Kimpo Airport we were met by AID USOM/K and Korean Government officials, including the Director, Mr. Bom Soon Lee, of the National Industrial Research Institute (NIRI) of the Ministry of Commerce and Industry (MCI). Of that Institute we also met Mr. Young Gu Ha and Mr. Nam C. Paik who were to become our guides on most of our tours and visits in Korea. Mr. Niels C. Beck, Industrial Advisor USOM/K, assisted by Mr. Woo Taik Moon, accompanied us to our quarters, gave us orientation instructions and background reading material that proved most helpful and included: "End-of-Tour Report" U-513, "Korea Export Program" IMD-1, "This is Industry in Korea" IED-1, and "Inspection of Export Products in Korea", all by Niels C. Beck. He also explained some of the implications of the Cabinet's recent reshuffle as it affected our mission.

Monday, October 9

A national holiday to celebrate the anniversary of the Korean Alphabet (Hangul) Proclamation.

The NBS team had is first day of relative rest, reading, writing, and becoming oriented.

Tuesday, October 10

After an official welcome to the Republic of Korea by the Vice Minister for Commerce and Industry, Mr. Chul Soong Lee, we visited the Quality Control Section headed by our host Mr. Chong Hak Kim. His Section, formerly the Export Inspection Section, is located in the First Industry Bureau of MCI and administers the new (October 1, 1967) Quality Control Law, giving protection to domestic consumers. Mr. Kim explained:

(i) the division into seven industrial fields, the systems of labelling, minimum requirements, and factory grading;

(ii) the parts played by the 17 semi-private quality control inspection stations and by NIRI;

(iii) the relationship to the KS (Korean Standard) system.

A courtesy call followed on Minister Kee Hyong Kim of the Ministry of Science and Technology (MOST). Dr. Kim formerly at Pennsylvania State University is holder of many patents and a distinguished ceramist with many attractive ideas on future progress and prospects for science and technology in the ROK.

At the US Embassy we met Mr. G. E. Robert Meyer, Commercial Attaché, and Mr. Bradford W. Miller, Jr., Commercial Officer, chiefly to discuss an agenda item for the visit at the end of the month of the US Secretary of Commerce, Mr. Alexander B. Trowbridge.

Wednesday, October 11

Director Bom Soon Lee of NIRI and his staff prepared a special welcome for us. After a general discussion of NIRI and the hoped-for "sister relationship" with NBS, a luncheon was given by the division chiefs led by the Director himself. Mr. W. D. Hyun is Chief of the First Division, Sin Sut Oh, Chief of the Second Division, and Sang Sup Lee, Chief of the Industrial Export Division. We started on thorough tours of the entire Institute. Mr. D. S. Augustin Kim, Section Chief of Inorganic Chemistry, and Mr. Jung Ik Raw, Chief of the Textile Section (who had been an NBS

visiting scientist from June-December 1965) first showed us their laboratories. The library was visited next and the testing and analysis center, the strength of which gives NIRI the reputation it enjoys in the ROK.

Thursday, October 12

A meeting with the USOM Deputy Director, Mr. Roger Ernst, proved to be helpful. His sincere welcome and thoughtful briefing revealed a deep regard for ROK and a practical approach to the real problems the nation has to face.

The remainder of the day was devoted to further inspection of the NIRI facilities and to study of the applied research programs, which are closely linked to pressing problems of ROK industry. The Mechanical Engineering Section is headed by Mr. Duck Kyu Yoon and the Ceramics Section by Mr. Yong Wan Park. The NBS team was not really competent to assess the work of the Food Technology Section. The Export Inspection Division, and the Administration Section led by Mr. Oh Soo Kwon, are mostly clerical groups.

Friday, October 13

In view of the great importance of electrical standards in the national measurement system of an advancing industrial nation a visit was made to the Electrical and Communications Laboratory of the Ministry of Communications (MOC), accompanied by Mr. Albert A. Nicolay, Chief of the Communications Branch, USOM/K. Although legally that Laboratory presently has the responsibility of promulgating electrical standards in Korea in conformity with the International System, this duty is not adequately carried out and is probably not appropriate for a laboratory oriented almost entirely towards communications.

A visit was also made to both the headquarters and the magnificent building site of the Korea Institute of Science and Technology (KIST). We were received by the President, Dr. Hyung Sup Choi, General Eung Kyun Shin, Vice President, and Mr. Donald D. Evans, Battelle Memorial Institute (BMI) advisor. The plans for KIST were explained and well illustrated by a lively discussion group on problems in the food industry, attended for example by Mr. Yong Sung Kim, President of the Korea Flour Mills Association. Main buildings will be completed by the end of 1968. A trust fund eventually of almost US$M4 is expected to earn 30% interest. The staff numbers presently more than 100 to be raised to about 250 in a year and will include about 25 at "principal investigator" level. Sixteen major surveys about industrial needs are presently being compiled. Symposia, thesis research on part-time basis, and sabbatical leave at least every three years are special features. The general conditions of employment should attract back to Korea nationals of that country who in the US or other countries have achieved a high standard of scholarship in the

sciences. President Johnson's gift of NBS standards is not matched by plans to provide a universal calibration service for members of the public demonstrating a need. Individual arrangements, of course, could be made for appropriate fees. In general, however, KIST is planning only to establish a system for acceptance of larger research contracts than would normally be involved in individual calibration services. To date two such large contracts are under way, both sponsored by the ROK government--one for long-range supply and demand for energy, the other for study of long-term scientific and technological development in Korea.

Monday, October 16

The first morning visit was to the ROK National Bureau of Standards in MCI and under its new Director, Mr. Young Bae Kim, who is an economist by training. He gave an excellent account of his Bureau which with the help of a system of Government-appointed committees establishes standard specifications, especially those leading to the KS (Korean Standard) marking. Throughout our stay in Korea we were impressed by the will of manufacturers and government to collaborate constructively to achieve realistic specifications that would reassure consumers and raise the reputation of Korean industrial products. For this purpose many foreign specifications especially those from the US, Japan, Britain, and Germany are copied with minor amendments. A system for gradual tightening of specifications is in effect. The Government-appointed technical standards committees have wide representation but, as everywhere, there are problems in obtaining responsible consumer opinions.

Next we talked with General J. S. Ro of the Korean Standards Association who explained the intermediary position which the KSA occupies between the NBS (ROK) on the one hand, and producers, consumers, etc. on the other. KSA is an essentially private organization approved and recognized by MCI and has the additional purpose of improving productivity in industry by better production control. KSA also publishes a monthly journal. With USOM/K help an English translation of Korean standard specifications has just been completed.

In the afternoon an inspection was made of the Bureau of Weights and Measures in MCI, administering the Law of Weights and Measures which does not include electrical standards or standards of radioactivity. In the absence in Paris of the Director J.K. Lee, we were received by the chiefs of the two principal divisions: Certification, Mr. C.K. Kim and General Affairs, Mr. H.J. Cho. The facilities of the Bureau are not commensurate with the needs of an industrial economy of a rapidly progressing nation. The national kilogram and meter bar are kept in the vaults of the Bank of Korea.

The Patent Bureau is headed by Director Choon Hang Chun who appeared well informed about patent practices in the US and elsehwere. His own organization administers patents and trademarks, but the NBS team was not qualified to assess its effectiveness. As yet no appreciable help can be given to Koreans for obtaining patent protection abroad. This appears to us an important service to be given to a people on whose inventiveness their future prosperity depends.

A busy day was concluded at the Korea Trade Promotion Corporation (KOTRA) where we were received by Mr. Dok Yong Chun, Section Chief in the Business Service Department. KOTRA is the "show window" of the fast expanding Korean industry aimed especially at foreign buyers. Its bimonthly "Korea Trade" journal is attractively produced and distributed through eleven "Trade Centers" in the US, Japan, Germany, Hong Kong, Vietnam, Thailand, Indonesia, and Singapore. There are twelve smaller KOTRA offices and five "correspondents" strategically located throughout the non-communist world.

Tuesday, October 17

Our first visit to a Korean factory took us to Cho-Il Rubber Industrial Company Ltd. at Youngdongpo near Seoul where Mr. J.D. Ryu was our host. Although it is not a large company, it has reached KS quality on some of its products. Natural rubber in ROK is all imported; domestic synthetic rubber will become available soon; reclaimed rubber is added in rather high proportion to lower quality products. Rubber filler dust is a slight problem in some areas. There are many hand (but tool assisted) operations in rubber boot and shoe production. These are the principal products of the company. Raincoats, rubber boats and air mattresses account for most of the remainder.

The United Nations Development Program has clearly made a major contribution to Korean technology by its provision of the UNESCO Fine Instruments Center at which we were received by the Director, Mr. Seung Yup Park, formerly the Director of NBS(ROK); the Chief Technical Adviser, Colonel John E. Steel of Britain; and a cosmopolitan supporting staff. It would be quite wrong, however, not to emphasize the enthusiasm and increasing competence of the Korean staff who as time goes on will take more and more initiative and responsibility.

The major aim of the FIC, as we see it, is to provide competence and training in the correct use, maintenance, servicing, repair, and recalibration of scientific and industrial instruments. Even now FIC is helping many laboratories in ROK to assure effective use of many pieces of equipment purchased abroad. Yet our tour of many establishments has convinced us that an urgent need persists. Throughout Korea there are many instruments which are not used at all or not effectively, at times for lack of a relatively inexpensive replacement part. There is thus not the slightest doubt that FIC is and will continue to fulfill a critical need.

In addition FIC, working with the Korean Measurement Instruments Industrial Association, hopes to stimulate and give detailed advice on domestic manufacture of instruments including the development by FIC of prototypes. This is another set of worthwhile aims, that will bear fruits in a country in which skill and patience are strongly developed human characteristics, and in which an electronic industry has taken firm hold.

A proposal has also been submitted to UNESCO, USOM/K, and the ROK Government for FIC to provide an interim calibration center based on temporary assistance by the US 8th Army Calibration Facility. FIC must keep standards for instrument calibration. Under those circumstances FIC might well offer a reimbursable service to anyone in ROK requesting it and demonstrating a need. The benefits could be considerable, especially because it is a widespread misconception that manufacturer's settings of instruments remain accurate and stable without limit of time, storage, and conditions of use. We have not reviewed in detail FIC's proposal for laboratory certification.

At the Koolodong Export Industrial District we saw in its infancy the first and ambitious industrial park administered by a non-profit corporation. Eventually it is hoped that it will earn in foreign exports more than $M20 annually, employ over 10,000 and include more than 50 participating independent factories. The showrooms are finished and attractively styled. Samhwa Hapsung Industrial Company is in production with rubber shoes and toys; Dongnam Electrical Industrial Company with TV and transistor radios; Sunny Electrical Machinery Industrial Company is said to produce "crystals and industrial jewel bearings", but there was no opportunity to see the product; Dairyuk Keumsok Industrial Company is producing brass fittings and faucets and Simson-Sanup Company is producing Christmas lights of which it is by no means the only ROK manufacturer. Most of the area, however, as yet is undeveloped land, conveniently located near Kimpo Airport, Seoul, and railroad services.

In the afternoon we visited four of the 17 independent Testing Institutes:

1) The Korea Metal Inspection and Testing Institute. Non-destructive testing equipment did not include radiographic but only ultrasonic apparatus which, used by itself, is generally inadequate.

2) The Korea Electric Machinery Inspection Agency. There is no periodic recalibration program for test instruments.

3) The Korea Fabric Testing and Inspection Institute with a former NIRI employee as Director, Mr. Young Su Yuk.

4) The Korea Textile Inspection and Testing Institute (KOTITI).

We will here give a few details of KOTITI partly because it is typical of the responsibilities and emphasis of these Testing Institutes and partly because it is a fine organization. Due to an administrative error, we were not expected but were received by Mr. Hyum Duck Lee and Mr. C.K. Kim. We were fortunate in that our visit happened to coincide with one by Mr. Don Leland of the Quality Assurance Division of the US Army Procurement Agency. It made us realize how effectively this particular official, and probably many like him, are helping Korean industry to comprehend details of quality standards and control by constructive personal cooperation for a more effective process than mere reading of the texts of specifications. These texts, despite much conscientious writing, are apt to allow misinterpretations particularly when foreign language difficulties are involved.

KOTITI provides a good testing service to industry with competent staff and fairly good,well-maintained equipment, that appears fully used. The service is also available for applied fiber research by contract. The Institute carries out standard mandatory fiber tests for standard fees for domestic and export merchandise. It operates training classes, classifies cottons and is available for arbitration in its field of competence.

Not all branches of ROK industry are so well served by the relevant inspection institute. The textile fiber industry in its relation to KOTITI is probably setting a good example to other industries. The full story of how domestic and export sales are benefitted by KOTITI's activities is, of course, not known to us after one brief visit. It was not surprising, however, that in this field one or two factories we saw had themselves similarly good test equipment and were competing in world markets. KOTITI in turn had confidence in their in-house inspection procedures. There was, however, an area of overlap with the Korea Fabric Testing and Inspection Institute.

Wednesday, October 18

Preparations for our journeys through provincial centers prevented a very full program of visits.

A visit was made, however, to Yonsei University, especially to Professor Choong-Hyun Chung, Secretary General of the Korean Physical Society which was inviting us to give several topical lectures and to attend the semi-annual Physical Society Meeting which was to take place at Taejon during our stay.

Yonsei has a beautiful campus with modern buildings; is a Presbyterian Foundation; has had substantial help from the 5th US Air Force and 8th US Army; has a large Medical Center; and appears to offer good undergraduate science teaching. It hopes soon to start post-graduate teaching

in selected departments. One clearly would like to meet more graduates at critical spots throughout industry and ROK government test and research laboratories who will carry back messages on the kind of training that will help Koreans to meet their urgent technological problems.

Thursday, October 19

Accompanied by Mr. Niels C. Beck and his assistant Mr. Woo Taik Moon from USOM/K, we flew to Taegu, third largest city in ROK and capital of Kyungsangpukdo, the largest of the eight provinces of ROK. There our party was joined by Mr. Nam C. Paik and Mr. Young Gu Ha of NIRI who had travelled by train. Apart from Mr. Beck's return to Seoul because of urgent preparations for his transfer to Saigon, the party stayed together on the six-day journey through southeastern Korea.

At an official welcome by Vice Governor Nam Bong Jin of Kyuongsangpuk Province, the progressive outlook and increasing industrial importance of the area became clear. The chief of the Industrial Section of the Provincial Government of Kyungpuk, Mr. Joon Hi Lee, explained how industry is attracted and supported by the new Provincial Industrial Laboratory, which we visited next. In its development much encouragement and $60,000 worth of US equipment (a universal testing machine) had been given by USOM/K through the offices of Mr. Niels C. Beck in particular. Gratitude for his personal services was expressed in a simple ceremony and a commemorative certificate handed to him by the Vice Governor.

At the Provincial Industrial Laboratory our host was the director, Mr. Young Ku Han. The Laboratory is well laid out on a good site conveniently located next to major new Government buildings and operates under a Provincial Government Law passed in 1965. Its relations to NIRI are tenuous, because it reports through the Governor's office to the Ministry of Home Affairs (MOHA). The Laboratory executes tests for local industry; gives guidance and consultation for fees to local industry on development of raw materials and of products to KS specifications; runs training programs; and there is some applied research presently chiefly on water quality and hardness, on local clays and their firing characteristics, and on dyeing polypropylene textiles. The staff of 40 includes 27 graduate scientists, the top job of the Institute, that of the director, is presently graded as 3B, the same grade as that of a laboratory chief at NIRI (see Appendix 3--Government Employees Salary Scale). The Laboratory has an effective advisory committee of local industrial leaders and university professors.

In the afternoon we visited the Che-Il Woolen Textile Company where we were received by Mr. Hal Sik Son, director and mill superintendent. The president of the company is one of the leading industrialists of ROK,

Mr. Byung Chul Lee. The Taegu plant, established in 1954, is large (almost 3,000 employees, more than 20,000 spindles, more than 120 looms), very modern, and employs up-to-date testing and inspection methods. Almost all the raw wool is imported from Australia and New Zealand. The export merchandise is fully competitive on a world market, and largely accounts for a rapid increase in ROK annual exports of sweaters, $M14 and of woolen fabric ca. $M3 to the US, Canada, Netherlands, and Sweden.

In sharp contrast our visit to the Hyup-Rip Manufacturing Company was an unforgettable experience. Suffice it to make two points:

(1) There was a total lack of safety precautions.

(2) Even so, the Company deserves some praise--it is evidently competitive in world markets for umbrella frames which are quite intricate mechanisms. This firm's production is so organized that quality control and inspection are guided by sound statistical practices.

Next we visited the Kyungpuk Productivity Center with its executive director, Mr. Yong Soo Ahn as principal host and Mr. Suk Kyu Bae, the counterpart industrial advisor for USOM/K in Taegu.

Friday, October 20

First we visited the Agricultural Research Station at Taegu directly responsible to the Agricultural Inspection Agency of the Ministry of Agriculture and Forestry (MOAF) of the Federal (ROK) Government. That Agency has a consultative committee of farmers and university experts which sets standards of product weight, length, etc., and establishes samples e.g. of seeds for quality of agricultural raw materials (e.g. seed grain) and products. They do not do research in crop or livestock development, crop rotation, reforestation, and general dispositions in land use. These latter functions are mostly covered by the Rural Development Office.

To return to the Agricultural Research Station at Taegu, it is one of seven similar stations in ROK responsible for agricultural districts corresponding roughly to the provinces. The Taegu Station has 27 subbranches in counties. With these branches it employs 176 persons. The equipment in the Station is quite impressive and well used in rather restricted space. Communication with MOAF in Seoul appeared to be direct and effective.

A lunchtime meeting took place in the Taegu compound of the US 8th Army at the invitation of Mr. Charles Luton, industrial advisor to USOM/K attached to the Kyungpuk Productivity Center.

Mr. Lunton, with an American colleague, had expended a considerable effort in helping the Sun-Il Aluminium Company to build a reverbatory aluminum melt furnace for foundry use, the company we had visited that morning. Mr. Oh Sik Chang, President of the Sun-Il Industrial group had been our host. Its products have won the KS mark, but some would not be competitive in world markets because of design faults. As regards safety, production methods are by no means as primitive as at the umbrella factory visited on the previous day, but still leave room for much improvement. There is administrative talent here and one obtains the impression that this Company will continue to prosper even after the large-scale production of aluminum in ROK begins under a cooperation and licensing agreement said to be signed with a Japanese group. Under these circumstances, the value of the cryolite research project at NIRI (Inorganic Chemistry Section) may be questioned.

In the afternoon a seminar-type discussion took place under the auspices of the Taegu Chamber of Commerce and Industry. It was attended by about 30 government officials, laboratory scientists and technicians, as well as leaders of local industry. The subject was inspection and quality control. We felt it most important to talk about physical standards, measurement systems, and instrument calibrations, whereas the audience was more anxious to hear our views on Korean written standard specifications, and on how standards are established and enforced in the US. The Koreans appeared unaminous that specifications ought to be enforced by regulation. We emphasized that additional in-plant inspection by the manufacturer could not only save governmental laboratory time but equally unnecessary wastage in production. We may have succeeded also in convincing the audience that standard reference materials can often save much time and effort in raw material characterization and production. Several manufacturers' representatives expressed a desire that equipment in the Provincial Laboratory be supplemented so that tests which must now be sent to NIRI could be performed locally with less delay.

A visit was also made to the Yung Hwa Textile Industrial Company shown to us by the plant manager, Mr. Chang Hee Lee. It is a medium-sized weaving and fishnet manufacturing plant, using only man-made fibers, almost exclusively nylon. Working conditions are mostly quite good. There is space for further expansion, and management is confident that the firm is well able to hold its competitive position.

Monday, October 23

The drive to the port city of Pusan took us past fertilizer (urea) plants which have transformed productivity of agriculture in ROK, the oil refinery and the first units of a petrochemical industry at Ulsan.

Pusan is the second largest city of ROK. It is the seat of the Provincial Government of Kyongsangnamdo, yet the city itself has considerable autonomy. Our party was honored by a reception by the (Provincial) Governor Kae Soon Lee, who summarized the impressive and increasing industrial importance of the Province, its striking beauty in its mountains, coastlines and historic sights, and he referred to the key importance of Pusan harbor.

Director Deok Kweon Hwang guided us around his Pusan Kyongnam Industrial Research Institute. It has a very similar scope, purpose, competence, and programs to the Kyungpuk Provincial Industrial Laboratory at Taegu. The principal differences are:

1) It is situated in a very crowded area of Pusan but near the principal Government buildings. Plans exist to expand the Laboratory by the removal of an entire block of residential property. In this way the Laboratory will obtain a main road frontage.

2) The City Government of Pusan contributes to the Laboratory budget. Nevertheless, it principally reports through the Provincial Governor to the Ministry of Home Affairs. Contact with NIRI is therefore tenuous.

The Kun-Sul Paint Chemical Company was shown to us by its Managing Director, Mr. Hak Yung Cho. The products are a wide variety of paints, lacquers, resins, varnishes, and small plastic tiles. Rudimentary test equipment is operated. Raw materials are mostly imported, their uniformity in quality is left in the hands of suppliers. Some development work is currently in progress on protective coatings for ships.

We saw next the Pusan Branch of the Central Fisheries Inspection Station shown to us by its chief Mr. Jong Sang Won. There are 14 similar fishery inspection institutes and development laboratories all directly responsible to the Fisheries Development Agency in MOAF. The organizations and line of responsibilities closely resemble those of the Agricultural Inspection Agency previously described (October 20).

An excellent impression was made on us by the presentation of the 1st Analysis Division Chief of the Customs Inspection Laboratories (till recently the Bureau of Customs), Mr. Choi. Administratively this Laboratory comes under the Ministry of the Treasury and has almost no direct communication with NIRI. It is concerned not only with fairness of taxation (import duty) on foreign imports but equally with export articles controlled by law, for example under export quality regulations. The Laboratory reports to the Customs Collector in parallel with the Import and Export Bureaus and a bureau concerned with surveillance. The Laboratory is rather well equipped, has a competent staff; and renders a clear-cut public service.

Tuesday, October 24

It was United Nations Day, a public holiday; but we found Gold-Star Electronic Company running all departments on a shift basis. Our chief guide was the General Manager, Mr. Hyung Je Cho. All of ROK is justly proud of this modern Korean plant, a subsidiary company of Lucky Chemical (see below). Gold Star started in 1958, now has annual sales of $M15. Their capacity is:

1) 500 000 radios
2) 40 000 TV sets
3) 50 000 electric clocks
4) 300 000 watthour meters
5) 12 000 motors
6) 20 000 refrigerators
7) 100 000 fans
8) 100 000 telephone receivers
and 9) 70 000 automatic switchboards.

Recently an associated cable company started working with domestic electrolytic copper as raw material. Five 50% owned subsidiaries produce some component parts, others are produced by 18 small and medium sized companies supplying exclusively to Gold Star.

The Company itself employs 4000 workers, on a 15 acre site with 7 1/2 acres of floor space. Two hundred employees hold university degrees, many of them are concerned with inspection and testing. The Company in the field of automatic switchboards works under license from Siemens, Germany. There were eight resident German engineers who undoubtedly have a remarkable effect on the quality of workmanship and managerial techniques. Their influence was being felt even outside their assigned area for cooperation. In particular, we noted that electrical standards in this Company had international traceability via the German Siemens Company, through the German PTB.

It is our impression that a foreign advisor contract is a sound method of operation.

The Korean Government has emphasized its flexible and cooperative attitude, for example, by agreeing to set up facilities for bonded factories, which would not sell directly to the Korean market.

Gold Star has shown that electronic and small electrical applicances for domestic use and export can be profitably produced in ROK.

At the parent Lucky Chemical Company, whose president, Mr. I. H. Koo, is a member of one of ROK's most successful industrialist families, we were guided by the production chief, Mr. Soon Mo Kim, of the Tongnae plant, which was working on the UN Day. It is a polyvinlychloride plant

with an annual capacity of 3000 metric tons, making films, sheet, fishing floats, raincoats, wall and floor tiles, swimming rescue rings, inflatable toys, vinyl leather, vinyl shoe tops and zippers. It manufactures some of its own plasticizers and is currently expecting delivery of a new calendering machine. The most notable test technique used was a radioactive sheet thickness gauge directly controlling roller pressure.

Daehan Chinaware Company Ltd. was shown to us by its President Mr. Yu Sang Choi. It is an older establishment, which however had to restart almost from scratch in 1956. Using mostly imported machinery including three oil-fired tunnel kilns but domestic raw materials (better selection and characterization of which would prove beneficial), this firm now exports attractive earthenware to countries in South East Asia and Panama at an annual rate of $M1. There are few test facilities, and hardly any applied research is being done by the Company. No association with a foreign consultant is presently sought.

Wednesday, October 25

At the joint invitation of the Korean Physical and Chemical Societies, we gave six hours of seminar talks at the College of Liberal Arts and Sciences, Seoul National University (SNU) on the "Present status of the electrical units,""the morphology and properties of crystalline synthetic polymers," and "crystals, their growth and use in metrology".

We had a good audience from all the well-known universities in the Seoul area, but unfortunately no one from NIRI or the Communications Laboratory attended. Some of our remarks in a sense were especially adapted to be of interest to them. However we did establish contact with a number of prominent university professors who entered into stimulating discussions. For example Professor Hi Gyn Kim of Kyung Hee University is interested in crystal growth.

Thursday, October 26

Preparations continued for the visit of the U.S. Secretary of Commerce. NIRI has submitted a recommendation for the relevant agenda item to MCI. There is not likely to be much conflict of viewpoint, except possibly in NIRI's wish to request gifts of surplus NBS equipment. In general, we explained, there is remarkably little usable equipment that is discarded by NBS. Outdated equipment requiring repair would add greatly to their troubles.

Friday, October 27

Attendance at the Korean Physical Society Meeting at the College of Arts and Sciences, Cheongnam University in Taejon was a privilege and pleasure. Immediately after arrival by train we presented a modest but original paper, such as might have been presented at an American Physical

Society meeting. The paper is to be offered for publication in the Korean Physical Society Journal. Arrangements were made with the Editorial Secretary, Professor Chung Hum Kim, of Korea University, for the manuscript to be forwarded in January 1968 subject to NBS editorial approval. Dr. Kim is a well-known nuclear physicist formerly of Rochester University, New York.

A discussion took place also with Professor Yon Duk Kim of Soegang College in Seoul. Professor Kim is a Berkeley nuclear physicist who is expanding his activities into the solid state area, because it is easier under Korean conditions to teach experimental techniques to students in that field. Professor Kim is nevertheless quite pessimistic about job opportunities for his graduates. At least he will proceed cautiously in increasing the number of his students. We accepted his invitation to visit his College on November 2.

By chance we also met with KIST architectural advisor Mr. John C. Rollow with whom the need for proper housing of the standards presented by President Lyndon B. Johnson was discussed. The lack of firm plans for these standards was again evident.

Saturday, October 28

The Korean Physical Society Meeting moved to Taejon College, another university with a beautiful campus in the outskirts of Taejon, Provincial Capital of rapidly expanding industrial and cultural activities.

An interesting discussion took place with Dr. Won Chung of KIST, a well-known solid-state physicist of Bell Telephone Laboratory, who recently returned to ROK and with his physicist wife is looking at the Korean scene, and has reached views closely similar to our own. He fully realized the desirability of closely relating research in that country to immediate and pressing needs.

Dr. Llewellyn A. Sanderman, physicist and USOM/K Scientific Education advisor, delivered a paper on "Integrated Course of Physics and Chemistry". It was translated into Korean, sentence by sentence, and outlined current science teaching experiments in the US.

Monday, October 30

The Korea Bearing Industrial Company in Inchon was shown to us by Mr. Yung Jo Park director and plant manager. It is run on semi-military lines, but seems to have an enthusiastic and competent work force. It is the only ball-bearing company in ROK making a large range of steel balls, ball bearings, cylindrical and taper roller bearings as well as single and double thrust bearings.

This manufacturer clearly requires a good gage test laboratory, which needs to be housed in the constant temperature room to be completed early next year. The set of master gages was purchased from Japan; is tested for internal consistency several times a year; but has not been rechecked against the gages of a national metrology laboratory. As yet, there is no facility within ROK that could be of service to this Company.

At the Korea Plate Glass Company, Inchon, alternatively named Han Kuk Glass Industrial Company, we were led by Mr. Yong Goo Kang, graduate of Ohio State University. It is an impressive, rapidly expanding plant; using mostly domestic raw materials; employing 700; producing principally window glass, and soft glass tubes mostly for fluorescent lighting. Some frosted glass, wire-reinforced glass, and architectural glass "bricks" are also produced. The test facilities are good and handled by competent staff. Contact with the NBS Glass Section is sought and will clearly be of help. NBS standard reference materials are currently used and many relevant NBS publications are available.

The Hankuk Machine Industrial Company, Inchon, a semidependent ROK government corporation reporting through MCI to EPB, was shown by the Technical Director, Mr. Kweng Soo Yuck. We also had a brief interview with President Rak Eun Chung, who is Chairman of the Board of Trustees of KIST and thus provides a potentially important link to help KIST in maintaining contact with industrial needs in addition to those voiced by contracting sponsor firms.

This Machine Company is a very diversified steel foundry, forging, rolling and heavy engineering company. It is closely affiliated to some Japanese firms, especially for the manufacture of diesel engines, and to DEMAG of Germany for overhead cranes. Its most impressive products include a 1700 ton press and distillation towers. The laboratory and test facilities are the best we have visited in the metallurgical field within ROK. The non-destructive testing facilities, for example, include X-ray inspection facilities that are most competently handled. Staff is on more modest pay scales than in private industrial companies. This was deplored by the Technical Director, because it led to rapid turnover of apprentice technicians and young engineers. However, so good appeared to be the training here that men leaving the employ of Hankuk Machine Industrial Company will surely carry into private industry important competences.

Tuesday, October 31

After a second interview with Mr. Roger Ernst, Deputy Director of USOM/K, we talked to Mr. Pressler, a mineral resources expert of USOM/K who has clearly done a great deal to support ROK in programs leading to the discovery and exploitation of natural mineral resources. Outstanding has been the development of tungsten ore, now a very major export.

Dr. Hyung Sup Choi, now president of KIST, started in tungsten mining; later became director of the Government operated Research Institute for Mining and Metallurgy*, where an outstanding contribution has been the recent development of production of ultra-pure bismuth (99.99%) from domestic ore. This product sells on the world market with a quality bonus.

Joined also by Dr. David Jordt USOM/K advisor, we visited the Geological Survey of ROK, where a visiting scientist from the US was introducing good spectrographic analysis as well as X-ray fluorescent and diffraction (phase) analysis. There is no doubt that better characterization of ores will continue to improve the ROK position in this field.

A chance meeting with Mr. Soon Jong Kim of the Tae Hwa Rubber Company, a larger producer than Cho-Il Rubber (October 17), gave us another opportunity to review quality control techniques in an industry that relies almost entirely on imported raw materials.

Wednesday, November 1

An encouraging interview took place with Minister Chung Yum Kim the new head of MCI in the presence of Vice Minister Lee, the heads of NIRI, NBS (ROK), FIC, KSA, and representatives from the Bureau of Weights and Measures, as well as the First Industry Bureau of MCI. They listened to our principal recommendations. While Minister Kim wanted to move to implementation and while he personally would give his full support, some of our recommendations would require legislation, a necessarily slow process. He took a major step toward integration of the responsibility for national physical standards and a unified national measurement system by placing NBS(ROK) and the Bureau of Weights and Measures under Mr. Bom Soon Lee, Director of NIRI.

A scheduled interview with the Minister of Science and Technology had to be abandoned because Minister Kee Hyong Kim had a call to the Prime Minister's Office. Instead, we had a discussion in the Bureau of International Relations in MOST, which has a government-wide role and in a sense was organizationally responsible for our mission.

Our team leader appeared on the US Army TV network to discuss the role of physical standards in international commerce.

Thursday, November 2

A visit to Sogang College was of great interest. It is a Jesuit College on a beautiful campus. We visited Professor Yong Duk Kim's undergraduate physics laboratory, and had a discussion with the Chemistry

---

*Not to be confused with the Institute of Tungsten and Mining in MCI whose director is Dr. Ung Kee Kang, a chemical engineer.

Department Chairman Professor Sang Up Choi, formerly of Purdue University, who is on the Board of Trustees of KIST, former Secretary General of the Korean Chemical Society, and former director of the Atomic Energy Institute, which we were to visit that afternoon.

After a luncheon given by Vice Minister Lee of MCI, we went out to the Atomic Energy Research Institute operating under the Office of Atomic Energy in MOST. Our principal host was Dr. Chwa Kyung Sung, director of the Office of Atomic Energy, formerly of NIRI. Time was short and we pursued only the problem of the various physical standards. Certainly the scientific competence within the ROK Government in atomic physics and chemistry is here. There is at the present time no work being done here on standards of radiation intensity, radioactivity standards, or standard reference materials.

A related and impressive activity is in the Chemistry Division headed by Dr. Yon Sun Kim, a distinguished scientist trained at Purdue. Industry has been surveyed for useful application of radioisotope techniques. The list of such cases will be considerable when the final report is published.

The Institute since 1962 operates a TRIGA Mark II reactor. The annual budget of the Institute is only $M 0.16, but since 1962 a large number of samples (4,000) have been irradiated and 25 different radioisotopes have been produced. Neutron diffraction and other research is on a modest scale. The Institute is divided into the following divisions: Reactor Physics, Physics, Biology, Health Physics, and Chemistry.

Another visit to FIC (compare October 17) gave us the opportunity to have a brief but open discussion with Director S. Y. Park and his staff. We were presented with an interesting questionnaire sheet. Only a fraction of the problems could be discussed in the time available, but there is no doubt that contact and collaboration with NIRI and indeed with NBS is desired.

The USOM/K directorate gave an evening reception in honor of Mr. Niels C. Beck upon his postponed but now very imminent departure for Vietnam. Hope is held out that he will be able to return briefly to ROK when our report is received, so that he can assist in discussions on possible implementation.

Friday, November 3

Discussions on a final communique between NIRI and the NBS team took up much of the day after a morning ceremony at NIRI.

In the afternoon we gave a semi-popular lecture to a US 8th Army Discussion Group organized by Dr. John L. Bastian, Director of Education, 8th Army HQ.

Saturday, November 4

After signature at NIRI of the joint NIRI/NBS Team agreement (see Appendix 2), we made ourselves ready for the afternoon flight to Tokyo, The Kimpo airport ceremony was very cordial. Each of us felt that future contacts will progressively strengthen our exchanges of knowledge and experience.

Appendix 1

Abbreviations Used

AID	Agency for International Development
BMI	Battelle Memorial Institute
EPB	Economic Planning Board
FIC	UNESCO Fine Instruments Center
IMSRR	Institute for Metrology Standards and Related Research
KIST	Korea Institute of Science and Technology
KOTITI	Korea Textile Inspection and Testing Institute
KOTRA	Korean Trade Promotion Corporation
KPC	Korea Productivity Center
KS	Korean Standard (specification)
KSA	Korean Standards Association
MCI	Ministry of Commerce and Industry
MOAF	Ministry of Agriculture and Forestry
MOC	Ministry of Communications
MOHA	Ministry of Home Affairs
MOST	Ministry of Science and Technology
NBS	U.S. National Bureau of Standards
NBS(ROK)	National Bureau of Standards of the Republic of Korea
NIRI	National Industrial Research Institute
ROK	Republic of Korea
SNU	Seoul National University
USOM/K	U.S. Operations Mission/Korea

Appendix 2

Agreement Between the National Bureau of Standards team and Director Lee Bom Soon of the National Industrial Research Institute on a Sister Relationship between the two organizations.

A team of three scientists from the National Bureau of Standards, U. S. Department of Commerce, is visiting the Republic of Korea at the invitation of the National Industrial Research Institute, Ministry of Commerce and Industry, to study standards and quality control practices in domestic and export industries, and to examine the national measurement system and means by which its availability to Korean technology can be improved.

As a result of these joint studies a "Sister Relationship" is being established between the U.S. National Bureau of Standards and the technical arm of the Korean Ministry of Commerce and Industry -- The National Industrial Research Institute.

The two institutes have agreed to collaborate in support of international programs of standards and measurement practices. They expect to exchange experiences and publications, and after the team's report is available and has been studied, to consider other ways in which the "sister relationship" can be strengthened.

Dr. Bom Soon Lee
Director,
National Industrial
Research Institute
Ministry of Commerce
and Industry.
Republic of Korea.

Dr. Forest K. Harris
Team Leader
National Bureau of Standards
Department of Commerce
U.S.A.

Appendix 3

Government Employees Salary Scale

Grade	Example	Approximate Annual Salary in $	Research Differential (approx.)
1A	NIRI Director	1600	$440
2A	NIRI Division Chiefs	1200	440
2B		1000	440
3A	NIRI Laboratory Chiefs	800	440
3B		578	440
4B	NIRI University Graduates	396	180

Occasional in-grade steps are a maximum of around $25.00 per annum.

USCOMM-NBS-DC

DEPARTMENT OF COMMERCE ★ NATIONAL BUREAU OF STANDARDS ★