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D03529

United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG.98/9
16 December 1971

Original: ENGLISH

Training Workshop on Metrology
12 - 23 October 1971, Nagoya (Japan)

FINAL REPORT 1/

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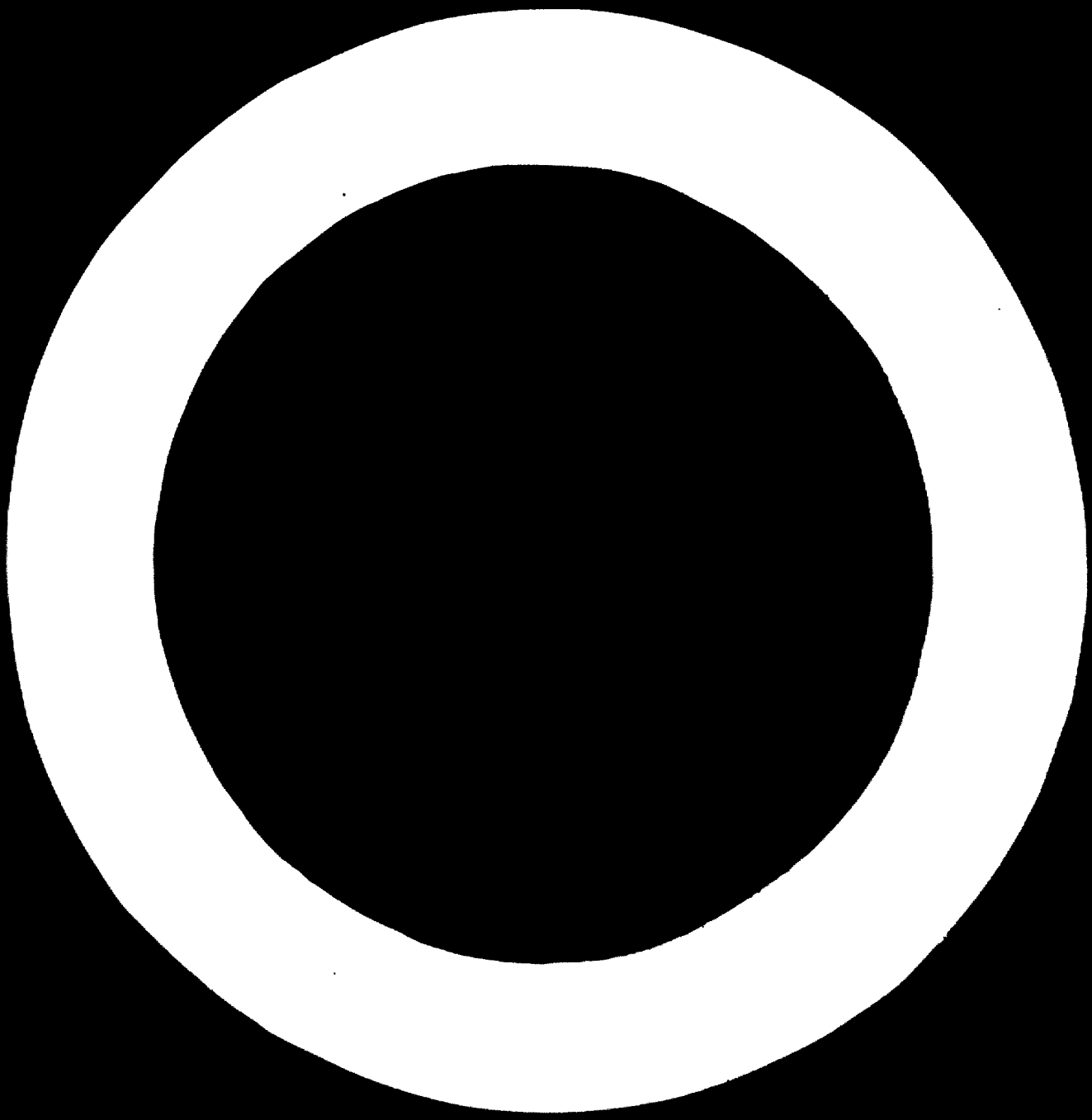

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INTRODUCTION

The Training Workshop on Metrology organized by UNIDO in co-operation with the Government of Japan was held in Nagoya, Japan, from 12 to 23 October 1971.

The purpose of the Training Workshop was to discuss the various metrology problems facing the developing countries of Asia in order to suggest practical measures for strengthening and improving these services.

Dr. Seiji Takata, Acting Director of National Research Laboratory of Metrology, welcomed the participants of the Workshop. The participants were then welcomed by the Director of the Training Workshop, Mr. Y. Prokhorov, UNIDO, who further read a message from Mr. I. H. Abdel-Rahman, Executive Director of UNIDO. An address of Mr. M. Nishibori, Director-General of the United Nations Bureau, Ministry of Foreign Affairs, was read to the participants by Mr. Nomura, a representative of this Bureau. The participants were also greeted by Mr. George Duggar, a representative of the United Nations Centre for Regional Development in Nagoya as well as by Mr. M. Takeda, Director of the Nagoya International Training Centre, Overseas Technical Co-operation Agency. The texts of the addresses are given in Annex I.

The Training Workshop was attended by 12 participants from the following Asian developing countries: Afghanistan, China (Republic of), Ceylon, Indonesia, Iran, Malaysia, Nepal, Philippines, Republic of Korea, Singapore, Thailand. The participants held responsible positions in their respective countries working in governmental institutions wholly or partially engaged in providing Metrology Services to industry - National Institutes of Standards and Industrial Research, Institutes of Science and Technology, Bureaux and Departments of Weights and Measures, etc. Their country reports are presented in Annex II. Five expert-consultants participated in the Workshop. Three of them came from the United Kingdom, Netherlands, and the Arab Republic of Egypt. There were two expert-consultants from Japan. The Workshop was also attended by a representative of UNESCO, as well as by an observer from Physikalisch-Technische Bundesanstalt, Federal Republic of Germany. A list of the participants, experts and observers, is given in Annex III.

The Workshop unanimously elected the following officers:

Chairman:	Mr. M. Najafi	(Iran)
Rapporteur:	Mr. H. Goonetilleke	(Ceylon).

A list of discussions papers prepared for the Workshop by the expert-consultants is given in Annex VI, with country papers prepared by the participants from the developing countries.

At its closing session all those present approved the draft report of the discussions. The draft recommendations, formulated by the participants and experts as a part of the report, were considered and approved (see the following chapter).

The Workshop was addressed by Mr. Yamamoto, Director of Japanese Research Laboratory of Metrology, who commended the Workshop as a forum for the exchange of experience on these important subjects and complimented the participants on their discussions and meaningful recommendations. Speaking on behalf of UNIDO, Mr. Y. Prokhorov expressed appreciation to the Government of Japan for its hospitality and thanked individuals in the Japanese Government for their special efforts in organizing and servicing the Workshop. Closing statement was also made by the Chairman of the Workshop, Mr. M. Najafi, who, speaking on behalf of all the participants, thanked UNIDO and the Japanese Government for organising the Workshop.

RECOMMENDATIONS

The participants, after careful consideration of the important role that metrology plays in the development of industry, made the following recommendations:

1) The Government of each Asian developing country is recommended to give priority to the establishment and/or strengthening of its national metrology service in order to promote the development of its industries and establish equity in trade.

Each national metrology service should be commensurate with the needs of the country and should normally include:

a) a national standards laboratory for establishing and maintaining standards of measurement
b) a national service of legal metrology (for this purpose the term "legal metrology" is taken to mean all measurements required by the law of a country)
c) a service for the calibration of measuring instruments used in industry, science and education.

It may be desirable to establish in addition facilities for evaluation, testing and/or repair of new types of instruments and instruments in service.

2) The Government of each Asian developing country is recommended to support industry, ensure equity in trade and protect the consuming public by:

a) establishing suitable standard specifications to improve the quality of its products or to control the quality of imports
b) establishing suitable facilities for testing products or imports to determine compliance with specifications
c) establishing a system for marking products which comply with the approved specifications and monitoring the maintenance of the quality of such products.

3) The Government of each Asian developing country is recommended to review:

a) the existing facilities for training staff to man the services described above and to make suitable provision for the increasing manpower needs which the development of these facilities will involve
b) the existing laboratory facilities to determine what additional provision is necessary to meet its plans in good time.

4) The Government of each such country is recommended to participate as far as possible in the activities of appropriate international organizations such as the General Conference of Weights and Measures (CGPM), the International Organization of Legal Metrology (OIML), the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), with a view to obtaining the maximum benefits therefrom. In this connection, attention is drawn to the recommendations adopted at the CASTASIA Conference held in Delhi in 1968.

5) It was unanimously agreed that the UN Agencies primarily concerned such as UNIDO and UNESCO be requested to assist in the following ways:

a) to give maximum publicity to the recommendations of this Training Workshop in all countries and to other international or regional organizations such as ECAFE
b) the preparation of details of available facilities for training in metrology
c) the preparation of lists of generally-acceptable equipment for the maintenance of standards, for the provision of calibration facilities, for the setting up of testing laboratories and other allied services
d) the preparation of lists of publications relating to metrology, as well as preferred techniques and procedures for the calibration of standards of measurement; this should be done in collaboration with appropriate international bodies.

6) It was also recommended that the Governments of Asian developing countries co-operate in the intercomparison of measurement standards and in the harmonization of standard specifications. This could possibly be done under the auspices of ECAFE.

7) It was also recommended that those countries in Asia which have not yet adopted the metric system of measurement (SI) do so as early as possible, noting that deferment of the change will increase the cost.

Participants were reminded that direct technical assistance from UN agencies such as UNIDO and UNESCO can be requested by any developing country for the purposes outlined above.

SUMMARY OF THE DISCUSSIONS

Role of Metrology in Industrial Development

Metrology encompasses all the knowledge and activities associated with quantitative measurements. It is and has been a fundamental activity in any society, whether it is an agrarian or industrial one. The growth of scientific knowledge and the resultant development of industrial and engineering process in any society, are primarily dependent on the ability to measure any desired physical quantity. The development of scientific knowledge itself has been greatly dependent on the ability to measure with increasing precision and accuracy.

It was recognized that with the development of scientific knowledge, scientific metrology itself is developed. The mutual interdependence, therefore, of scientific advance and metrological capability was accepted. That the same interdependence exists between scientific metrology and applied metrology, that is metrology in industry and commerce, was also agreed upon.

An example of this interdependence is the concept of interchangeability of component parts which is a fundamental one in any large scale engineering process. It can be achieved only if the production of the component parts themselves can be carried out within specified limits as to their dimensions. The latter is dependent entirely on the capability of the industry to measure accurately and to control the measurement process itself. One other example was that unless the measurement made in the industries of developing countries are accurate the export of their products will be affected, causing a loss in foreign exchange.

The development of the statistical methods both in metrological aspects of the measurement and in the assessment of measurement results was considered a necessary concomitant of the application of the metrology to any industrial process.

The same need exists for accurate measurements to comply with increasing requirements of Weights and Measures Laws for the approval of new measuring devices, as well as in the case of pre-packed commodities.

It was recognized that the problems that developing countries face in applying the principles of applied metrology to industry may include:

a) The existence of several systems of units of measurements in the country, some of them of local origin and others introduced from abroad, and the confusion caused by the indiscriminate import of measures and measuring instruments based on different systems of units.

b) The lack of an effective nation-wide organisation of the metrology activity in the country (sometimes, the existence of an out-dated and inefficient organization is more detrimental to the development of modern metrology services that the absence of any organisation at all).

o) The lack of a developed national industry of measures and measuring instruments, or the existence of primitive workshops and factories occupied with the production of measures of inferior quality.

d) The lack of qualified personnel of all levels to run the metrological activities in the country, and the lack of technical personnel suitable for recruitment for these activities in general.

e) The lack of consciousness of the importance of metrology among concerned government officials and industrialists as well as among the general public in the country.

Relationship between Quality Control, Standardization and Metrology

It was generally agreed that quality control can be summed up as being the fitness for purpose of a product and that it has 3 aspects; namely:

- quality of design
- quality of conformance
- quality of reliability.

The quality of design was considered to include the setting up of standard specifications in conformity with the specifications of ISO and the standard specifications of other large countries, modified to the needs and capabilities of industry in a developing country.

The quality of conformance was considered to depend upon the controls exercised by a manufacturing unit to ensure that a product complies with the specifications set out for the manufacture of the product, and it was agreed that the national metrology service of a developing country should assist in the carrying out of quality control of products by technological guidance, and the calibration of the measurement instruments of the manufacturing unit.

The third aspect, the quality of reliability, was considered necessary to ensure that in use the product continues to perform within the specification for a suitable period of time. The three aspects of quality control require the application of metrology whether by private or governmental organisations.

It was agreed that manufacturers who comply with the requirements of a standard specification may be permitted to use a marking system approved by the standards institution to inform the public that the products comply with the requirements of the particular standard. It was recognised that the utilisation by manufacturers of such certification marks involves the improvement of metrological operations associated with quality control in the manufacturing units themselves, and thereby improves the general industrial standing of the country.

Concepts of Metrology Services

For a metrology service to be established in a country, it was agreed that the fundamental requirement was that it recognizes by law a measurement system for use in all its measurements. In this context, it was emphasised that the metric system of measurement in its current form with suitable modifications was the most advisable measurement system for any country to adopt.

The establishment of national standards for units of measurement and the establishment of a metrology laboratory responsible for the calibration of all derived physical standards of quantity, were considered to be essential.

In order to serve the country in all metrological requirements, the measurement law should concern itself with all the commercial and industrial measurements of the country.

The administrative system that must necessarily be set up to implement the metrological laws, and extend the measurement practices throughout the country, should be based primarily on a metrology laboratory which has in its custody the national standards and which is responsible for calibration of all the standards that will be required in the various subordinate offices throughout the country.

Legal Metrology and Control of Weights and Measures

Legal metrology has been defined as "the part of metrology relating to units of measurement, methods of measurement and measuring instruments, concerned with the requirements of legal regulations which are meant to ensure equity from the point of view of reliability and suitable accuracy of measurement".

Hence, it was agreed that the following would form part of a government's functions in relation to legal metrology:

1) Supervision of the correct use of the units
2) Establishment, maintenance and dissemination of national standards of measurement, and the guaranteeing of their accuracy by comparison with international standards
3) Provision and maintenance of derivative standards within the country
4) Participation in the work of other national organizations which are interested in metrology
5) Drafting of appropriate regulations and the supervision of the manufacture and repair of measuring instruments
6) Detection of infringements
7) Co-ordination of metrology carried out by different bodies
8) Participation in the work of international organisations dealing with legal metrology
9) Organization of training programmes in legal metrology.

The earlier conclusion that the metric system of measurement (SI) was the most advisable system for adoption was reinforced, but it was urged that an organization such as the International Organization of Legal Metrology takes upon itself the task of preparing a definitive text giving those non-SI metric units which may have to be used for a certain period. It was recognized that such a document would help developing countries in preparing their legislation. It was also considered important that a definitive list of the standards of measurement necessary to establish units be set out by the International Organisation of Legal Metrology or the C.I.P.M. or any other international organisation. This document should be comprehensive to suit the needs of the developing countries and be available in more than one international language.

It was recognized that in case of the measurement of some commodities the correctness of measuring instruments which measure other attributes of the product is as important as that of those which measure the quantity. An example of such a commodity was the delivery of gas where pressure and temperature are of the same significance as the volume.

It was also recognised that each country will have to decide for itself, depending on its situation, which fields of measurement it proposes to control, particularly in the case of developing countries. It was noted that compulsory verification would be necessary in the areas of measurement where control is exercised.

<u>The Organization and Scope of Activities of a National Metrology Service</u>

It was agreed that the main objectives of a national metrology service were:

1) Protection of consumers
2) Establishment of equity between trading partners
3) Improvement of measurements in industry
4) Assistance to research and technological development by making the country's measurement compatible with those of other countries
5) Assistance to exporting industries
6) Support of education and scientific research.

It was considered that in order to achieve these objectives, particularly in the case of a developing country, a national metrology service should have an organization which would:

a) maintain and disseminate standards of measurement
b) help and monitor the measurements required by the industries of that country
c) ensure that the measurements carried out by the country's export industries would be compatible with international requirements.

Furthermore, it was considered essential that the provision of these services be accepted as a function of the government of a country to ensure the protection of public in that country, and to foster the country's economic growth.

The scale of such activity was generally considered to extend from the maintenance of national standards of measurement to the supervision of weights and measures for trade, including making calibration services available to industry and scientific institutions in order to develop confidence, both inside and outside the country, in measurements made by such bodies.

It was however decided that the priorities for the activities of a national metrology service listed above have to be determined by each developing country after assessing its needs not only for the immediate present, but also for the future after careful consideration and assessment of commercial, industrial and technical requirements.

It was agreed that a national metrology service could offset some of the costs of maintaining its service by recovery of the whole or part of the cost of the services it provides, other than the cost of maintaining national standards of measurement. It was also recognized that when in any country laboratories exist which have adequate facilities to carry out certain calibration or measurement tasks envisaged for that country, use of such facilities should be actively considered to avoid duplication of costs involved in setting up new laboratories.

It was agreed that before handing over such responsibility to any laboratory, the national metrology service should check and confirm the capabilities of the laboratory and institute arrangements to monitor its performance henceforth.

It was noted that measurements could be conveniently considered in the following groups for the setting up of laboratory services; mechanical, electrical low frequency, electrical high frequency, fluids, optical, thermal, acoustic and ionising radiations.

It was recognized that in planning laboratory services and facilities adequate consideration should be given to the special environmental requirements of different types and classes of measurement as well as to the needs of the supporting services.

National Standards (étalons): Methods of Measurement

It was agreed that the maintenance of national standards is a primary function of a government. It was considered that a developing country should maintain national standards according to the level of accuracy that is required f for that country. It will, therefore, be necessary to consider what equipment will be needed for national standards to reach a level of accuracy which need not be higher by more than one or two steps than what is required for general use in the country. The purchase of equipment of a much higher level of accuracy than the country needs would be uneconomical.

It was agreed that these national standards should be calibrated at the B.I.P.M. or at a suitable laboratory in a developed country. Further, it was considered desirable that such standards should be packed according to selected specifications and when practicable sent by diplomatic courrier or similar means. This would minimize the risk of damage in transit.

It was also agreed that in addition to standards of length, mass and volume, each developing country should consider the setting up of other national standards as required, such as for electrical units, temperature, frequency, force, pressure, density and illumination. It was considered that in doing so the cost of maintonance of standards as well as the availability and the training needs of tochnical personnel should be borne in mind.

Measurement and Measuring Instruments, Calibration and Maintenance

It was generally agreed that the purchaser of a measuring instrument desires to be sure that it will serve the purpose for which it was obtained.

He usually does this by:

1) testing it himself
2) accepting a report of type-approval tests carried out by an independent organization
3) obtaining a certificate of calibration from an independent organisation, or
4) buying on the strength of the supplier's recommendation and/or implied warranty.

It was agreed that in the case of a developing country attempting to industrialise itself, a calibration service of some kind should be set up in order to offer to its users facilities for calibration of measuring equipment. This is particularly desirable because in such a country a large proportion of the measuring equipment therein probably has been imported. The user therefore is more often unable to determine for himself whether an instrument performs according to its specification initially or whether it continues to perform within the limits expected.

It was recognized that the setting up of a suitable service would eliminate the necessity, for most types of measuring equipment, of sending an instrument back to the country of supply at an expense disproportionate to the cost of the instrument. It would also reduce the risk of bad performance of control systems due to faulty measuring devices.

It was agreed that the performance level of a calibration facility to be set up should, as in the case of the physical standards of measurements, be geared to the levels required in that country, being generally a step or two higher than the levels of accuracy and precision expected to be required in the next few years.

It was agreed that the preparation and/or use of suitable specifications for packaging of instruments would help to minimize the risk of inaccurate results from instruments due to shock, damage or disturbance of those instruments during transit either at the supply stage or during subsequent use. In this field the experience of authorities in more advanced countries could be helpful.

It was agreed that periodic calibration of any measuring device is necessary to determine whether it is performing within its specifications. The periodicity of such calibration must depend on the type of measuring instrument and the conditions of its use.

It was underlined that adequate documentation of all calibration work is essential to a satisfactory service and the governing rules should cover not only the form of the certificates issued but also the laboratory records of work done. Such laboratory records should be sufficient to provide all necessary information about a particular calibration performed at some past date, though the necessary period of retention may need to be settled locally. The informati in a certificate of calibration or measurement should clearly identify the instrument involved and give adequate information to the user about the true val of its readings or of the ascertained value of the device in each case accompani by the estimated uncertainty of the values assigned.

It was also agreed that when a certificate reports compliance with a specification but does not report the actual measurements made, the understandi should be that the item reported on has met the relevant specification limits narrowed by the uncertainty assigned to the measurement process used.

It was further agreed that provision of adequate national standards of measurement and facilities for calibration should preferably be accompanied by correspondingly good facilities for the local repair of defective instruments. It was recognised that for such arrangements to be satisfactory, adequate arrangements must be established and maintained for the training of suitable staff for repair and calibration work and it was noted that the shortage of suitable staff is frequently most noticeable at the level of high-grade technicia which are frequently not produced by the local education systems in such countrie

Introduction and Application of Metric System and SI Units

It was reiterated that the Metric System (SI) was the system of measurement that should be used in a country for all the measurements made therein - be these scientific, technological, industrial or commercial.

It was agreed that countries in which the metric system had been legal for some time but which had not adopted SI, should do so.

It was noted that the General Conference of Weights and Measures at its last meeting had recognised the mole as a new base unit of the SI system. Similarly, the Pascal had been accepted as a name for the unit of pressure and the Siemens as a name for the unit of conductance.

It was agreed that, due to present conditions, it was not possible for any country to adopt SI units wholly and to do away with all non-SI units. Particular examples of necessary non-SI units are the case of the minute and the hour. If SI units only are to be legal, then speed limits will have to be given in meters per second and not kilometers per hour which is the more practical form. Another example is the kilogramme-force which will have to be retained for some time in view of the numerous tables which are expressed in this unit at present.

It was agreed that countries which at present do not use the metric system of measurement should actively consider such a change, since, otherwise, the cost of maintaining existing schemes of measurement would increase rapidly. This decision should be made in the light of the fact that all the leading industrial countries, which at present do not use the metric system of measurement, are changing over to its use or contemplating to do so.

It was generally agreed that each country would have to make its own programme for implementing the change, depending on the pressures that will be exerted in its commercial and industrial activities by the demands placed on it for execution of orders in metric units.

Further, it was agreed that priorities for implementing the change would have to be arranged in each country according to its own situation.

It was generally agreed that the first step to be taken towards this change, would be the legal recognition of the metric system of measurement for all activities and the establishment of the necessary standards for the units.

It was considered that a programme phasing a change-over within a limited period would be the best way of implementing the change. The period of transition however should not be too short or too long.

It was agreed that in each country a particular body would have to be assigned responsibility for this change. This body should be at the highest level. It was agreed that this body should be responsible for the diffusion of knowledge about the metric system not only in schools, technical institutions, factories, etc., but also among the general public.

It was considered that the phasing out of old units should be done sector by sector in industry and commerce. In a developing country it may be convenient to take commodities singly or as a group. At the end of the period given for making the change in the transactions of a single commodity or a group of commodities the use of the non-metric units could be forbidden for such transactions. It was agreed that in framing the weights and measures laws implementing the metric system, the ability to do this should be provided for.

It was considered that in planning the change, each government should consider what assistance it should give to each sector to facilitate the change.

Training in Metrology

It was generally agreed that one of the most serious problems encountered by developing countries in promoting industrial growth is the lack of suitably qualified personnel. This lack is specially felt in the field of metrology.

It was agreed unanimously that for a metrology service in a country to serve actively and successfully the scientific and industrial needs of the country, it should have adequately trained personnel. It was agreed that the personnel required by the metrology service would normally be of three different levels. The first level is that of professional metrologistscapable of handling metrology activities whether scientific or industrial at the highest level needed. This is particularly so in the case of developing countries for which it was agreed that all metrology activities would best be concentrated in the early stages either in one laboratory or in a group of closely-connected organisations. The second level is that of highly-skilled technicians ("super technicians") who would not only have a good general education but should also have specialised training and experience in the fields of industrial metrology or legal metrology or both. The third level consists of two basic groups. The first of these is capable of handling repair and maintenance of instruments in

metrology laboratories. The second group consists of those skilled in particular measurement or calibration operations either in production organisations or laboratories. Some of the construction in calibration repair technicians may well be of the quality corresponding to the second level.

It was agreed that at the highest level, the basic qualifications should normally include a degree in engineering or physics, followed by specialised professional training and experience in metrology. Experience of research might be identified by possession of a post-graduate degree. Staff in the second level can be provided in two ways, either by training within the national metrology service, particularly in the field of legal metrology, or by the provision of suitable courses in educational institutions complete with adequate practical experience. The third level can be met by training in special technical schools combined with in-service training wherever it can be provided.

It was agreed to seek the help of UNIDO in the formulation of such training schemes by preparing, in co-operation with specialised international organisations, a directory of relevant training programmes available in developed countries. Furthermore, it was agreed that in addition to the forms of training mentioned above, fellowships for the study of metrology in developed countries, study visits to well-established metrology laboratories, participation in meetings, seminars and refresher courses would help the personnel of the metrology services in developing countries to improve their knowledge and keep abreast of new developments in this field.

It was finally agreed that the organisation of training in metrology in a developing country should take into account all the aspects of the requirements not only of a national metrology service but also of industry and commerce.

Co-Ordination and Co-Operation at the Regional and International Levels

There exist two international organisations for co-ordinating work on metrology; the first, the General Conference of Weights and Measures, is concerned with defining the units in the metric system and establishing international standards of measurement; the second is the International Organisation of Legal Metrology, which is concerned with standardising laws relating to measurement, regulations controlling measuring instruments, and methods of testing measuring instruments.

It was generally agreed that membership of the International Organisation of Legal Metrology would prove beneficial to developing countries, particularly in view of the fact that a country's contribution to the organisation could be adjusted according to the level of metrology existing in that country. It was agreed that draft recommendations for measuring instruments put out by the International Organisation of Legal Metrology would be of considerable help to a developing country formulating its own requirements in this field.

It was also agreed that it would be helpful if UNIDO or any other UN organisation would assist the International Organisation of Legal Metrology so as to enable that organisation to give more active help to the developing countries.

It was agreed that regional co-operation among the countries in Asia would help them considerably in improving their standards of metrology. It was agreed that inter-comparison of standards of measurement of these countries by their metrology laboratories would not only improve knowledge of techniques of measurement but would also help to maintain and develop the skills of the personnel in those laboratories. It was hoped that UNIDO would help to organise such a programme.

It was agreed that one of the fundamental problems facing personnel of metrology services in developing countries was the lack of adequate documentation on techniques of metrology. This problem has two aspects, the first being the cost of the various journals carrying articles on metrology, the second being that the working documents of large metrology laboratories are not published. These latter documents are the most important for developing countries and it was agreed that UNIDO be recommended to set up a documentation center for collecting and disseminating information on techniques and methods of metrology.

FIELD TRIPS

During the Workshop all the participants have undertaken four field tripe kindly organised by host organisations.

The first trip was undertaken to the factory of SHIMADZU SEISAKUSHO Ltd., Kyoto, one of the largest firm in Japan, specialised in putting out various types of measuring equipment and apparatuses to be used in industrial research and production as well as in medicine. The participants had a good chance of acquainting themselves with production process of these apparatuses, their purpose and work. The participants were also acquainted with the factory metrology laboratory and its functions.

The following visit led the participants to the factory of Nippon Sharyo Seiso Kaisha Ltd, the firm in Nagoya producing various kinds of railway transport, where they became familiar with the production process as well as with some control systems being used in this factory.

Special mention should be given to the trip to the National Research Laboratory of Metrology (Tokyo) where all the participants were closely acquainted with the work of the various units of the laboratory, their equipment, measuring instruments as well as with the corresponding research programmes.

A N N E X E S

ANNEX I

OPENING ADDRESSES

Address by Mr. Seiji Takata, Acting Director of the National Research Laboratory of Metrology

Good morning, distinguished guests and dear friends. We, all the staff of the Japanese Research Laboratory of Metrology, are very glad to see that the Workshop on Metrology has just opened here in Japan. And I myself feel it a great honour to have such an opportunity to make address of welcome at this opening session in place of the Director of our Laboratory.

Unfortunately the Director, Dr. Yamamoto, is not able to attend this ceremony, because he is now travelling in Europe. He attended the International Committee on Legal Metrology as well as the General Conference on Weights and Measures, both held in Paris.

By the way, Mr. Van Male, the Director of the Service of Metrology of Netherlands and one of the distinguished experts invited to this workshop, did also attend the two international conferences already mentioned.

Now a question may arise in your mind, I guess:

Why is the Japanese Director not here, while the Director of such a distant country as the Netherlands is here. It is really a strange situation, isn't it ?

Yes, and my interpretation of this situation is as follows:

This situation is nothing but a reflection of the present status of international co-operation in the field of metrology. Everyone knows the importance of international co-operation. Everyone responsible for metrology is always looking for chances to enhance international co-operation.

Nevertheless, the chance, particularly the chance of visiting institutions in foreign countries and the chance of discussing with experts in foreign countries, have been given to us only infrequently.

Therefore, every metrologist is accustomed to utilise any chance given to him to completely.

Another example I would like to point out, is the case of the Director of our own Laboratory. He also feels strong need to utilise the chance given to him completely. For this reason, he is still travelling in Europe to make deeper and stronger contact with European institutions of metrology. Such feeling caused him not to be able to attend this opening session of the workshop held in his own country.

I hope that my interpretation about the presence of the Director of the Netherlands and about the absence of the Director of Japan would be accepted by all the participants of this meeting.

The Director of our Laboratory will certainly see you in Tokyo with great pleasure at the opportunity of your visit to the Laboratory, as scheduled on the last day of this workshop.

To close my address I wish to all of you that you should utilise the chance given to you by this workshop as completely as the two Directors are doing now.

Thank you, see you again on the day of your visit to our Laboratory.

Message from Mr. I. H. Abdel-Rahman, Executive Director of UNIDO

The experience of a number of countries on their way towards industrialisation has shown that the problems of economic construction can be successfully solved in a country only if it has, along with ensuring a number of industrial services including standardisation and quality control system, a special metrology service which provides for the uniformity of values and measurements throughout the country and obtains the results of measurements carried out in different part of a country with the help of various measuring devices reciprocally agreed upon.

The system of metrology services has a special importance for developing countries; yet many of them, if not most, fail to have one. At present, they are using a great diversity of local measurements and weights. Apart from the national units of measurement, the developing countries are now widely using the measurements of their former parent-states. The use of these measurements greatly impairs the economic co-operation among the developing countries, even if they are found in one and the same region.

In addition, the use of measurements of former parent-states impairs the contacts between the developing and industrially-advanced countries, and prevents the former from receiving any economic and technical aid from the latter.

Hence the developing countries are faced so far with two major problems in the field of metrology: firstly the introduction of a unified national system of measurements, and secondly, the adaptation for all countries of the metric system recommended by the International Legal Metrology Organisation as an international measuring system.

By holding this Training Workshop, UNIDO wishes to stress the importance it attaches to the existence of sound metrology services in the Asian developing countries as a prerequisite for the rapid industrialisation of these countries.

The Agenda of the Workshop covers a broad range of aspects pertaining to the setting-up and successful functioning of national metrology services.

It gives much attention to the organization and function of a special national institution called upon to provide for metrology services in a country. In the developing countries, such institutions, along with metrology services, are, as a rule, engaged in the elaboration of national standards, their introduction into industry as well as into quality control operations.

This situation is due to the fact that all these problems are mutually interlinked; standardization and metrology are indeed the basis for increasing quality of goods through a certain quality control system, and thus greatly facilitating the successful industrial development of a country.

This training workshop taking place here to-day shows recognition by all concerned of the fact that although much has been done by way of providing metrology services, much more remains to be done. Your task is this workshop is to endeavour, to suggest, practical measures for strengthening and improving metrology services in Asia, including further specific activities which could be undertaken by UNIDO in this field, UNIDO will, of course, in co-operation with other UN agencies and in the first place with UNESCO, continue to give its utmost attention to assist governments, upon their request, in the creation of new or the strengthening of existing national metrology services. Such assistance may take one or a combination of the following forms:

1. Assistance in determining, at the planning stage, the technical feasibility, structure and scope of activities of metrology services in general, as well as of national metrology institutions in particular, which are generally called upon to carry out metrology activities in a country.
2. Long-term assistance under the UNDP Special Fund programme in the initial operation of established institutions.
3. Fellowships to local institutional management personnel for further training studies abroad for periods of up to one year.

The first step, in each case, namely the submission of a request, must necessarily be taken by the Government.

It is indeed a pleasure to have the opportunity of holding this workshop in Japan, and I wish to seize this opportunity to express my gratitude and thanks to the Government of Japan for its kind co-operation. On behalf of the UNIDO, I extend to all of you my best wishes for success in your deliberations.

Address of Mr. Nagahiro Nishibori, Director-General of the United Nations Bureau, Ministry of Foreign Affairs

Mr. Chairman, Ladies and Gentlemen,

It is a great honour and pleasure for me to have the opportunity to say a few words on behalf of the Government of Japan.

I would like to extend a most cordial welcome to the participants from so many of the Asian countries with which Japan has long enjoyed close and friendly relations. I would like to extend also my heartiest welcome to the lecturers and Mr. Prokhorov of UNIDO Secretariat. I should like to take this opportunity to express my appreciation of all the efforts put into organising the workshop by

the people concerned, especially the National Research Laboratory of Metrology and the Overseas Technical Co-operation Agency which are hosting this workshop in co-operation with UNIDO.

Since its inception in 1967, UNIDO has consistently made efforts to assist developing countries in promoting their industrialization. Japan has co-operated as much as possible to make UNIDO's activities more effective for the benefit of the developing countries. Japan has so far organized training programmes, dispatched experts and conducted research in various industrial fields.

As you are aware, we are now at the threshold of the 1970s designated by the United Nations as the Second Development Decade, for which further efforts both national and international will be needed to attain our goals of social and economic growth in the developing countries.

Industrial development is one of the most important contributing factors to overall economic and social development. A key element for successful industrialization of the developing countries is the availability of a number of required services such as applied industrial research, standardisation, quality control and a national metrology system. A National metrology system is, in general, called upon to ensure authenticity, reliability and comparability of measurement results and their unity.

The measurements are the basis for the scientific knowledge resulting from the experimental research work, for the development of new techniques, checking and planning of material resources, improvement of technology, automatization of production and for many other purposes of human activity.

For this reason, I believe, it is particularly appropriate and opportune for us to exhcange views and discuss the problems involved in the National Metrology System in developing countries. I am quite sure, the knowledge and understanding you will acquire and whatever recommendations you may decide to make as a result of the discussions in this workshop will be extremely helpful to our common objectives.

In closing, I should like to express the earnest hope that this workshop will be a great success and at the same time I sincerely hope you will enjoy your stay in Japan, although it is of short duration.

Thank you.

<u>Address of Mr. M. Takeda, Director of the Nagoya International Training Centre, Overseas Technical Co-operation Agency</u>

Mr. Chairman, honourable guests and dear participants,

On behalf of the Overseas Technical Co-operation Agency, I wish to express our cordial welcome to all the participants and experts who have gathered here to attend the Workshop on metrology for ECAFE developing countries. Several months ago when our Agency was approached by the Ministry of Foreign Affairs to support the idea of organizing a training workshop on metrology sponsored by the United Nations Industrial Development Organization, we thought that we should not avoid the burden and responsibility for lending assistance to this kind of worthy endeavour. Through our experience of affording many forms of

technical assistance to the developing countries, we are fully aware of the key role played by national metrology services for industrial development.

Our Agency, therefore, feels it most opportune as well as privilege, to co-operate in this important international workshop. In the past, we have hosted or organized a number of seminars or training courses with international organizations such as OECD Development Center or United Nations Asian Institute for Economic Development and Planning on problems of economic and social development. Regarding co-operation with the United Nations Industrial Development Organization which has one of the greatest future in the United Nations family, this is the second time after the workshop in the use of Consultants for Asia and the Far East Regions held in 1969 in Tokyo.

Lastly, I myself and our agency will always be happy to help you not only in regard to the workshop itself but also to your personal matters, therefore, you are kindly requested to keep the close contact with us on any matters so that your stay in Japan may be pleasant.

I sincerely hope that the discussions starting from to-day will be most enlightening and fruitful.

Thank you.

ANNEX II

COUNTRY REPORTS

AFGHANISTAN - Metrology Service in Afghanistan, by Mr. A. R. Bahrami

Afghanistan has adopted the metric system in converting the currency units into decimal and the length units into meters which are currently in use throughout the country. But the country has made painstaking efforts since 1965 to generalize the new weight system which has been successfully done and has won widespread popularity in the country. Since, according to the regulations, the enforcement of metric system is compulsory, i.e., existence of complete harmony among all weights and measurements throughout the country, the subject was proposed to Kabul Municipality at the beginning of its introduction and its usefulness from the standpoint of timesaving and facility in business dealings were discussed.

Finally, it was decided that the former old-fashioned system of weight should be eliminated and superseded by the new metric system which is based on correctness and precision.

Thus, despite prevailing problems and lack of necessary means, we did succeed in bringing about a unified and standardized weight system and spread it all over the country.

But, nevertheless, we should confess our short-comings and problems that we face during our routine job. These problems exist, first of all, due to lack of trained personnel and means available. At the beginning, an extensive amount of charts, and diagrams which were prepared solely to help shopkeepers convert their local weights into metric system were printed and distributed to them. But as most of them were incapable of reading the chart of conversion tables and diagrams, paid less attention to them continuing to use the old-fashioned system of weights and measurements.

Undoubtedly, our country is a developing country and as the implementation of projects are slow in such countries, Afghanistan is not an exception. However, we do our best to popularize the system and fight against the obstacles which would hinder the speedy dissemination of the system. Despite numerous problems lack of trained personnel, lack of necessary means, and other limitations - we have succeeded in furnishing the Kabul city stores with new system of metric weights.

As far as liquids are concerned, there is no criteria, and set standards at hand which could be applicable to metric system at the moment, and all stores sell liquids mostly by weight. In this connection, the government of Afghanistan is conscious of the fact and tries to do away with this procedure. To do this, large laboratories furnished with necessary equipments are prerequisites.

Yet, some standard scales which have been granted to Afghanistan by India and France are currently at our disposal and are being used primarily for the synchronization of other scales and measurements. However, the means available at hand are not sufficient enough to meet our needs. As the use of this system is not only limited to the capital and its vicinity, and its dissemination to

other parts of the country, the organizing different regional departments for th purpose is very important. To achieve this goal, necessary means and standards for each department are indispensable.

We have extensive plans in various fields of metrology on hand. To control and supervise all means of measurements are the function of the department of metric system. To implement this extensive project, we have always tried to publicize it through mass media, radio, news-papers, magazines, etc.

Since its establishment, this department has regularly tried, with the co-operation of people, to improve and publicize the so-called profitable project to the provinces other than Kabul where the density of population is high, and a substantial amount of the scale sets have been distributed to most of the stores. Besides, orders for some more metric weights have been put to the factories where these metric weights are manufactured. To acquaint people to these systems, some of the metric weights should be taken to the provinces where they are unable to manufacture for themselves. The present projects of the market scale is commonly called ROBBEAL, and is under discussion in a factory.

Hopefully, the project will go into effect soon.

Yet, we still feel handicapped, for production of the delicate parts is not possible in our country.

CEYLON - Organization and Scope of the Metrology Service in Ceylon, by Mr. H. L. K. Goonetilleke

This paper sets out the position of the Metrology Service in Ceylon as it is now and indicates the directions in which it is hoped to develop the service in the next few years, so as to serve the growing needs of the country both in its commercial and industrial growth and the increasing demands of the technology.

Historical

The foundation of a metrology service in any country is primarily dependent on the measurement system which is legal for use in the country. Ceylon, by its most recent past history uses, at present, the British System of measurement. This system was legalized for use in 1978 by an Act which was primarily intended to legalize the use of the British units and to establish standards. Although the administration at that time attempted to disseminate the units by setting up standards of weights and measures in various provincial offices, no attempt was made to establish a Metrology Service or even frame Regulations laying down specifications for the manufacture and use of weights and measures. The 1878 Law did not consider the control of weighing or measuring appliances as being a part of the control of the measurement process and therefore did not mention them in the Ordinance. Although the effects as regards the weighing and measuring appliances actually in use was not great as to specification and accuracy, it helped to disseminate the British units of weights and measures into general commercial practice. Considering the previous background of the history of the Island with periodic invasions from the Indian sub-continent culminating with the colonization of the coastal areas by the Portuguese at the beginning of the 16th century, followed by the Dutch who took over from the Portuguese 150 years later, the achievement is significant. One of the influences it effectively removed from the scene of everyday measurement was any weight or measure

introduced by the Portuguese or the Dutch. One must bear in mind the beneficial effects of this since the British took over the Island from the Dutch in 1796 before the innovation of the Metric System of Measurement.

It was less successful in other areas and in one particular trade that of the retail trade in gold introduced of weight which was not in use in the United Kingdom, namely the weight of a gold sovereign and a half sovereign as units for transactions in this commodity. It did not also touch the system of weights and measures used in Ayurveda, the local system of medicine which had as its own system of measurement one somewhat analogous to that used by Ayurveda in the Indian sub-continent. The measurement of grain too was unaffected, particularly grain grown locally. A number of different sizes of measures bearing similar names were used in different districts. Similarly the earlier system of measurement of land continued, but with the establishment of a Government Department for carrying out surveys in 1826, new surveys were done in the British System.

The present attempts to change this state and improve the practice were delayed till after the last war, when the current Weights and Measures Ordinance was enacted. This Ordinance is more comprehensive in outlook, it extends the scope of operation by specifying units of length, area, volume and weight for transactions in the country. These units are the units of British System of Measurement. The orientation of the Ordinance is mainly to cover commercial transactions, and this is easily understandable. The mainstay of the economic life of the country at that time was the production of the three cash crops for export. Hence, the stressing of the commercial aspects of measurement. Since the measurement system is based on the British, the legal pattern is oriented to British Weights and Measures practice. The original definitions in the Weights and Measures Ordinance of the yard and pound were directly related to the definition definitions of the Imperial pound. Subsequent to the redefinition of the Imperial units in the British Weights and Measures Act of 1963 it was necessary to redefine these units. Considering the hierarchy of the Standards in Ceylon and the direct dependence on the physical standards in Britain, it was decided not to change the pattern for the present and to redefine the units in relation to the British Act. Another reason for doing so was the possibility of a decision to change to the Metric System early, when the whole pattern so necessarily have to be restructured.

<u>The Present Legislation</u>

The units legal for use are defined by various schedules and as has been stated earlier are based entirely on the British units. However, a saving clause exists to permit the use of local measures of capacity if they are specially authorized on the one hand and customary measures for the measurement of land without any restriction. The reasons for this was outlined in the opening paragraphs of this paper. However, although the present legislation enacted in 1946 which was not enforced till 1955. The reasons for the delay was the difficulty of obtaining the requisite standards in the years following the war, as well as the findings of necessary technical personnel to man the service.

In the meantime the use of the traditional measures of capacity used for grain in commercial transactions dwindled considerably. This was the direct result of the Government becoming, in the war years and the years immediately afterwards, the sole purchaser of paddy (unhusked rice) these purchases were made by the bushel and thereby created sufficient momentum for its use even in the period when the purchase of paddy was free. Hence it was found unnecessary to consider authorizing the use of any local measure in any particular area for trade. This however does not mean that the use of these measures have died out completely. They are still used to some extent in sowing, and in remote areas in village fairs.

Standards

The legislation provides for the setting up of Ceylon standards of length, volume and mass, and these are established by (a) a yard, (b) a gallon and (c) by two sets of reference mass standards. The sets consist of the following:

A - A set of avoirdupois standards consisting of the following:
56 lbs., 28 lbs., 14 lbs., 7 lbs., 4 lbs., 2 lbs., 1 lb.,
8 ozs., 4 ozs., 2 ozs., 1 os., 8 drams, 4 drams, 2 drams,
1 dram, ½ dram

B - A set of grain weights consisting of the following:
4000 grains, 2000 grains, 1000 grains, 500 grains, 300 grains,
200 grains, 100 grains, 50 grains, 30 grains, 20 grains,
10 grains, 5 grains, 3 grains, 2 grains, 1 grain, 0.5 grain,
0.03 grain, 0.02 grain, 0.01 grain.
120 grams, 72 grams, 48 grams, 24 grams.

These were calibrated at the Standards Weights and Measures Laboratory of the Department of Trade and Industry in the United Kingdom before they were brought out in 1955 and were re-calibrated last year in keeping with the requirements of the Ordinance. These Ceylon Standards are housed in the Standards Weights and Measures Laboratory. The statute also enables the setting up of derivative standards for laboratory use - Secondary standards as well as the Tertiary or Working standards which are to be set up in the various districts and local authority offices. The secondary standards are verified against the Ceylon standards, whilst the working standards are verified against the secondary standards. 64 sets of working standards are distributed throughout the country, and it is these standards which are used to verify commercial weights. Hence a fundamental principle of traceability from a commercial weight or measure of national standards exists. Calibration of weights of a higher order used in laboratories and industry are carried out in the Standards Laboratory itself against the appropriate level of standards dependent upon the accuracies desired.

Since the Weights and Measures Ordinance is at present primarily oriented towards commercial transactions it specifically sets out by definition the fields where the provisions of the Law would apply by definition of what a trade constitutes. The basic tenets as in all weights and measures law is to ensure equity in trading between the seller and the purchaser. In doing so regulations have been framed specifying the kinds of weights and measures and weighing instruments that could be used in the country. Specifications for their manufacture on the limits of accuracy they should apply with are also laid down. The Ordinance lays down that it is an opportunity for the trading public to have their weighing and measuring appliances tested periodically - in the case of Ceylon once in every 12 months. This is done by "tours" carried out by Inspectors of Weights and Measures attached to district offices over the calendar year. On these "tours" inspectors carry with them standards and equipment necessary for their work.

Carrying this concept of equity and protection of the public one step further, provision has been made subsequently, following the practice in a number of other countries, requiring goods which are packed in containers prior to their being offered for sale to carry a statement indicating the net weight or volume of the contents.

The Administration

To carry out these functions the Ordinance provides for the setting up of the necessary staff both technical and field. In relation to the senior technical staff the basic educational requirements are a Bachelors degree in Physics. This is followed up by the officer having to read for the Master's degree in Metrology. In the case of the field staff the basic qualifications are the General Certificate of Education with a pass in science subjects. They however undergo a training in weights and measures law, weights and measures practice, mechanics and other allied subjects after recruitment. At the end of the training period the trainee should pass a test. Refresher courses are planned from time to time to provide them with additional training facilities.

Future

The Government of Ceylon decided in 1970 to recognise the Metric System of Measurement with a view to changing over completely to the metric system over a limited number of years. This has necessitated the close look at both the Law and the directions in which the service should develop.

As regards the system of measurement it was clear that SI should be adopted as the principal system of measurement. The fact no metric system had been made legal for use makes the implementation of this somewhat easier. However, there are attendant problems, the first is that the present system will have to continue over a certain number of years and secondly due to the fact that although the metric system was not legal there exists a fair amount of instrumentation such as pressure gauges which are graduated in non SI units. Moreover in certain kinds of measurements particularly the common ones used in everyday life the use of SI only would be a little difficult. The problem is magnified by the fact that Weights and Measures Laws are to be restructured to cover all measurements made in the country and not only applicable to those used in commercial transactions.

It has been decided therefore to specify the units of measurement legal for use by means of a series of schedules to the main Enactment. This has the advantage that provision exists in the Law for the schedules to be amended by orders published in Government Gazette without the necessity of Parliamentary approval. This enables changes in the definition of the base and other units to be made shortly after C.G.P.M. makes any revision in the basic definitions or in the definitions of any other unit. The second is that since metrication is to be phased out, it would enable the deletion of the use of British units in specific fields whenever the change is completed there. Hence the schedules are arranged as follows:

Schedule 1: This contains the definitions of the six basic units of SI as given by C.G.P.M. which will be the base units of measurement for Ceylon. It also defines the supplementary units of angle. It also contains the definition of the yard and the pound in terms of the metre and the kilogramme.

Schedule 2: The first part of the schedule lists the prefixes of multiples and sub-multiples in SI for all units. The use of these will be valid for all measurements. The second part lists the non SI metric units the continuance of which has been deemed to be necessary. Units of British system which are currently in use are also listed. Since this schedule is intended to list all units used in all measurements, they are listed under the following headings:

(a) Measurement of length
(b) Measurement of area

(c) Measurement of volume or capacity
(d) Measurement of mass or weight
(e) Measurement of density and force
(f) Measurement of time and frequency
(g) Measurement of temperature
(h) Measurement of electric units
(i) Measurement of luminous intensity and illuminations
(j) Measurement of angle.

Schedule 3: This is restricted to listing those units both in Metric and British Systems, which will be legal for use in commercial transactions. This is necessary since it is the intention to restrict the number of denominations of weights and measures used in the trade. On the basis of the new Law which is being drafted at present, it is hoped to expand the service into a fully fledged National Metrology Service. The metric standards of length, mass and volume are to be purchased shortly. National standards as well as the other derivativ will be established. Standards of length will include "end" standard (slip gauges or Gauge Blocks) and this marks the first step towards extending the service to industry at a high level of accuracy. The plans for expansion are that in the year following the offering of calibration facilities for slip gauges, standard hydrometers, etc. for carrying out density measurement will be obtained. Two years after this is intended to set up temperature standards for the country. A year following this electrical standards are to be set up. Two years later standards of frequency and one year later standards for pressure.

CEYLON - Co-Ordination and Co-Operation at the Regional and International Levels by Mr. H. L. K. Goonetilleke

No metrology laboratory can exist independent of other national laboratories This is more so when it comes to laboratories of the underdeveloped countries which do not have facilities for basic research in metrology on the one hand and secondly are limited in resources to improve its technology and therefore its measurement capabilities on its own. Therefore it is essential that co-operation with other National Metrology Laboratories is essential.

It is true that the source of all units of measurement is the International Bureau of Weights and Measures in Paris, but membership of the C.G.P.M. is extremely expensive and in relation to the often difficult foreign exchange situation in under-developed countries, the price of membership is not commensurat with the capability to derive the best use. This is more so because the level of technology in the National Metrology Laboratory of an under-developed country has not yet reached the levels at which the International Bureau operates. Hence it is here regional co-operation particularly amongst the membership members of the ECAFE countries would considerably help to raise and develop the level of Measurement capability in the National Metrology Laboratories of the countries of those region to levels which would approximate that of the larger National Laboratories of developed countries in the first instance.

In the paper on National Standards certain techniques of mass measurements on the lines developed by the U.S. National Bureau of Standards were outlined, and the significance and the importance of their use for smaller metrology laboratories pointed out. Many more steps could be taken to improve the levels of information and to cross check on the measurement procedures of a particular National Laboratory by having the same procedure repeated in adjacent countries, particularly if the capabilities of that laboratories are the same or better. Therefore the principle of "Round Robin Calibration" adopted by the larger national laboratories could merely be followed by the smaller laboratories in the ECAFE region. This would not only improve the knowledge the country has of its own standards and of its measurement procedures but also reduce considerably the costs of having standards calibrated at large national laboratories or at the International Bureau periodically, since "Round Robin Calibrations" are done on a voluntary basis for which no fee is charged. The only cost of such calibration to a National Metrology Laboratory will be the cost of transportation of its standards. This in most cases would be less than the cost of sending standards to the International Bureau.

However, it is necessary that each National Laboratory sets out very carefully its own procedures of the measurement processes of the various standards, the precision it has achieved and the uncertainties of the values attached to each standard. This information should be disseminated widely throughout the member countries of the ECAFE region and this leads to the second point in which regional co-operation can develop.

Centre for collection and dissemination of dimension on Metrology

One of the major problem of any field of technology which the under-developed countries face is the lack of adequate information of achievements of other laboratories in smaller fields. One of the primary reasons for this is the lack of foreign exchange to purchase the necessary technical publications. There are very few journals which are devoted to metrology wholly and even so are restricted to reports and articles on very special developments in the field of measurement. However useful they are, they do not quite serve the needs of underdeveloped countries which cannot afford the instrumentation which is used in these particular experiments to be able to reproduce them.

What is needed more is the dissemination of technical notes developed from working papers which are circulated within the laboratory and within the confines of the country concerned. It is these papers which reflect the improvement in the capabilities and techniques in the larger National Laboratories, in the course of, what may be called, routine measurements. It is these techniques and methods which can either be adopted totally or modified for use by smaller metrology laboratories without much difficulty or cost.

Hence it is advocated that UNIDO sets up through the ECAFE a documentation centre, which primary function were, to collect all information on metrology and its practice not only from the International Bureau but also from the larger metrology laboratories such as the N.P.L., N.B.S., P.T.B., I.M.M., N.R.L.M., N.S.L., etc., as well as the articles on metrology published in either specialized or general journals and disseminate them to member countries of the ECAFE in the form of bulletins. The bulletins could be issued either bi-monthly or quarterly or even monthly. It could also at the same time be the receiving centre for the reports of the calibration and the statement of achievement of each National Laboratory in the region and process them before sending them out again to the other member countries.

This centre could later on take over the functions of organizing the "Round Robin Calibrations" mentioned in the earlier part of this paper.

CHINA, REPUBLIC OF - Status of the Implementation of the Unifications of Weights and Measures in the Republic of China, by Mr. Yih-teh Lee

1. Foreword
2. Brief History of Chinese Measuring Standard System
3. Service Scope of the National Bureau of Standards
4. Current Status of Metric Standard System
5. Review of the Execution of the Standard Measures in the Republic of China
6. Future Outlooks

1. Foreword

Weights and measures are tools of necessity in our daily life. In our ancient times, each dynasty established its own standard of weights and measures, forming a unique measuring during its reign. Since the measuring system is closely related to our daily activities and ever increasing trade between countries, it is very urgent to set up a unified system. Our government, realising the importance of this necessity, has since adopted the metric system as the standard of our weights and measures.

2. Brief History of Chinese Measuring Standard System

Different weights and measures were used in provinces before the founding of the Republic of China in 1911. Since then, our government called meetings to discuss the possibility of unifying the measuring system. Finally, the metric system was adopted by a conference attended by representatives of industrial and commercial societies under the guidance of the government. This system was supplemented by a market measuring system called 1-2-3 system (1 market volume unit equals to 1 liter; 2 market weight units equal to 1 kilogram; 3 market length units equal to 1 meter). For promotion of this new system and enforcement of the unification of weights and measures throughout the country, the National Bureau of Weights and Measures was established in 1930, responsible for directing and supervision of its inspection offices in different provinces and cities, issuing license to firms selling measuring apparatus, and inspection of the manufacturing of measuring apparatus and instruments as well as the training of inspectors. Later on, all provinces and cities set up their own measuring inspection offices, and trained their inspectors. After the World War II, the National Bureau of Standard was established to take over the administration of the defunct National Bureau of Weights and Measures and the Industrial Standard Committee. It is under the direction of the Ministry of Economic Affairs.

3. Service Scope of the National Bureau of Standards

a. Carries out the unification of the standard measuring system
b. Calibrates all measuring apparatus such as pressure gauge, hydrometer, etc.
c. Approves and issues permits to firms for manufacturing and selling measuring apparatus
d. Trains inspectors and promotes new knowledge and techniques in this regard
e. Answers questions regarding the measuring problem.

Current Status of Metric Standard System

a. Measuring Apparatus (Percentage rate of the use of the metric system):
   - Weights 80%
   - Measures 93%
   - Table Weight Scale 95%
   - Wood bar weight scale 60%
   - Balance 100%
   - Water meter, electric meter, milage meter and pressure gauge 100%

b. Status of Public and Private Establishments using the Metric system
   - Province owned enterprises - All use the metric system
   - National and province joint enterprises - All use the metric system
   - National enterprises - Most of them use the metric system, except the petroleum industry
   - Canned food, aluminium, and enamel ware industries - All adopted the metric system
   - Sugar, textile and knitting industries - Most of them use the metric system

c. Status of Textbooks
   - Primary school textbooks: The metric system is taught on measuring subjects
   - High school textbooks: The metric and the English systems are both taught on measuring subjects, with emphasis on the metric
   - College textbooks: The English measuring system is still used in some of the science books

d. Inspection and Calibrating Instruments
   At present, the National Bureau of Standard has constant temperature and humidity room for micro-testing and precision calibration of instruments. Its work has reached internationally accepted standard.

5. Review of the Execution of the Standard Measures in the Republic of China

China has used its specific weights and measures for a long time. It is not easy to change the whole practice in a short time. To carry out the metric system, it requires full co-operation of all the people in society. Our government has now taken the following procedures to implement the unification:

a. To prohibit any manufacturing and selling of weights and measures apparatus that are not in the metric system and contrary to the regulated specifications
b. To ban any import of the English and Japanese measurement apparatus except those for the purpose of research and experiment
c. To promulgate "Regulations Governing the Marking of Quantitative Figures on Commercial Packages" by which manufacturers and firms are to be ordered to follow the metric system
d. To strengthen the training of inspectors. Students of the Central Police Academy and the Provincial Police School are taught lessons concerning standards of weights and measures in order to help them carry out the unification of the metric system when they graduate

e. Each year, officials in charge of industry and commerce as well as standards inspectors of various cities will be invited to attend a conference to review the results of the execution of the metric system and to plan for further improvement
f. An annual inspection will be held to investigate and prohibit the use of non-metric apparatus.

6. Future Outlooks

From the above, we can see that the metric system had been used by the Chinese society up to 90 per cent. Our government is trying to implement the conversion up to 100 per cent.

We believe that the weights and measures systems in other nations are also being improved, from individually independent states to a unified condition. We hope that there will be a universal system of weights and measures that will be adopted by all nations of the world. The Metric system will the right answer to this universal system. It is hoped that this system could be adopted by the world community through the assistance of the United Nations. We have been trying very hard to convert our old system to the metric system, but we still welcome any technical assistance and advice in this regard. We believe that the seminar of weights and measures sponsored by the Industrial Development Organization of the United Nations will help promote the unification of the weights and measures in the world, which will further improve the co-operation among the nations of the world.

INDONESIA - The Field of Metrology in Indonesia, by Mr. Marjono

The field of Metrology in Indonesia is managed by a Directorate of Metrology Standardization and Normalisation. As National Metrology Services this Directorate is divided into 20 offices of Metrology Inspection Services which are placed throughout Indonesia.

The place of the N.M.S. in the system of governmental institutions is under the Department of Trade Republic of Indonesia, that is under the Directorate General of Survey and Development, Department of Trade.

A. Historical Background

The use of the the metric system of weights and measures is compulsory and universal in Indonesia. The introduction of the metric system caused no difficulty and no serious objections were made concerning the use of new measures in the whole sale or retail trade.

It was beginning of 1923 that the old measures were prohibited. At that time, the first Weights and Measures Act was just valid throughout Indonesia, called "Undang2 Tera tahun 1923" ("The Weights and Measures Act, 1923").

The Act was the basis of the Directorate of Metrology until now, but there were some technical reforms on the act.

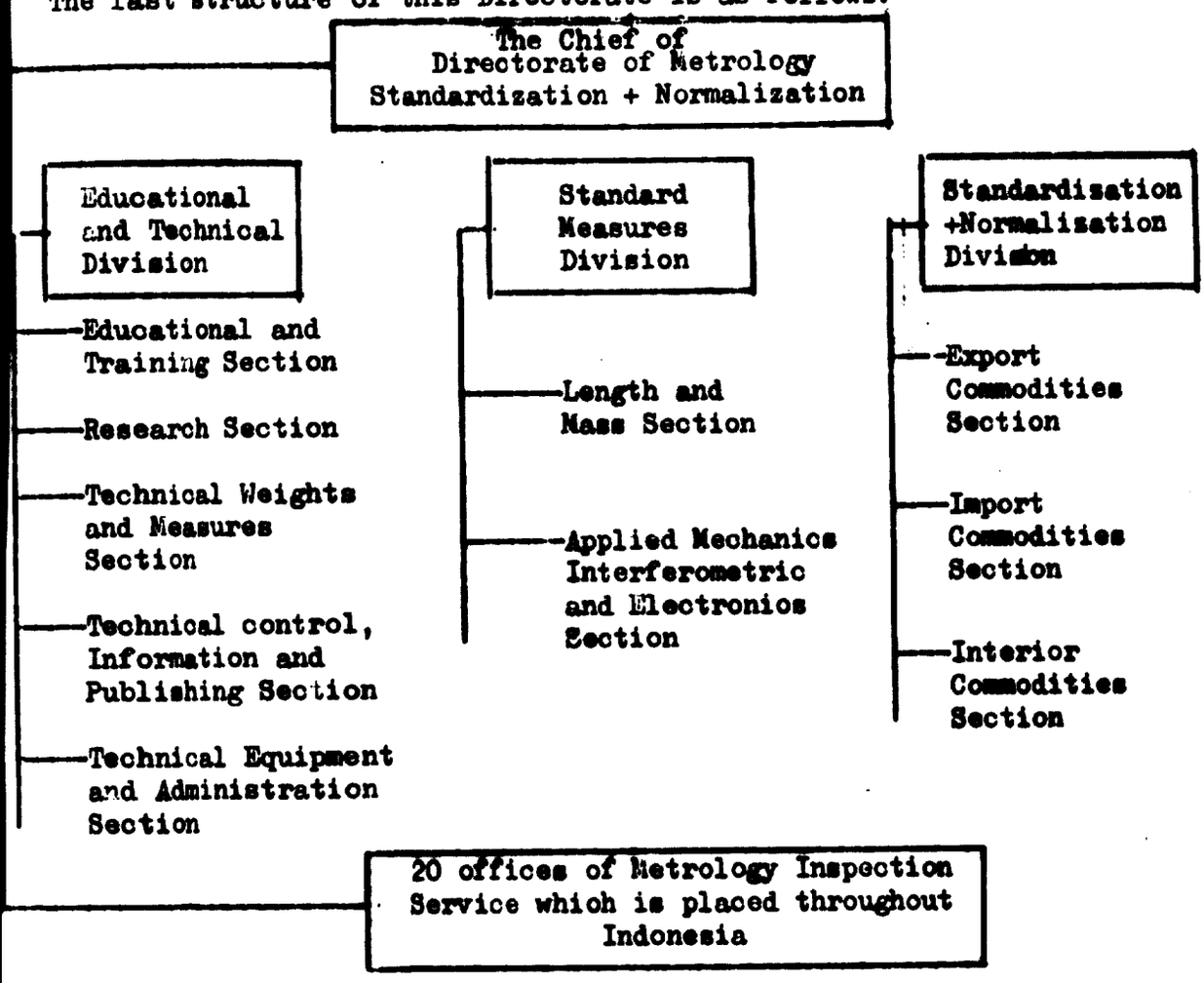
The first reforms date back to 1928 and are called "Undang2 Tera tahun 1928" (The Weights and Measures Act, 1928). Then 21 years later the last reforms followed, called "Undang2 Tera tahun 1949" (The Weights and Measures Act, 1949).

This Act was the judicial basis for the setting-up and operating the National Metrology Services in Indonesia until now.

B. Structure and Functions of Directorate of Metrology

The structure of the Directorate of Metrology, Standardisation and Normalization is based on the decision of Trade Minister Republic of Indonesia.

The last structure of this Directorate is as follows:



The functions of the Directorate of Metrology are "regulating and controlling the smoothness of carrying out the policy in the field of Metrology and carrying out the Weights and Measures Act, 1949", that are:

1) Work on science in the field of Metrology
   These duties are especially carried out by the Standard Measures Division, and include:
   - Keeping, protecting and using the Unit Standards of Directorate of Metrology,
   - Carrying out the experiment in the field of Weights and Measures
   - Upon request, checking/testing/comparing the standards or measuring instruments of manufactory or industry
   - Giving advice to the industry for practising the measuring methods which are based on Metrology
   - Making relation with the bodies either in the home country or in the foreign country; in this case Indonesia has become a member of O.I.M.L. and Convention du Mètre.

2) Checking and controlling the weights and measures used in the transfer/accepta of goods quantity, especially on trade as meant in the Weights and Measures Act, 1949.
These duties are carried out by 20 offices of Metrology Inspection Service and include:
- Calibrating and re-calibrating every year the weights and measures
- Controlling the use of weights and measures in order to use the instruments as a matter of course
- Giving information to the societies in order to have a critical attention when they receive a quantity of goods
- Controlling and checking the weights and measures imported from other countries.

This controlling purposes to protect the industry of weights and measures in the home country, and also to prevent importing of measuring instruments which do not fulfil the technical Metrology conditions in Indonesia.

3) Educating in the field of Metrology, including:
- Carrying out the Academy of Metrology: Senior High School certificate plus theoretical and practical training on legal Metrology for 3 years; after this Academy, the candidates can be appointed as Inspectors of Metrology
- Carrying out the Course of Assistant Inspector: Senior High School certificate plus theoretical and practical training on legal Metrology for 1 year
- Carrying out the Course for the Observer of Violation of the Weights and Measures Act (=Kursus Pengamat Tera): Junior High School Certificate plus specialized basic theoretical and practical training on legal Metrology and Law for 1 year
- Carrying out the Course of Sworn Weighers (=Kursus Penimbang Bersumpah): Senior High School certificate plus specialized basic theoretical and practical training on legal Metrology for 3 months.

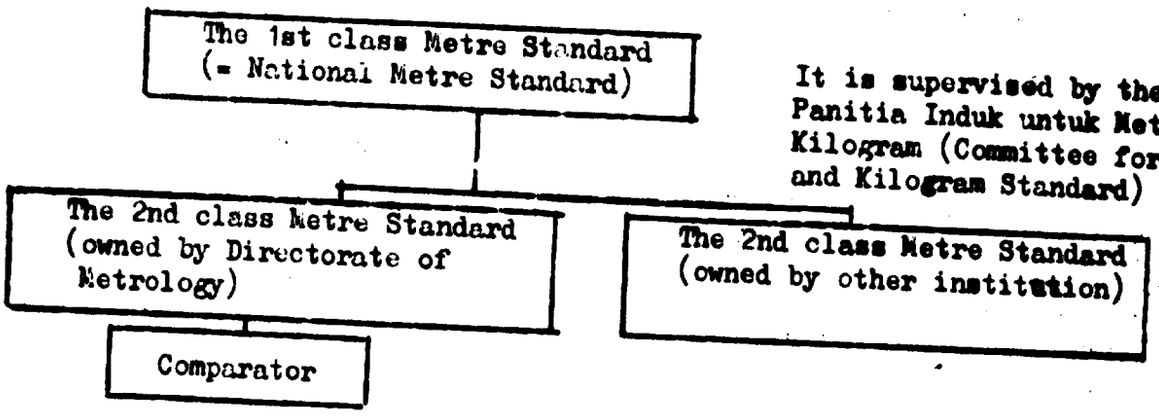
In order to carry out point 2), the Directorate of Metrology is mentioned on the Weights and Measures Act, 1949, and all about the appointment in the General Regulation and Technical Regulation of Metrology is in the State Issue No 15277 and 15311 of 1949.

C. Standard Measures in Indonesia

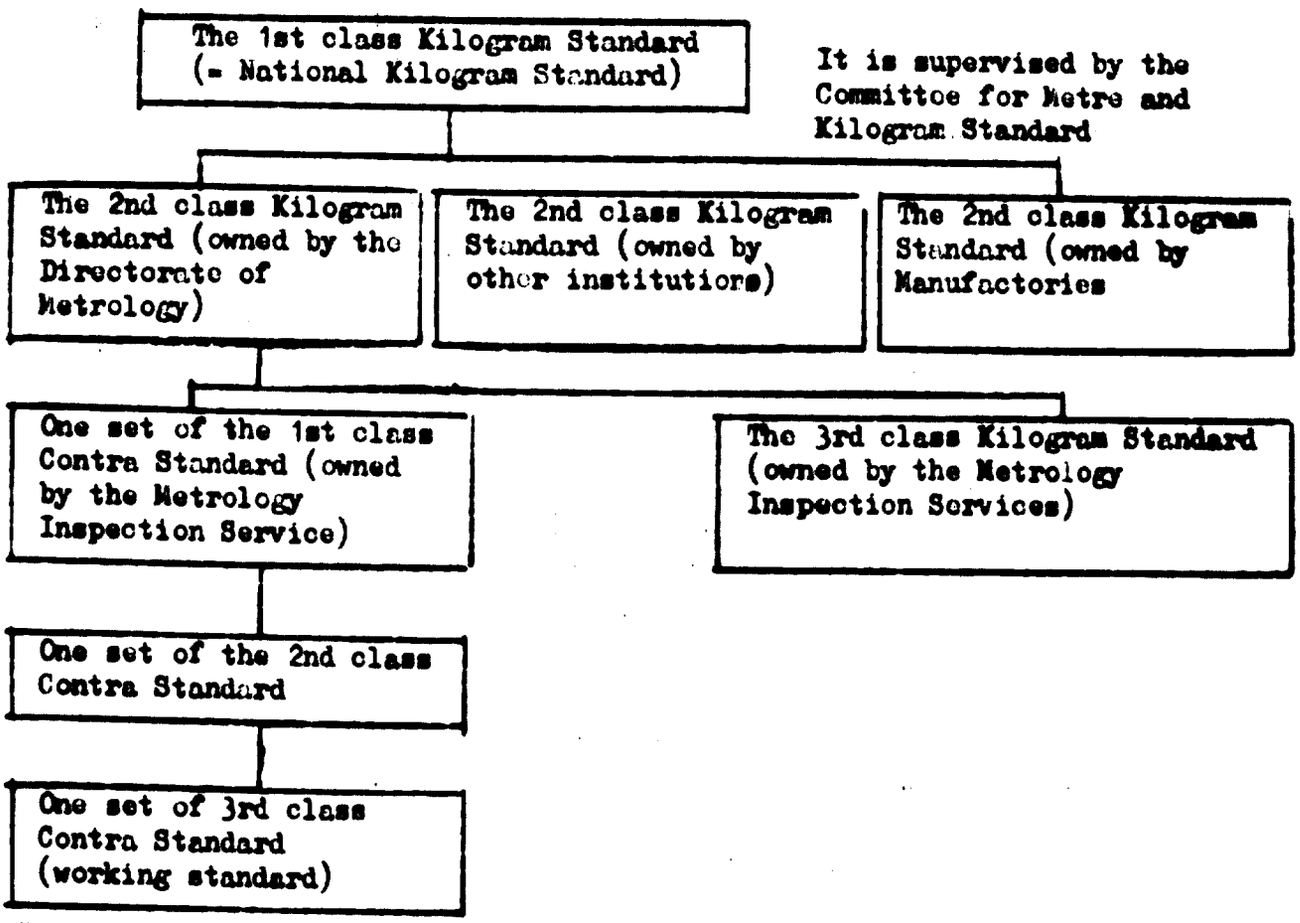
Until now, Indonesia has only two National Standards that are the National Metre Standard X - 27 and the National Kilogram Standard K - 46.

The classification of Standard in Indonesia is as below:

1) Metre Standard



2) Kilogram Standard



NOTE: - The 1st class Standard (=National Standard) is owned by the Government and kept in the Directorate of Metrology; it is supervised by the Committee for Metre and Kilogram Standard (Panitia Induk untuk Meter dan Kilogram). The members of the Committee are:
Directorate of Metrology, Directorate of Land Registration Officer (Direktorat Pendaftaran Tanah), Directorate of To ografi and Bandung Institute of Technology.
This standard is compared with the International Standard every 10 years

- The 2nd class Standard is degraded from the National Standard, and is owned by the Directorate of Metrology; it is compared with the National Standard every 10 years

- Contra Standard is a group of Standards which is compared with the higher Standard every 5 year
In the contra standard, there are many standards in the comparison: 1, 2, 5.
For instance, from the 2nd class Kilogram Standard we degrade the 1st class contra standard as follows:
1 g, 2 g, 5 g, 10 g, 20 g, 50 g, 100 g, 200 g, 500 g, 1000 g, etc.
We degrade these standards by less square theorem

- The working standards are those used daily.

D. Equipments and Instrumentation

Until now the Directorate of Metrology has the following equipment:
Transversal comparator, De Koningh Comparator, Becker Comparator, Micro Indicator, Becker Balance, Mettler Balance, Stanton Balance, Sartorius Balance, Length measure for calibrating the steel tape measure, proving-tank, Installation of Gas Meter, Installation of after Meter, and installation of tank-lorries.

There are many kinds of measuring instruments which are calibrated and re-calibrate every year, as:

System Fairbanks scales, beam scales, weightoridge, gasoline-pump, capacity measures, counter scales, length-measures, proving-tank, tank-lorries, self-indicating scales, steel tape measures, brass weights, steel yards scales, datchings.

And besides that we calibrate the oil tanks for export quantity, usually called strapping.

The industries of weights and measures instruments in the home country have very muc economized since 1950 the foreign exchange of the Government.

But because of lack of capitals and experts, they can only produce the following instruments:

System Fairbanks scales, beam scales, capacity measures, counter scales, length measures, tank lorries, brass weights, steel yards scales and datchings,

Whereas we have to import from other countries the self-indicating scales, gasoline pumps, precision balance, etc.

We believe that to develop these industries, we must co-operate with the developed countries in order to produce the instruments in our home country.

D. Planning of the Directorate of Metrology

According to the Development Programme, the Directorate of Metrology has the following plans:

1. Rehabilitation of the balance room of the Directorate of Metrology
2. Rehabilitation of the Laboratory of Standards measure division
3. Rehabilitation and extension of the workshop of Educational and Technical Division
4. To build a verification room for testing and calibration of newly-built and imported measuring instrument and devices
5. Rehabilitation of all the old instruments which have not fulfilled the conditions
6. Carrying out the calibration of Gas Meter, water meter and electric measuring devices; until now we are still preparing the regulation for that purpose
7. For a long-term plan we envisage a project of building technical laboratories, with two storeys on the ground and 1 stage underground. The rooms underground will be used for laboratory operations as: keeping the comparator, balance room, saving up the National Standard and Metrology Standard, etc. The first floor will have the verification room of the Education and Technical Division and Standard Measures Division. The last floor will be used for administration room, meeting room, library, etc.

That is the general situation of the field of Metrology in Indonesia as far as I know.

IRAN: The Development of Standards for Weights and Measures in Iran, by Messrs. Mansoor Taghizadeh Najafi and Sohrab Charagozlou

1) Origin of the Bureau of Weights and Measures in Iran

The first step towards setting up an institution in Iran, responsible for the establishment of standards and weights and measures was taken on 31 May 1925, when a law for this purpose was enacted by Parliament. This law ordained that thenceforth the Metre, the Kilogram and the Litre should be used instead of the currently used units named Gaz, Deram, and Paymaneh respectively, and that the multiples and subdivisions of the new units should be in accordance with the International Metric Convention of 20 May 1875. The appended table of the law determined multiples and subdivisions of the measurement units of Length, Mass and Capacity on the basis of Metre, Kilogram and Litre.

This law decreed, at the same time, that the official measurement units of our country should immediately be based on the above-mentioned units, and that the employment of other units were illegal and punishable as specified.

Manufacture and supply of physical standards, as the law prescribed, came under the Government monopoly.

For the implementation of this law not only a new government institution, that is a Bureau of Weights and Measures, was created, but several ministries, connected in some ways with this matter, were made responsible for it.

The Bureau of Weights and Measures was endowed with power to implement the law, by controlling the units used in trade and business, and persecuting the infringers of the law. This law was immediately enforced and more or less realised in big cities and towns, but due to insufficiency of provisions and inefficient communications, the scope of its enforcement and realisation did not reach the more remote areas. So by the 1930s a new law with more promising provisions seemed necessary.

On the first of January 1933 the new law for weights and measures was passed by the parliament. This was more elaborate than, but in principle concordant with, the previous one, all units being in the metric system. The new law allowed the government to produce some of the current local weights and measures in accordance with the metric system as specified; for instance MAN was specified as being equal to 3 kilograms and SIR as equaling 75 grams.

The new law prescribed that the methods of implementation of the law and the inspection of the units used as well as the prevention of the salesmen from defrauding in terms of inaccurate weights and measures should be determined by the authorities concerned and ratified in the form of by-laws by the cabinet of Ministers. These by-laws were not prepared until May 1952.

From 1933 till 1945, the conversion of the weights into Metric system and substitution of the local weights by kilogram was carried out by the authorities with much interest but without a precise programme and not in a regular manner. The inspections were often sporadic and somehow irregular due to the lack of sufficient staff. But since 1945 regular yearly inspection of the weights has been carried out and correct weights have been marked by the Bureau of Weights and Measures in accordance with the law.

Up to 1951 the tradesmen and salesmen had to take their weights to the Bureau themselves in order to be inspected and marked each year. This naturally caused some difficulties in the procedure of inspection and diminished the speed of action.

To overcome these problems, at that time, groups of itinerant inspectors were formed to call directly to the tradesmen for on the spot inspection of the weights or else taking them to laboratories for closer examination. In the same year manufacturing of the weights and measures were released from state monopoly and the private industries began to manufacture them under the control and inspection of the Bureau of Weights and Measures.

Between 1951 and 1962, the Bureau took other measures for the unification and correction of length measuring sticks, scales, weights and other measures, and for training of experts in the field of weights and measures to serve in other cities and towns.

2) ISIRI's take-over of the responsibility

From May 1962, according to the decree of the Council of Ministers, the responsibility for the implementation of the law of weights and measures and of its appended by-laws were given to the Institute of Standards and Industrial Research of Iran. Since this time the Bureau of Weights and Measures, now a body under ISIRI, has worked hard not only for yearly control of weights and measures, and supervision of the firms manufacturing them, but also for the development of the administration of the local offices of the Bureau. Some important provisions of the by-laws of 1952 which had not come into effect until 1962 became the main activities of the Bureau. For this purpose two types of organizational units were created: A central laboratory and a field service for weights and measures.

As a start the central laboratory has mainly consisted of offices in Tehran equipped with a limited amount of reference standards and equipment and lacking in trained personnel. This central office has been able to cope with day-to-day tasks thanks to mobile units consisting of four inspection groups, each comprising an inspector, a fee collector and one or two technical workers, each group being provided with the necessary equipment. A special truck equipped with heavy weights is used for calibration of weigh-bridges.

The field service for weights and measures inspection in other places than the Tehran area has been placed under the authority of local ISIRI offices concerned with quality control of products. There are at present 16 branch offices of this type all around the country. The inspection activities of the branch offices have however up to the present been greatly reduced due to the lack of trained personnel.

According to laws and regulations measuring instruments and weights which are produced for sale, exhibition or export whether new or repaired should be tested, calibrated and stamped by ISIRI. This also includes instruments imported from other countries. Private enterprises intending to manufacture measuring instruments should first apply for a permission from ISIRI and the site and installations of manufacture should be inspected before the licence for manufacturing of these goods is issued. The applicants have to follow all the regulations issued by ISIRI.

Already when the Institute of Standards was created it became apparent that great improvements had to be made as regards technical equipment and personnel in order to cope with the tasks stipulated by law. Most urgent was the creation of an improved Central Laboratory where national reference standards could be kept and working standards calibrated for all the activities of ISIRI thereby not only covering the needs of the weights and measures service but also some of the quality control inspection services. This Central Laboratory should also be charged with the training of personnel for the field services to be reorganised and re-equipped.

The planning for the building of the Central Laboratory was started in 1966 based upon a report listing the requirements at that time established by Professor R. Vieweg, former president of the PTB and UNESCO consultant. The construction of the laboratories started effectively in 1968 at the same time as a request was formulated to UNDP for technical assistance in experts, fellowships and equipment. The project was accepted as a Special Fund project by UNDP and is at present being executed by UNIDO in co-operation with UNESCO.

The project is entitled Metrology Centre but includes also some important materials testing activities to complement those already established within ISIRI. A new building has been provided at the site of the ISIRI laboratories located 40 km west of Tehran. The Metrology Centre will be organized in three distinct divisions: Mechanical Metrology Division, Electricity Division and Mechanical Testing Division.

The Mechanical Metrology Division will maintain the national standards for mass (weight) and length to which substandards used in the country will be calibrated. It will also be provided with reference substandards for volume of liquids and gases. Special installations are planned for water-meter and gas-meter calibration. Thermally stabilized rooms are provided for calibration of gage blocks and tolerance gages used in industry and for measuring tapes used by public works. A special section is provided for training of field inspectors for the weights and measures service.

The Electricity Division will maintain the national reference standards for the electrical units such as for voltage, resistance, capacitance, inductance, power, and execute calibration of secondary standards used by industry and public services such as voltmeters, amperemeters, wattmeters, kilowatthourmeters, current transformers, etc. A special section of this division will take care of calibration of lamps and instruments in terms of the photometric units. A special frequency and time standard laboratory is planned within this division whereby standard frequencies and time signals may be re-transmitted for calibration purposes to other public services such as the broadcasting and telecommunication administrations. A great part of the activities of the Electrical Division will be devoted to approval tests of electrical materials and equipment such as cables, switches, sockets and household appliances. This section will have facilities for environmental testing of equipment and meterials to heat, cold, vibration and shock.

The Mechanical Testing Division will maintain national reference standards for force, pressure and temperature so as to enable calibration of testing machines, manometers, thermometers, thermo-couples and optical pyrometers. This division will also have laboratories for the determination of mechanical properties of metals such as tensile strength, hardness, etc., and for the examination of structure by metallographic methods. A special unit for spectographic determination of the composition of metals and minerals is also planned. This division will also be provided with means for non-destructive examination of containers and machine parts using methods such as gamma-radiography and ultrasonics. A special laboratory is being built for destructive testing of containers such as gas bottles and fire extinguishers. A fine and medium mechanics workshop will be integrated with the Mechanical Testing Division.

At present the building is practically terminated and the necessary equipment is being ordered. Two experts have started their assignment. It is thus hoped that Iran very soon will have all the necessary facilities for calibration of the equipment used and produced within the country. The growth rate of the local industry is very big and the quality control system imposed on the manufacturers by the Ministry of Economy requires a technical follow-up which ISIRI expects to be accomplished through the creation of its Metrology Centre.

KOREA, Republic of - Metrology, Standardization and Quality Control in Korea, by Mr. Chong Man Hong

1. Supervision of the Quality of Measuring Instruments Metrology is directly concerned with commercial transactions, science and engineering as well as daily life.

So, the Bureau of Weights and Measures, Ministry of Commerce and Industry, decided to perform governmental control for the promotion of precise, fine equipments by strict quality control of the manufactured measuring instruments. The means used to this end are:

A. To improve the standards of accuracy of measuring equipment
B. To stick the officially approved label
C. To induce the advanced techniques
D. To promote the qualification of the inspectors of weights and measures
E. To provide round-trip technical assistance to the manufacturer
F. To direct the administration of the local inspection.

2. Standardization

National Standardization has begun since early 1960s.

In 1960s, the Industrial Standardization Law was enacted, and the Korean Standards were to be determined by the Director of Standards, through the deliberation of the Industrial Standards Committee.

The Committee is organized by members selected from college professors, manufacturers, consumers and the Division concerned of the Korea Institute for Science and Industry. This Committee supervises the work of a number of specialise sections each concerned with one particular branch of industry. As a matter of fact, the Committee would refer practically to the Japanese Industrial Standards and American or German Standards.

But we always try to make standards suitable to our local needs. So, re-examination is applied to the individual items every three years.

3. "KS" Mark

Manufacturers can mark the letters "KS" on the products which meet the requirements of KS.. This is a kind of license system or seems to be a means to guarantee public welfare. The manufacturer naturally follows the Korean Standard specifications during production and quality control. So the consumer can trust the quality of the goods marked "KS" in a certain sense and our government has the power to order any manufacturer to mark "KS" by the Law of Quality Control when the quality of the specific goods should be guaranteed, e.g. household electrical appliances were ordered to conform to Korean Standards.

MALAYSIA - Metrology in Malaysia, by Mr. U. Kaloo

The following is not to be treated as an official or binding statement by any of the organizations or departments mentioned here but is a collection presented by the author based on discussions with members of various organizations.

Metrology as an applied science is in its infancy in Malaysia. At this stage of development 6 different departments and organizations are actively involved in the development of metrology.

Teaching institutions:

1. - University of Malaya (MU)
2. - Technical College (Tech)

Government departments:

3. - Standard Institute of Malaysia (SIM)
4. - National Institute for Scientific and Industrial Research (NISIR)
5. - Technical Services Department, Ministry of Defence (Mindef)
6. - Department of Weights and Measures (DWM)

A. Equipment and Laboratories

1.+2. The University of Malaya and the Technical College both have fairly well equipped metrology laboratories with equipment in each totalling approximately US$ 100,000. The equipment in the University of Malaya was obtained through UNESCO funds and that in the Technical College from Government funds under the First Malaysia Plan. The equipment in both laboratories cover basic length and angle standards down to interferometers to enable length calibrations at primary standard level; instruments for ascertaining form surface finish and geometry but not roundness; gear and screw thread measuring equipment as well as other precision equipment like optical compensators, small 3 anis universal measuring machines, autocollimators and the like. In fact, equipment-wise both laboratories come up to the level of college laboratories in the U.K. approved for general use under the B.S.C.

3. The Standards Institution thus far concentrated on providing some testing facilities and together with the NISIR is in the process of developing a 25 acre site to provide for intensive testing facilities. At this stage, there is no metrological equipment and the department is in the process of specifying and ordering some basic equipment. The SIM was set up in 1968.

4. NISIR has first been set up this year and at present is in the process of developing its office spaces together with SIM.

5. Mindef is setting up a metrology laboratory for length, form and angle measurement as required for a group of light industries. Much of this equipment is already on order and expected to cost about US $ 75,000. These facilities are being set up with aid from Australia. Judging from the equipment under order the laboratory when completed will be similar to the metroloyg laboratory of Ford's at Dagenham or Renault's in Paris.

6. The Department of Weights and Measures are custodians of the national standards for weights and length (at land survey level). This Department is one of the sections of the Survey Department.

B. Functions

1+2. The primary function is training. No country can build a sound metrology service at any level without a suitable trained manpower. Metrology is at present a compulsory subject for all those undertaking mechanical engineering at a professional level.

The second function is to serve industry and government departments. Calibration, checking and measuring services are available to all industries in the country and they can make use of the facilities and staff in these teaching institutions at a nominal charge. The same service is also available free to any government department.

3. The SIM started off with specifications for a large number of Malaysian standards. This was done by a group of locally available knowledgeable people in the field with voluntary representation from the universities, industries and government department who digested the most applicable and relevant positions of such standards like the B.S., Am. S., Canadian S., Japanese S., Aust. S., N.Z. S ISO Std., French Stds., and Indian Stds., and made any further changes as demande by local conditions. The initial drafts circulated to all relevant industries, government departments and other organizations which were given same time for conveying their comments. The Committee would meet again, make allowances for a comments, and then adopt the standard as a Malaysian Standard. Any product (loca or imported) complying with this standard is given the SIM mark which thus guarantees a cent minimum performance or quality. At present, there is no compulsion on any manufacturer, local or foreign, to seek this level. The SIM will eventually provide testing facilities for a large number of products covered by its own specifications.

4. NISIR the newest organization has as functions the promotion, co-ordinatio and undertaking of scientific and industrial research. In the field of metrology, its major contribution will probably be coordination. For NISIR has among its other plans the intention to create an "experience and instrument and machinery inventory". This means that under its planned "Industrial consultancy service" it will be able to direct a "customer" for any metrological service to an existing organization which has the expertise and the equipment necessary. The very important implication of this is that there will be minimum duplication. If research is required into problems of metrology, NISIR will either be able to undertake this on its own or delegate to some other better equipped organisation.

5. It is the intention of the Ministry of Defence to develop its production of ammunition and small arms. Thus, the metrological equipment that it will require will be put into its own industrial applications. This service will again be available on request to other government departments and even private industry where a fee will have to be paid with first priority to armed forces requirements.

6. The role of the department of weights and measures as a custodian of legal standards is quite likely to be shortlived, because the logical place for such standards is the SIM and moves are already being made to effect this transfer.

Thus the metrology equipment and expertise in the country are aimed at:

(a) Training
(b) Specialized service to industry
(c) Verify quality and performance to national standards
(d) Provide legal standards
(e) Carry out research programmes

and also deliberately avoid duplication at all levels by suitable co-ordination.

NEPAL - Adoption of the Metric System in Nepal, by Mr. A. P. Shrestha

Nepal is a landlocked developing country situated between the Republic of China in the north and India in the south. Nepal was ruthlessly exploited for over a century by the Rana regime and she remained in complete isolation from the outside world till 1951. Thus the impoverished economic state of the country was quite natural. In fact, the country was beyond the reach of modern scientific and technological development and was stagnating in the primitive economy with a limited number of industries and backward agricultural sector. Under these circumstances it can be easily presumed that there was lack of institutions carrying out the services such as industrial research, standardization, metrology, etc. In the absence of such institutions weights and measures and weighing and measuring instruments in use were neither authenticated nor standardized and thus were quite unreliable.

Outdated old system

Weights and measures that were in use in the country could be broadly divided into two categories. The Nepali system in which weighings are done in Dharni, Pau and Tolas (One Dharni = 2.4 Kg approx.) and volumetric measures in Pathi and Mana (One Pathi = 4.5 litre nearly) and the Indian system of Maund, seer, Chattak in weights and liquid seer in Volumetric measure. Regarding the linear measure yard (British System) was in use all over the country. In the hilly regions and central valley the first system was prevalent, while in the southern Terai regions the second system was in use. In the northern montainous part of the country, due to lack of transportation facilities, bartering system still prevails.

Plan to convert to decimal system

In order to do away with this outdated dual system of weights and measures, and to have a more scientific system in the country, His Majesty's Government took initiative to convert to the Metric System in the year 2022 (1965). The programme of conversion to Decimal System was entrusted to the Mint Department, as it was the custodian of some Tola standard weights and a set of standard Mana, Rathi-Capacity measures and further it had done some verification works of weights and measures with these standards in the past. The department had to prepare the groundwork necessary for the adoption of the decimal system. These were, (1) to train the officers and inspectors in the technique of verification of Weights and Measures and weighing and measuring instruments, (2) to procure national prototypes (duly verified by the international organization), standard weights and measures and weighing and measuring instruments, (3) to establish the central laboratory and branch offices at different parts of the country (4) the legislation of the standard weights and measures Act and rules based on Metric system, (5) to get manufactured the traders metric weights and measures and lastly (6) to educate the people in the system.

To get the first hand knowledge of the working of the system, the then director of the Mint Department was sent in an observation tour to the Scandinavian countries. On his return the chief Assayer was sent to West Germany and two other officers to India, to get training in the verification work and legal metrology for eight months and six months respectively. The Government, in order to impart training to maximum number of personnel, has made a policy of sending two inspectors for training in India under the Colombo plan every year.

Procurement of national prototypes and standards

National prototype "Kilogram" duly certified by BIPM had been procured from France. This prototype, under the recommendation of OIML, is being constructed fro a very much less expensive special quality nickel chromium alloy called "NicralD" instead of constructing it from an extremely expensive alloy: iridioplatinum. Regarding length measure, as the new definition of metre is being adopted, the question of what type of National Prototype is to be acquired is still under consideration. Primary standard weights manufactured in U.K. and verified by the British Board of Trade and Secondary and Working Standard Weights and Measures made by the India Government Mint, Bombay, and Certified by the National Physical Laboratory Dehli were being duly procured. Finally after the procurement of precision as well as secondary and working standard balances, the Central Laborato was established in Mint in 2024 (1967). Mention should also be made here of the Scientific Aid of the British Government under which standard weights and measures and weighing and measuring instrument and auxiliary equipments worth £ 15,000 were donated to the department.

Legislation of the Act and Rules

The Weights and Measures Act based solely on the Metric System was being drafted and presented to "Rastriya Panchayat", the elected house of representatives of the country, and then, passed on by the house, it received the seal of approval of the King in 2025. The Weights and Measures enforcement rules under the Act was promulgated in 2027 only. Now, since the immediate and abrupt exercise of all the functions involved in the vast field of weights and measures is not practicable the rules have embraced weights and weighing and measuring instruments like beamscales, countermachines, platform weighing machines weigh-bridges and metres and measuring tapes only. The application of the system to other of its aspects such as petrol pumps, taximeter tank wagon, etc., is under consideration.

Manufacture of Traders Weights and Measures

The next problem the department had to face was regarding the design and specification of traders weights and measures. There were no experienced manufactures of weights and measures in the country. They, therefore, had to be imported from other countries. Indian manufacturers, when they came to know about the decision of the Government to change over to decimal system, came forward with proposals to supply the weights and measures at the most competitive rates. The easiest way to solve the problem was to adopt the design in use in India. Thus designs of brass weights and capacity and linear measures as in India were adopted, but having the distinct official seal of H.M.G. and the denominations appearing also in Devnagari numerals. As regards the commercial cast iron Weights ranging from 500 to 50 kg, their designs were adopted as recommended by OIML for international use. Orders for the weights and measures likely to be immediately required, as per sample statistical survey of traders in the valley and two major towns in the Terai Birgunj and Biratnagar, were placed with the Indian manufacturers and duly procured. They were subsequently verified and stamped in the three offices which had already been established.

Educating the People in the System

The changeover into the decimal system all over the country within the anticipated period totally depends on the attitude of the people towards this system. Unles the people with knowledge of the old system riveted in their memory by its application through centuries will fully co-operate, the success of the programme will be bleak. So in order to bring home to the general public the advantages of the metric system having uniqueness of possessing the decimal property, mass propaganda was being carried out. Booklets providing information about the system, the desirability of its adoption and its advantages over the old system and also conversion tables were being distributed. Intensive propaganda was also carried out through the media of radio, cinema, posters and articles in the daily papers.

Enforcement of Standard Weights and Measures

The background necessary for the smooth inception of decimal system being thus created, the Standard, Weights and Measures Act was first enforced in the three major towns Kathmandu, Lalitpur and Bhaktapur in the valley, and in Biratnagar and Birgunj in the Terai in the fiscal year 2027/28. Weights and Measures procured from India and subsequently verified and stamped were sold to the traders through the dealers. Traders were requested to bring the weighing instruments in their possessions which were also verified and stamped and certificates to use them were issued and their statistics were kept in record. The complete changeover to the new system all over the country within a year or two is not feasible. It has, therefore, been envisaged that a time period of five years will be necessary. Accordingly the same provision is being made in the Act. Metric system thus being already introduced in the valley and two towns of the Terai region, will be enforced in the other parts of the country systematically beginning with important towns and villages and extending to the remoter areas later. In this context mention should be made here of the more important markets Dharan, Janakpur, Hetauda, Bhairawa and Pokhara in Kosi, Janakpur, Narayani, Lumbini and Gandaki Zones, which have been selected for the introduction of standard weights and measurers this financial year.

The programme of conversion to metric system has thus been started just in time and there is no doubt that it will prove to be in harmony with the development of industries in the country and endeavour the diversification of trade.

PHILIPPINES - A Glimpse of Standardization in the Philippines, by Mr. J. P. Planos

The first significant step taken towards the establishment of standards specifications in the Philippines was made in 1916 when the Committee on Standardization of Supplies was created with the promulgation of the Executive Order No.21 by the then Governor General Francis Burton Harrison. The composition of the committee consisted of the Chief Purchasing Agent of the then Bureau of Supply as Chairman and the respective Directors of the Bureau of Public Works and that of the Bureau of Science (now the National Institute of Science and Technology) at the time as members.

Subsequently, this committee was placed under the Division of Purchase and Supply in the Department of Finance on October 3, 1928. The standardization work was only confined to supplies purchased by the various government offices such as raw and boiled linseed oil, petroleum spirits, paints, etc. A little later, however, the standardization of other commodities was assigned to other agencies of the government, namely: in 1934 to the Sugar Quota Administration - sugar; in 1949 to the Bureau of Forestry-timber; in 1954 to the Philippine Coconut Administration- coconut and its by-product; in 1958 to the Division of Specificatio in the Bureau of Supply Coordination- government purchases; in 1959 to the Native Tobacco Classification Council- native leaf tobacco; in 1960 to the Philippine Virginia Tobacco Administration- Virginia tobacco; in 1961 to the Bureau of Fiber Inspection Service- all fibers; in 1962 to the National Cottage Development Authority- cottage industry products, etc.

The standardization activity in our country during the past few decades was confined principally to agricultural products and raw-materials and very little was undertaken, if any, on industrial products. This can be easily surmised because our agricultural economy and our position in the international trade and commerce had been more that of a supplier of raw materials. While we were under the protectorate of the U.S., we did not find the urgent need of formulating our own industrial product standards for whatever standard specifications we then required, could easily be obtained from the ASTM, the Federal Standard Stock Catalog, the SAE or from other sources prescribed by other standard agencies in the U.S. after some modifications. The period starting from the American occupatio up to a few years after the independence of the Philippines may be called a period of "adoption" of U.S. standard specifications. There were not many technical problems then regarding product standardization for our principal market was, and still is the U.S., and our export items were only a few.

Standardization before our independence was employed, therefore, to develop and promote our principal agricultural export products. With the declaration of our political independence in 1946, however, and with the very high rate of growth of our population, we came to the conclusion that we have to gear our economy from an agricultural to that of an agro-industrial economy if we hope to give our people a better opportunity of attaining a higher standard of living. This would then require reassessing and directing our total efforts in order to improve our economic condition to include application of standardization activity on a more wider base so as to encompass all potential industrial products either intended for local consumption or for export. We believe as others do that economic problems can largely be resolved by increasing the foreign exchange receipts. This can only come about, however, by reducing cost while at the same time improving the quality of the export products. It is for this reason that the present administration has been giving export incentives to our local manufacturers/exporters and it was for this very reason also that for the past decade the Republic of the Philippines has became much concerned with standardization and the science of measurement. This means, however, strict conformance of our export products to international standards or adherence to the buyers standard Specifications and the application of adequate quality control measures in our manufacturing processes.

It might be of interest for the other representatives in this workshop to know that we have other private or government agencies involved in standardization work. There is for example the Philippine Standards Association a private agency which was incorporated in 1955 and partly subsidized by the National Science Development Board starting from 1963. The creation of the Bureau of Standards under R.A. No 4109 approved on June 20, 1964, and later the creation of the Philippine Standards Council by Executive Order No 68, dated May 28, 1967, of His Excellency the President of the Republic of the Philippines could more or less testify to the earnestness of our government of promoting our economy through the adoption and adherence to standards and quality control measures.

The National Institute of Science and Technology, the Presidential Economic Staff, the Philippine Chamber of Industries and other government and private enterprises as well as various civic and professional associations serve as resource personnel to sit as members of the technical committees being formed from time to time. The NIST, in addition, under a Memorandum Agreement executed with the Bureau of Standards, collaborates and assists standardizing bodies in matters of testing requirements. This agreement was prescribed as a requirement by our National Economic Council in the proposed establishment of a testing and standards center under the NIST which project was presented to the United Nations Development Programme for possible assistance and implementation in 1965.

With a few exceptions, commercial testing laboratories are generally operated by some bureaus or agencies of the government. There is for example the Forest Products Research and Industries Development Commission in Los Banos, Laguna under the National Science Development Board, the Food and Drug Administration under the Department of Health, the Material Testing Laboratory under the Bureau of Public Works, the Metallurgical Services Division of the Bureau of Mines, the Tests and Standards Laboratories of the NIST and the Bureau of Soils under the Department of Agriculture and National Resources. Of these government laboratories, however, the TSL covers a wider area of activity. It accepts requests for analysis ranging from various types of raw-materials to the semi-finished and finished industrial products.

The TSL under the NIST has, as its main functions, the following activities, namely:

1. To maintain the national standards of physical measurements;
2. To calibrate weights and measures;
3. To determine the quality and composition of materials and to issue certifications in relation thereto;
4. To perform analysis and tests for the purpose of establishing suitable standards of products;
5. To assist other government agencies in technical matters pertaining to t their official functions, and
6. To offer technical advice and consultation.

To carry out these functions, the TSL is presently organised into different laboratories having the following areas of activities:

1. Weights and Measures
2. Fuels and petroleum
3. Paper and textiles
4. Organic materials
5. Paints and allied products
6. Metals and alloys
7. Engineering materials
8. Water and inorganic materials
9. Biological examinations
10. Mechanical and electrical products
11. Specifications and standards.

It is because of the great responsibility placed upon the shoulder of the NIST in the matter of assisting and supplementing the testing and calibration requirements of these standardizing bodies and also in undertaking other equally important technical functions that it thought necessary to propose a project on technical assistance to the UNDP. We, particularly from the NIST, are very happy to receive news from the UNIDO, Manila, only a few months ago to the effect that an SIS expert will be assigned to assist us in our standardisation problems. On behalf of the government of the Republic of the Philippines may I express here the kind sentiments of a grateful nation: MABUHAY UNIDO. We hope that the assistance will not be the first and the last.

The metric system as the fundamental system of weights and measures throughout the Philippines was provided for in the Philippine Commission Act No. 1519 of 1906 subject however to some qualifications. As provided for in Sect.8 of this Act, the metric system shall be used in all official documents. No weights or measures except those of the metric system shall be employed in any contract, deed or other documents and that in ordering commodities or articles from other countries the standards of weights and measures commonly used in such country in selling such commodities or articles may be employed.

The Bureau of Internal Revenue under the Department of Finance is charged by law with the duty of enforcing strict adherence to the rules and regulations regarding the commercial use of weights and measures. The Internal Revenue Agents designated Inspectors of Weights and Measures, empowered to inspect and test weights and measuring devices. The Sealers of weights and measures are the provincial, treasurers, the city treasurers, the deputy provincial treasurers and their deputies.

Commonwealth Act No 466, known as the National Internal Revenue Code was approved in June 15, 1939. Chapter VI of this Act provides, among others, for the fees for sealing of weights and measures, defines the responsibility of the Bureau of Science in comparing the secondary and fundamental standards and prescribes the punitive provisions in cases of fraudulent practices relative to weights and measures.

In some areas of commercial transactions the English System is still in use, like for example in the sale and purchase of lumber, in the measurement and sale of clothing materials, in the disposal or sale of diary products like milk and ice-cream, and in the dispensation of canned foods and drug preparations. Long usage and local customs, as is true in other countries, are deterrent factors for a complete adoption of the metric system in commercial transactions.

SINGAPORE - Singapore Institute of Standards and Industrial Research, by Mr. Tan-Poh Lin

What follows in this short presentation should not be considered as the official position of the Government of Singapore nor any of its Agencies.

1. Background Information

Singapore is a small city state. It is roughly about 220 sq miles in area. It has no agricultural base, no mines, no forest products and no oil, i.e. it has no natural products to speak of.

Singapore's income has been traditionally derived from its port and its strategic location.

2. Industrialization Programme

Owing to the natural increase in the population, threatened pullout of the British forces, and rising unemployment, the present Government which came into power in 1959 started a systematic Industrialization Programme. Before 1960 the manufacturing sector contributed about 8% of our national income whereas by about 1970 the manufacturing sector contributed about 30% of our national income.

A piece of land on the north-west of the island which consisted of swamp and small billets was leveled and converted into an industrial estate - the Jurong Industrial Estate.

Thus with the systematic attraction of capital and Industries into Singapore and the creation of industrial lands complete with the attending amenities such as proper roads, electricity, drainage and so on, the Government was successful in getting a whole range of manufacturing industries to be set up. The manufacturing industries range from a mini-steel plant turning scrap iron into rolled structural steels, ship-repairing and ship building, and type-manufacturing plants to small precast concrete blocks.

Recently the Governement has given special encouragements to industries which have a high-skill or high technological content.

3. The Standards Testing Laboratory

About 1962, the Singapore Industrial Research Unit (IRU) was set up primary to provide the necessary technical services to the then infant industries. The IRU received considerable aid and technical advice from the New Zealand Government under the Colombo Plan.

The IRU was a Unit R under the wings of the Economic Development Board (EDB) which was the body spearheading the Industrialization Programme.

Testing equipments were purchased and staff were recruited. By about 1968, most requests for testings from Industries could be met by the IRU which then had a staff of under one hundred.

There was, and is, no Central Metrology Laboratory. Whatever checking or calibrating needed to be done was done by the different departments within the Unit.

4. The Singapore Institute of Standards and Industrial Research (SISIR)

Reflecting the need for increased quality in Singapore-made products with the view of securing export market, SISIR was set up in late 1968 to replace the old IRU.

In addition to standards testings, SISIR immediately started Standards drafting initially on products manufactured in Singapore.

Together with Standards drafting SISIR initiated the Quality certification scheme and set it up on a sound basis.

Under the Quality Certification Scheme a factory can request to be considered for the award of the Quality Certificate. A standard was chosen such that the product was supposed to be manufactured up to. Quality control was established in the factory and after a specified period of testing, should the factory be able to satisfy the conditions as specified in the Certification Scheme, a Quality Certificat Certificate was awarded specifically for the particular product only.

SISIR has a United Nations expert in Quality Control who has been advising the Standards and Quality Control Section.

SISIR is now in the phase of initiating the Quality Scheme. Under this Scheme the product has to meet the Singapore Standards.

To raise the quality of Singapore-made products and raise the efficiency of the factories, industrial research has to come in. Industrial Research, being placed within the Institute of Standards (and Standards Testings), has the advantage of close liaison with Industries as a whole and consequently the research carried out is more relevant. Also certain equipments and instruments can be shared by both groups together with the administration and other overheads.

5. Discussions

During our short experience with Industrialization, Singapore has just begun to identify its difficulties, needs and bottlenecks, and have received generous UNDP aid. By and large Singapore has implemented to its satisfaction the various programmes it set out to achieve. The Standards Testings have been put on a sound footing, the Standards Draftings are going on steadily, the Quality Control and Quality Certification Scheme have been implemented and the Quality Marking Scheme is just starting. However, to convert the Country from an industrially and economically developing nation to a developed nation, Singapore needs to possess technological initiative and know-how to solve the many technical industrial problems that arise from time to time. This technological initiative and know-how have to be developed and to this end Singapore is seeking UNDP help in setting up an Institute of Industrial Research as a UNDP special fund project.

THAILAND - Metrology, Standardization and Quality Control in Thailand, by Miss Phani Saengsawang

1. Metrology

The subject of weighing and measuring can be looked upon from several different standpoints. Weights and measures officials are interested in law and regulations on the subject and methods of verifying commercial weighing and measuring devices only. Scientists and engineers are interested in developing methods by which precision measurements are made to achieve successively better results.

The aspects mentioned above, in addition to the phenomenal growth of science and technology, lead the planners to the conclusion that the Department of Science, Ministry of Industry should have services concerned with scientific and engineering standards that have become necessary for the industrial progress of the Nation.

It is essential, in Thailand, that a metrology laboratory is established, capable of serving as the measurement center for the country. For each field mentioned above, there is a governmental body; please see under 1.1 and 1.2. Furthermore there is a semigovernmental body with related tasks, please see under 1.3.

1.1. Legal Metrology

In the case of what is now generally known as weights and measures, the primary function of weights and measures officials is to see to it that equity prevails in all commercial transactions involving determination of quantity. For this purpose, the weights and measures law and regulations were promulgated in 1923 by the Ministry of Economic Affairs, Department of Commercial Registration, Weights and Measures Division. The objective of the Division is to bring about a uniformity in the system of weights and measures. This is obtained by specification on types and tolerances of devices and by an inspection of the devices used in trade.

The prototypes of 1 meter and kilogramme made of platinum iridium are kept by the Division of Weights and Measures.

1.2. Scientific and Engineering Metrology

The Department of Science has been successively developed and is now the Government's central research and testing organization. There are divisions and specialized laboratories in the Department to meet the demand of the country. One division is that of physics and engineering.

This division has some fundamental measurement standards and precision tools. The secondary standards used are verified by NPL/in UK. Future development is planned to follow proposals made in 1962 by a UN expert for the fields of length, mass, temperature and electricity. However, for budgetary reasons some years will be needed to complete these devices.

The division provides services concerning precision measuring and calibration to scientific bodies and to industries.

For services of a less qualified nature, e.g. in commerce, other competent organizations can provide the facility.

Please see the attached list of instruments concerning length and temperature which are kept at the division.

1.3. Scientific and Engineering Metrology at Applied Scientific Research Corporation of Thailand (ASRCT)

The semigovernmental ASRCT has established an Instrument Repair and Calibration Center (IRCC). So far IRCC has mainly been working with electrical and electronic instruments. It provides services to all scientific groups. IRCC also has facilities for the designing and repair of apparatus.

2. Standardization

There are quite a number of standards bodies in Thailand, three of them will be mentioned here.

2.1. Center for Thai National Standards Specifications (CTNSS), semigovernmental, nevertheless the Thai member of ISO.

2.2. Office of the Commodities Standards, the standards body for exported products mainly agricultural, under the Ministry of Economic Affairs.

2.3. Thai Industrial Standard Institute, Department of Science, Ministry of Industry; this standards body is concerned with industrial products according to the Industrial Standards Act 1968.
TISI will shortly have a standards mark and give licences for products that are found to conform with its standards. This also means that the factories must have quality control facility. A follow-up control system is foreseen.

3. Quality Control

The Department of Science carries out practically all types of testing on request. In case this is asked for by producers or consumers, the Department can certify that a particular product meets a certain specification.

It is hoped that the certification scheme including the standards marking (as mentioned under 2) will lead to a much more systematic quality control in industry than at present.

The market, private as well as professional consumers, will no doubt become more quality conscious.

I. LIST OF LENGTH MEASURING EQUIPMENT ACQUIRED BY THE DEPARTMENT OF SCIENCE AT THE RECOMMENDATION OF THE UN EXPERT (1962)

1.1. Standards of Length

1.1.1 Combination length bars and accessories set MB10 comprising 10 bars ranging size from 10 to 1000 mm tapped at both ends inspection accuracy
1.1.2 Slip gauges in set No M105 comprising 105 pieces ranging in size from 0.50 mm to 100 mm, inspection accuracy, 2 sets
1.1.3 Slip gauges accessories suitable for use with item 2, 1 set
1.1.4 Cylindrical Reference Disc ranging in size from 2.5 mm to 100 mm
1.1.5 Roller Gauges, in set ranging in size from 5 mm to 25 mm, 2 sets
1.1.6 Ball gauges in set covering a range from 1.5 to 25 mm (3 balls of each size) 1 set

All the above items accompanied by calibration certificates of recognised standardizing laboratory (NPL).

1.2. Length Measuring Instruments

1.2.1 Bench Micrometer, range 0 to 100 mm with nonrotating anvils, reading by vernier to 0.001 mm

1.2.2 External Micrometer, set of 7 covering range 0 to 175 mm in steps of 25 mm and reading by vernier to 0.002 mm

1.2.3. Stick Micrometer, set covering range 75 to 750 mm and reading to 0.01 mm

1.2.4 Depth Micrometer, set covering range 0 to 75 mm reading in 0.01 mm and with 100 mm base

1.2.5 Vernier Height Gage, of 300 mm capacity and reading by vernier to 0.01 mm.

1.2.6 Inside Indicator Gage, for measurement of bores, set comprising 5 instruments covering range 9 to 200 mm and reading to 0.001 mm

1.2.7 Vertical Comparator, mechanical type reading in 0.005 mm, magnification 1000, Capacity 30 mm

1.2.8 Optical Projector, horisontal type. Westminster No. 2 with 4 inches focus lens

1.2.9 Indicator Gage, C.E.J. Nikrokator
Range 0.4 mm by 0.005 mm - 1 OH
Range 0.1 mm by 0.001 mm - 1 OH

1.2.10 Dial Indicators
Range Graduations
10 mm 0.01 mm - 1 off
3 mm 0.001 mm - 1 off

1.2.11 Test Indicators
Diameter of dial 40 mm reading in 0.002 mm.

1.3 Accessory Equipment for Length Measurement

1.3.1 Surface Plates, Granite, Grade A. lapped
24" x 18" 1 OH; 12" x 12" 1 off

1.3.2 Squares, precision, inspection accuracy, lengths of blade 4" 6" 12" and 18" respectively

1.3.3 Squares, Cylindrical
Height 6" Diameter 2 3/4"
Height 12" Diameter 3½"

1.3.4 Straightedges, toolmakers, set of four (2", 3", 4", 6") with glass test plate

1.3.5 Vee Blocks, precision
4" x 2 7/8" x 2 7/8" - 1 pair
2 5/8" x 2 5/8" x 1½" - 1 pair

1.3.6 Optical Flat, Quartz suitable for use with slip gauges, 0.000 001" accuracy, 2" diameter by 3/4" thick

1.3.7 Precision level, B S Type 1, sensitivity 10 seconds, length of base 12 inch

1.3.8 Stand for Dial Indicators
N.P.L. Cantiliver type

1.3.9 Toolmakers Clamps
In pairs, assorted sizes ranging from 1" to 4"

II. BASIC TEMPERATURE MEASURING EQUIPMENT ACQUIRED BY THE DEPARTMENT OF SCIENCE AT THE RECOMMENDATION OF THE UN EXPERT

These notes cover thermometer and pyrometry separately, and under each section is given (a) an abbreviated list of recommended equipment (b) some range and accuracy and field of use, and (c) full ordering details of the equipment recommended.

2.1 **Thermometry**

(a) Equipment

6 sets liquid-in-glass Thermometer
1 only Thermostatically controlled electrically heated water oil Bath
2 only Reading Telescopes
1 only Hypsometer

(b) General Notes

The 6 sets of Thermometers specified below should enable measurements to be made to best accuracies as follows:

-80° to $0^{\circ}C$ $\pm$ 0.2 to $\pm$ 0.5 deg. C
0° to $100^{\circ}C$ $\pm$ 0.01 to $\pm$ 0.002 deg.C
100° to $250^{\circ}C$ $\pm$ 0.05 deg.C
250° to $450^{\circ}C$ $\pm$ 0.2 deg. C

In addition to being used for making measurements to those accuracies if required in the range $-80^{\circ}C$ to $+450^{\circ}C$, the thermometers covering the range $0^{\circ}C$ to $250^{\circ}C$ could be used in conjunction with the thermostat Bath to calibrate working thermometers of other temperature measuring instruments in that range.

The reading Telescopes are required for reading thermometer scales when the best accuracies are required.

The calibration certificates supplied with the thermometers apply for at least 5 years. Ice point checks on them can be made very simply, and steam point checks may be made with the Hypsometer.

(c) Equipment ordering details

(1) Liquid-in-glass thermometers

For each of the following, to B S 1900 : 1959

type SR1/30 C, -80 to $+30^{\circ}C$ in 0.5 deg.
type SR7/51 C, -1 to $+51^{\circ}C$ in 0.1 deg.
type SR7/101C, 49 to $101^{\circ}C$ in 0.1 deg. with ice point
type SR8/151C, 99 to $151^{\circ}C$ " "
type SR3/201C, 149 to $201^{\circ}C$ " "
type SR6/251C, 199 to $251^{\circ}C$ " "
type SR11/452C, 198 to $452^{\circ}C$ in 0.5 deg. with steam point

All the above items are supplied with calibration certificates from a recognized standards laboratory (NPM).

(2) Thermostat Bath

Type NBS, working range -60° to $+300^{\circ}C$; with suction pump and two rubber hoses, plus two metal hoses for temperature over $150^{\circ}C$; with Thermosister TP regular including extra sensitive element; for operation on 230 Volt 50 cycle AC supply.

(3) Reading Telescope

Two only reading telescopes, magnification about x7, erect image, to focus down to about 18 inches or less.

(4) Hypsometer

One only Bosch Hypsometer, electrically heated 230 V. AC, similar to No. 984/obs.

2.2. Pyrometry

(a) Equipment and Details

(1) Platinum Thermocouple
Two only, Pt 13% Rh. V. Pt., 24 inch long, with ¼" refractory inner sheaths (Morgan triangle H or similar), 1 inch closed and Inconel outer sheaths and Ether (or similar) heads and head covers, plus two spare refractory sheaths each.
Three ditto only, but 36 inches long.
All five to be supplied with calibration certificates, for the range 0 to 1100°C, from a recognised standards laboratory.

(2) Thermocouple Polentiometer
Cabridge Workshop Model, with potential Source, complete with spare galvanometer and a calibrated certificate from recognised standards laboratory (NPL).

(3) Thermocouple Checking Furnace (one only)
Vertical Tubular Furnace, 3½" internal diameter, 30 inch deep electric; okw 230 V. single phase AC, Maximum temperature 900° with control box incorporated. Variac, ammeter, fuses, etc.; complete with spare muffle and one each stainless steel and copper blocks 3 inches diameter, 12 inches long with axial hole 1½ inches diameter x 10 inches deep.

(4) Thermocouple Wires
Chromel V. Alumel or T_1 V. T_2 bare wire
50 ft. of 10 SWG and 100 ft. of 16 SWG.
Twin hole insulators, 1 inch, domed ends
50 dos. for 10 SWG 50 dos. for 16 SWG.
Duplex braided CV. A or T_1 V T_2 wires (Asbestos/silicone/fibre glass covered) 200 ft. of 20 B.+S.
100 ft. of 24 B.+S.
Compensating/Extension Leads
100 ft. of 1/064 PVC Insulated and cotton braided, T_1 V. T_2
100 ft. ditto but copper V cupro-nickel (for Pt. Rh.)

(5) Optical Pyrometer
One only Leeds and Northrup Optical Pyrometer, type 8621C, ranges 775 to 1225°C and 1075 to 1750°C complete with spare lamp unit and type 8624 leather carrying case.

(b) General Notes
The Platinum Thermocouples, in conjunction with the potential could be used to make measurements at temperatures up to 600°C to an accuracy of about ± 2 or ± 3 deg. C and up to 1100°C to about ± 3 to ± 5 deg. C. Other platinum or base metal thermocouples could be calibrated to an accuracy of about ± 5 deg. C., by making comparison checks in the Thermocouple Furnace. For better accuracy at low temperature, thermocouples could be calibrated against standard

thermometer in the Thermostat Bath, (up to 250°C). By using refractory crucibles containing say zinc, antimony and silver, in the Thermocouple Furnace, the calibrations of the standard Platinum Thermocouples themselves could be checked occasionally at the freezing points of these metals (419.5°C, 630.5°C, 960.8°C) respectively.

The potentiometer, with its in-built Potential Source, could be used also for calibrating pyrometric instruments (millivoltmeter and potentiometer types) used with Thermocouples.

An Optical Pyrometer is a useful instrument for measuring high temperatures (800°C upwards), to the nearest 10 or 20 deg. C or so, in furnaces and kinds where the use of a Thermocouple is undesirable or impracticable.

ANNEX III

LIST OF PARTICIPANTS, EXPERTS AND OBSERVERS

PARTICIPANTS

AFGHANISTAN	RAHBANY, Abdul Rnouf Controller of Market Weights and Measurements Ministry of Commerce Kabul
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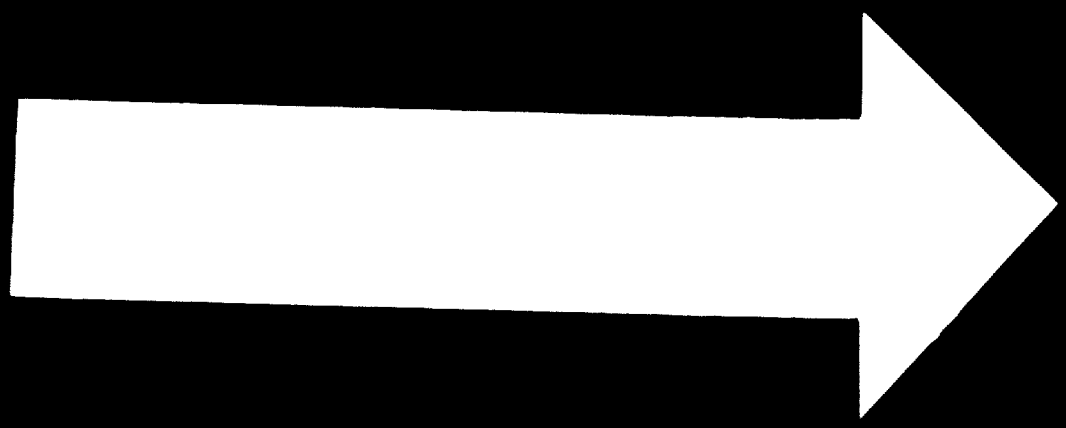

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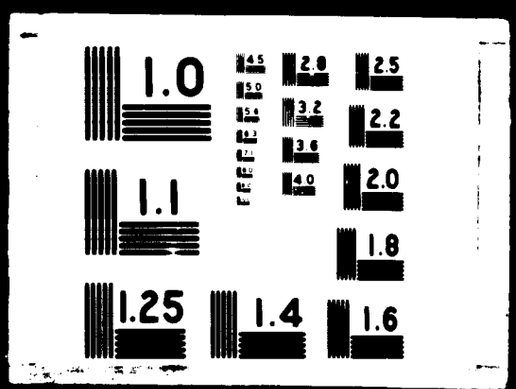

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VAN MALE, A. J.	President The International Committee of Legal Metrology 140 Eisenhowerlaan The Hague The Netherlands

OBSERVERS

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FEDERAL REPUBLIC OF GERMANY	SCHWEIDER, K. P. Physikalisch-Technische Bundesanstalt Bundesallee 100 33 Braunschweig (Head of Section for International Co-operation).

UNIDO STAFF MEMBER

PROKHOROV Y.	Director of the Workshop Industrial Institutions Section, ISI UNIDO - P. O. Box 707 A-1010 Vienna Austria

ANNEX IV

A G E N D A

1. Opening Addresses
2. Election of Officers
3. Adoption of the Agenda and the Work Programme
4. Role of Metrology in Industrial Development
5. Relationship between Quality Control, Standardization and Metrology
6. Concepts of Metrology Services
7. Legal Metrology and Control of Weights and Measures
8. Organization and Scope of Activities of National Metrology Services
9. National Standards (étalons) - Methods of Measuring
10. Measurement and Measuring Instruments, Calibration and Maintenance
11. Introduction and Application of Metric System and SI Units
12. Training in Metrology
13. Co-ordination and Co-operation at the Regional and International Levels
14. Discussion of the Report and Adoption of Recommendations.

ANNEX V

WORK PROGRAMME

Tuesday 12 October 1971

9.30 - 10.30	-	Registration, Administration and Financial Matters
10.30 - 11.00	-	Opening Addresses
11.00 - 11.30	-	Election of Officers
	-	Adoption of the Agenda and Work Programme
	-	Organisation of the Work
11.30 - 13.00	-	Item 4 - "Role of Metrology in Industrial Development"
	-	Statement by Mr. El Tawil, UNIDO expert/consultant
		Discussion paper ID/WG.98/4, page 1
	-	Discussion
15.00 - 18.00	-	Continuation of discussion on Item 4

Wednesday 13 October 1971

10.00 - 13.00	-	Item 5 - "Relationship between Quality Control, Standardisation and Metrology"
	-	Statement by Mr. Y. Okamoto, UNIDO expert/consultant
		Discussion paper ID/WG.98/5, page 1
	-	Discussion
15.00 - 18.00	-	Item 6 - "Concepts of Metrology Services"
	-	Statement by Mr. Y. Okamoto, UNIDO expert/consultant
		Discussion paper ID/WG.98/5, page 6
	-	Discussion

Thursday 14 October 1971

10.00 - 13.00	-	Item 7 - "Legal Metrology and Control of Weights and Measures"
	-	Statement by Mr. A. J. Van Male, UNIDO expert/consultant
		Discussion paper ID/WG.98/3, page 1
	-	Discussion
15.00 - 18.00	-	Item 8 - "Organisation and Scope of Activities of National Metrology Services"
	-	Statement by Mr. H. E. Barnett, UNIDO expert/consultant
		Discussion paper ID/WG.98/7, page 2
	-	Discussion

Friday 15 October 1971

10.00 - 13.00 - Study tour to Kyoto to industrial establishments

15.00 - 18.00 - Visit to the factory of SHIMADZU SEISAKUSHO Ltd.

Monday 18 October 1971

10.00 - 13.00 - Item 9 - "National Standards (étalons) - Methods of Measuring"

- Statement by Mr. T. Masui, UNIDO expert/consultant
  Discussion paper ID/WG.98/6, page 1
- Discussion

15.00 - 18.00 - Item 10 - "Measurement and Measuring Instruments Calibration and Maintenance"

- Statement by Mr. H. E. Barnett, UNIDO expert/consultant
  Discussion paper ID/WG.98/7, page 2
- Discussion

Tuesday 19 October 1971

10.00 - 13.00 - Item 11 - "Introduction and Application of Metric System and SI Units"

- Statement by Mr. T. Masui, UNIDO expert/consultant
  Discussion paper ID/WG.98/6, page 10

15.00 - 18.00 - Item 12 - "Training in Metrology"

- Statement by Mr. El Tawil, UNIDO expert/consultant
  Discussion paper ID/WG.98/4, page 9
- Discussion

Wednesday 20 October 1971

10.00 - 13.00 - Item 13 - "Co-ordination and Co-operation at the Regional and International Levels"

- Statement by Mr. A. J. Van-Male, UNIDO expert/consultant
  Discussion paper ID/WG.98/3, page 13
- Discussion

15.00 - 18.00 - Item 14 - Discussion of the Report and Adoption of the Recommendations.

Thursday 21 October 1971

Morning	-	Visit the Factory of Toyota Motor Co., Ltd.
Afternoon	-	Visit the Factory of Nippon Sharyo Seiso Kaisha Ltd.

Friday 22 October 1971

11.15 - 12.00	-	Flight to Tokyo
Afternoon	-	Free programme

Saturday 23 October 1971

Morning	-	Trip to the National Research Laboratory of Metrology (Tokyo)
Afternoon	-	Final Adoption of the Report and Recommendations
	-	Closing Addresses.

ANNEX VI

LIST OF DISCUSSION PAPERS PRESENTED AT THE WORKSHOP

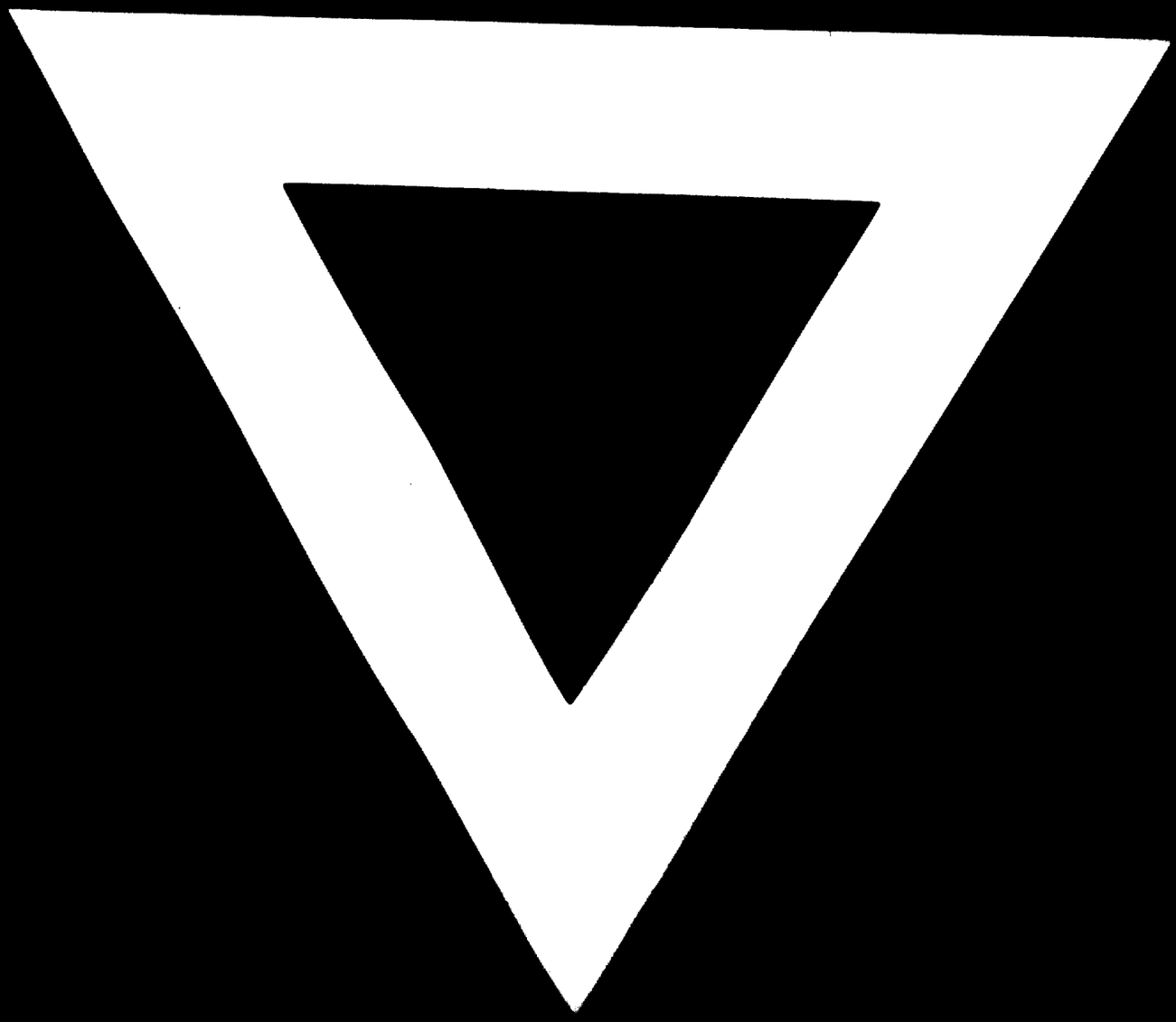
ID/WG.98/3 — Legal Metrology - International Co-operation in Metrology, by A. J. Van Male

ID/WG.98/4 — Role of Metrology in Industrial Development and Training in Metrology, by A. El-Tawil

ID/WG.98/5 — Relationship between Quality Control, Standardization and Metrology and Concepts of Metrology Services, by Y. Okamoto

ID/WG.98/6 — National Standards (étalons) - Methods of Measuring and Introduction and Application of Metric System and SI Units, by T. Masui

ID/WG.98/7 — The Organization and Scope of Activities of National Metrology Services and Measurements, Calibration and Maintenance, by H. E. Barnett.



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