NBSIR 75-769

Report on an NBS/AID/OAS Workshop on Standardization and Measurement Services in Industrializing Economies

Edited by:

H. Steffen Peiser
Robert S. Marvin
Michael McNeil
Joanne Mejeur

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

Held November 3 – 16, 1974

The Workshop was conducted as part of the program under the US/NBS/Agency for International Development PASA TA(CE) 5-71

Prepared for

Agency for International Development
Department of State
Washington, D. C. 20523

NBSIR 75-769

REPORT ON AN NBS/AID/OAS WORKSHOP ON STANDARDIZATION AND MEASUREMENT SERVICES IN INDUSTRIALIZING ECONOMIES

Edited by:

H. Steffen Peiser
Robert S. Marvin
Michael McNeil
Joanne Mejeur

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

Held November 3 – 16, 1974

The Workshop was conducted as part of the program under the US/NBS/Agency for International Development PASA TA(CE) 5-71

Prepared for
Agency for International Development
Department of State
Washington, D. C. 20523

U.S. DEPARTMENT OF COMMERCE, Rogers C.B. Morton, ***Secretary***
James A. Baker, III, ***Under Secretary***
Dr. Betsy Ancker-Johnson, ***Assistant Secretary for Science and Technology***

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

FOREWORD

The Staff of the Office of International Relations of the National Bureau of Standards desire to thank the Agency for International Development and the Organization of American States for making this Workshop possible, and to thank those persons at NBS and elsewhere who so freely gave of their time and knowledge to make it a success.

PARTICIPANTS

NBS/AID/OAS Workshop on
Standardization and Measurement
Services in Industrializing Economies

November 3 - 16, 1974

Left to Right:

Front row:

Mr. Roy Fung, Dr. Ronald T. Wijewantha, Mrs. Ofelia de Young
Mr. Jose Planas, Miss Zully Perdomo, Mr. K. A. Hussain,
Dr. Edward L. Brady (NBS), Mr. Vidalito F. Ranoa

Second row:

Mr. O. Donoso T., Dr. Zae-Quan Kim, Mr. Sumantri,
Mr. H. Steffen Peiser (NBS), Mr. Raul Estrada A.,
Mr. Romulo Ferreira, Dr. Samuel E. Chappell (NBS).

Rear group:

Mr. Ovan Julal, Mr. John R. Dise (NBS), Mr. Patricio Sierra H.,
Mr. Rodrigo Lopez A., Dr. Michael B. McNeil (NBS),
Dr. Zawdu Felleke, Mr. J. Mullins (Interpreter), Mr. Felix von Ranke
Mr. J. Frazier (Escort - Chauffeur), Mr. Antonio Rico L.,
Mr. Rafael Steinberg

TABLE OF CONTENTS

Page

INTRODUCTION

For several years the U.S. Agency for International Development and the National Bureau of Standards have had a cooperative program designed to facilitate the industrialization of various countries by helping them to develop a measurement and standards infrastructure. This program is handled by the Office of Science and Technology of AID and the Office of International Relations of NBS.

The program contains several elements, of which the most important are in-country surveys and workshops. The measurement surveys are designed to assess the state of standardization and measurement services in each country surveyed, and to identify needed additions or changes in such services. They are carried out by teams of experts both from NBS and from other countries facing similar problems. The workshops are held in the U.S.A., with visits to the NBS laboratories in Gaithersburg, Maryland, and Boulder, Colorado, and to other prominent standards and measurement services institutions both governmental and private. These visits and the presentations made during the workshops enable the participants to see how NBS meets its responsibilities and how it interacts with other governmental agencies and with various elements in the private sector. An additional major benefit has proved to be the exchange of experiences and solutions to various problems between participants from the various industrializing countries. Such exchanges were particularly productive during this Workshop, since many of the participants were from American nations with strong economic and cultural ties.

This report covers the fourth of these workshops, held November 2 - 15, 1974. It was co-sponsored by the Organization of American States, whose assistance made possible the attendance of a number of the participants from American nations, the inclusion of several papers by well-known authorities, and the simultaneous translation of presentations in English and Spanish. The names, affiliations, and addresses of the participants are given in Appendix 1.

Four distinct aspects of the national administration of standards were stressed during this Workshop:

a. Maintenance of national standards of measurement compatible with SI (the international system of units of measures) and transference of these standards to local institutions.

b. Field surveillance of weights and measures in the market place.

c. Procedures for the development of standards, including standards of safety, consumer protection, building codes, etc., as well as compatibility standards for such things as pipe threads.

d. Inspection and quality control of production (sampling, tolerances, control charts).

The presentations covered activities of NBS, of other federal and local governmental agencies, and of universities, research institutes, and private industry and commerce.

A full schedule of this Workshop is given in Appendix 3. The first week was spent principally at the NBS Gaithersburg laboratories, with several presentations by NBS staff members, plenary sessions with presentations by the Workshop participants, and special evening lectures by Dr. R. D. Huntoon, former Deputy Director of NBS, Professor Albert Waterston of the Department of Economics of American University, Mr. B. M. Gutterman of the Bureau of Foods of the U.S. Food and Drug Administration, and Mr. Herman Pollack, former Director of the Bureau of Scientific and Technological Affairs, Department of State. This first week's program also included a fine OAS-organized session on Latin American standardization activities, a visit to the District of Columbia Division of Weights and Measures, and special presentations covering the activities of the National Technical Information Service, the U.S. Geological Survey, and the Scientific Apparatus Makers' Association.

The program for the second week included visits to several non-governmental organizations concerned with standards and measurements: the American Society for Testing and Materials, a calibration laboratory of the General Electric Company, Leeds and Northrup, Inc., the Massachusetts Institute of Technology, Arthur D. Little and Co., Midwest Universities Consortium in International Activities, Underwriters Laboratories, Illinois Institute of Technology Research Institute, and the Denver Research Institute. It also included a visit to the Forest Products Laboratory of the U.S. Department of Agriculture, and concluded with a visit to the NBS Boulder laboratories where it ended with a special plenary session on metrology in Latin America, on which occasion a plan for a Pan-American system of cooperation in metrology was drafted.

The Workshop gave the participants a rather detailed exposure to standards and measurement activities in the United States. It included considerable treatment of standards and measurement information as vehicles for international technology transfer. The plenary sessions, and lively discussions throughout, enabled each participant to discuss his own problems and hear of common problems faced by his colleagues. Much of the discussion centered about the interplay between voluntary and compulsory standards, as well as between quasi governmental and private sector services, and the mixtures of these which have been adopted or are being considered in various countries.

This report includes texts of the special lectures, and of the presentations by the Workshop participants. It also includes, at the request of several participants, short summaries of some of the material presented by the various NBS representatives. The translations and editing, by the staff of OIR, have been approved by the authors.

COMPATIBILITY IN MEASUREMENT SYSTEMS

R. D. Huntoon
Consultant and Former Deputy Director
National Bureau of Standards

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies
National Bureau of Standards

November 4, 1974

It is quite natural for those nations which are seeking the advantages of a broader industrial-technological base to turn to those who already have established such a base and are seeking improvements in it, to ask "How did you do it?". This can be expected to elicit a response of the form, "Here is how we did it".

This answer allows the respondent to point, with a glow of pride, to the historical pattern of the development in his own country, and to indicate, by implication if not outright assertion, that duplication of this historical pattern will bring the developing nation to a similar position.

However, such an implication is likely to be both unwarranted and undesirable. Undesirable on the ground that the process is too slow and allows no leapfrogging over recognized errors, or past way stations which later knowledge shows can be readily by-passed. Unwarranted on the grounds that circumstances upon which a new development must be based may well be so different that an attempt to duplicate, say U.S. procedures, would be disastrous.

We hope that, in this NBS/AID/OAS Workshop on Standardization and Measurement Services in Industrializing Economies, the questions asked will be of the form "How can you help us to reach our goals of industrial development based upon your experience, the knowledge of world social realities, and our own unique social institutions?".

We, for our part, will undertake to avoid explanations of our historical development and try to provide to you information, learned from experience, in a form that you can intelligently apply to your own situations. Assuming agreement upon this approach, we can then turn attention to the subject matter of the Workshop - Standardization and Measurement Services.

1. Norms and Measurement

We begin with a clarification of terms. The English language uses the terms standards and standardization in a multiplicity of contexts.

Two of these will concern us. They are product standards and measurement standards.

Product standards, also called engineering standards, standard sizes, codes, specifications, performance standards, configuration standards, etc., relate to the measurable characteristics of things or substances. The French call them normes and Spanish speaking nations call them normas. I will call them normas.

Measurement standards are the physical realization of units of measure (or specified fraction or multiple thereof) in a measurement station, laboratory, region, state, nation or international laboratory as the case may be. I will refer to them as standards.

Normas represent an agreement by some sub-group of the society regarding the sizes or other physical characteristics of the product to which the norma applies. Products which when measured in accord with the agreement (or specification) yield results within the limits set by the norma, are said to "meet the standard", "meet-the-norma" or are "acceptable products".

It is important to note that the agreement is expressed quantitatively in terms of an accepted measurement language which must have sufficient sophistication to allow clear quantitative specification of an acceptable product.

Subsequently, the actual products as produced (or during production) are subjected to the measurement process to determine or verify that they do, in fact, meet the limits set in the specification. Those which do are accepted for consumption; and those which do not are rejected as unsuitable and are often called shrinkage.

We note and emphasize that measurement is involved both in the establishment of the norma prior to production and in the verification of product compliance with the norma. Thus, if advantage is to be taken of the many advantages of normas in an industrial economy, a national measurement system of adequate scope and sophistication becomes a prerequisite.

The essential nature of normas in an industrializing economy will be discussed extensively throughout the Workshop. We need not go into it here except to state the fundamental point that we find it difficult, if not impossible, to conceive of a satisfactory industrial structure that does not depend upon a functioning and well-developed set of normas. From this it follows that a viable, properly sophisticated measurement system is <u>necessary</u> but not sufficient for the required set of normas and thus for a satisfactory industrialization.

While a measurement system confers other benefits in addition, we consider this relationship to normas to be important enough to warrant careful attention to the measurement system in this Workshop. In the discussion which follows, we will concern ourselves with a measurement system in broad perspective, using normas only as necessary for illustrative examples. This is not intended in any way to indicate any lack of concern for the importance of normas, but rather to leave the discussion of them to others while we give attention to the fundamental measurement system upon which the normas must be based.

Any attempt to describe or discuss a system as complex as a measurement system for an industrialized nation must be considered to be but one picture among many, many possible ones. So it is here. Just as it happens in taking a photograph of a complex subject, the placing of the illumination will highlight certain aspects and leave other possibly equally important facets in the shadow. By studying many such photographs one develops an understanding of the subject based upon an integration of all that he has seen.

All of you here tonight have had various looks at measurement systems, some more than others. Each of you has his own mental picture of one. Perhaps you didn't think of it as a national system, or part of an international system. No matter, just so long as you have been thinking and observing enough to have a picture of your own.

This discussion will present another one, mine, as I saw it last week in preparation for this discussion. I will use, as my device for illumination in this discussion, an examination of the role of compatibility in a measurement system. The term compatibility may be a new one to some of you in this context. It is not a generally accepted term much as I wish it were. Its meaning in this context, will become clear as the discussion proceeds. It will not be precisely defined, just allowed to develop as needed. It will illuminate some important aspects of a measurement system in a unique way and will serve its purpose if it brings to you some aha's as you think about it in terms of your country's own system and needs.

By aha's I mean that, at one or more points during the presentation, you suddenly perceive some insight which causes you to say, "Aha, now I understand this aspect which I had not understood before".

2. Function of a National Measurement System

We will consider every instrumented place in the nation capable of making a physical* measurement, and actively engaged in doing so, to

---

* By the term physical measurement we include mechanical measurements, chemical measurements, electrical measurements etc. In fact, any kind of quantitative measurement which can be done by any physical mean as differentiated from emotional, phychological or subjective means.

be a (or station, for short). The total structure of all these stations with their myriad interfaces and with the supporting structure of soft-ware (Measurement Infrastructure, MIS) to insure its functioning, we will call the National Measurement System (NMS).

If two stations, anywhere in the NMS, are given identical measurands* to measure, and if the results of their measurements consistently agree within acceptable statistical uncertainties, the two stations are said to be compatible for that measurement within appropriate limits of magnitude. If they agree, within statistical uncertainties on all measurements they undertake to make, they are compatible. Note--nothing has been said about either station getting the "right answer", whatever that may mean, nor has anything been said about their accuracy. Since the stations are assumed to be separated spatially, we can say that they are compatible across space.

If the stations can also achieve compatible measurements at different times, we can say they have compatibility across time, i.e., they are in stable control (or both identically out of control). Without compatibility across time, the NMS rapidly approaches chaos, and any particular station which cannot achieve compatibility over time cannot be considered a qualified element of the system. It must be considered an outcast. We lump compatibility across space and across time into the one term compatibility, remembering that, without compatibility across space, the station is not even started on a career of usefulness, and without compatibility across time, it is not headed anywhere and its course cannot be trusted.

We can thus say that the function of the NMS (including its MIS) is to bring appropriate compatibility to every station in the system at uncertainty levels adequate for its (the station's) function. For completeness, the system must then provide acceptable definitions for the units of measure to be used throughout the system and means for determining and expressing accuracy in terms of them.

This leads naturally to the plan of examination which follows. We look first at the achievement of a compatibility-coupled system and then see how nationally accepted units of measure can be incorporated, along with statements relating to accuracy of measurement.

---

* The measurand is the physical entity submitting to the process of measurement. When we measure the length of a table the physical quality being measured is length, the unit of length is the meter (a foot) the table is the measurand.

3. Measurement Station

We represent a measurement station in the act of making a measurement schematically as shown in Figure 1. Three blocks are shown: (a) the measurand or artifact to be measured, (b) instrumentation and software in the form of a comparator, and (c) the station standard or local realization of the unit of measure. Not shown is the station operator who uses the station resources, a, b, and c in a process whose product is a measurement. This station process is indicated in Table 1.

Table 1

Station Process

Specify Measurand

Declaration

- Quantity
- Unit
- Replications

Act of Measurement

- Coupling
- Unit realization
- Comparison
- Recording

Replication

Result (Product)

- Measurement
  - Magnitude
  - Uncertainty

Referring to the Table we see that the process begins with a specification or identification of the measurand. Failure to specify the measurand clearly and unambiguously before the measurement is undertaken can lead to irrevocable error. This is often overlooked as obvious, yet in some cases the specification of the measurand is more difficult than making the measurement.* Certainly it must be unambiguous, at the outset, just what is to be measured.

---

* Consider the measurement of the time for a falling body to pass two reference positions in space as done in the determination of "g". The problem is to define sharply the instant at which the body passes the reference point. Given this sharp definition of the interval of measurement of the interval (the measurand in this case) is relatively easy. Achievement of the sharp boundery of the interval is the difficult undertaking.

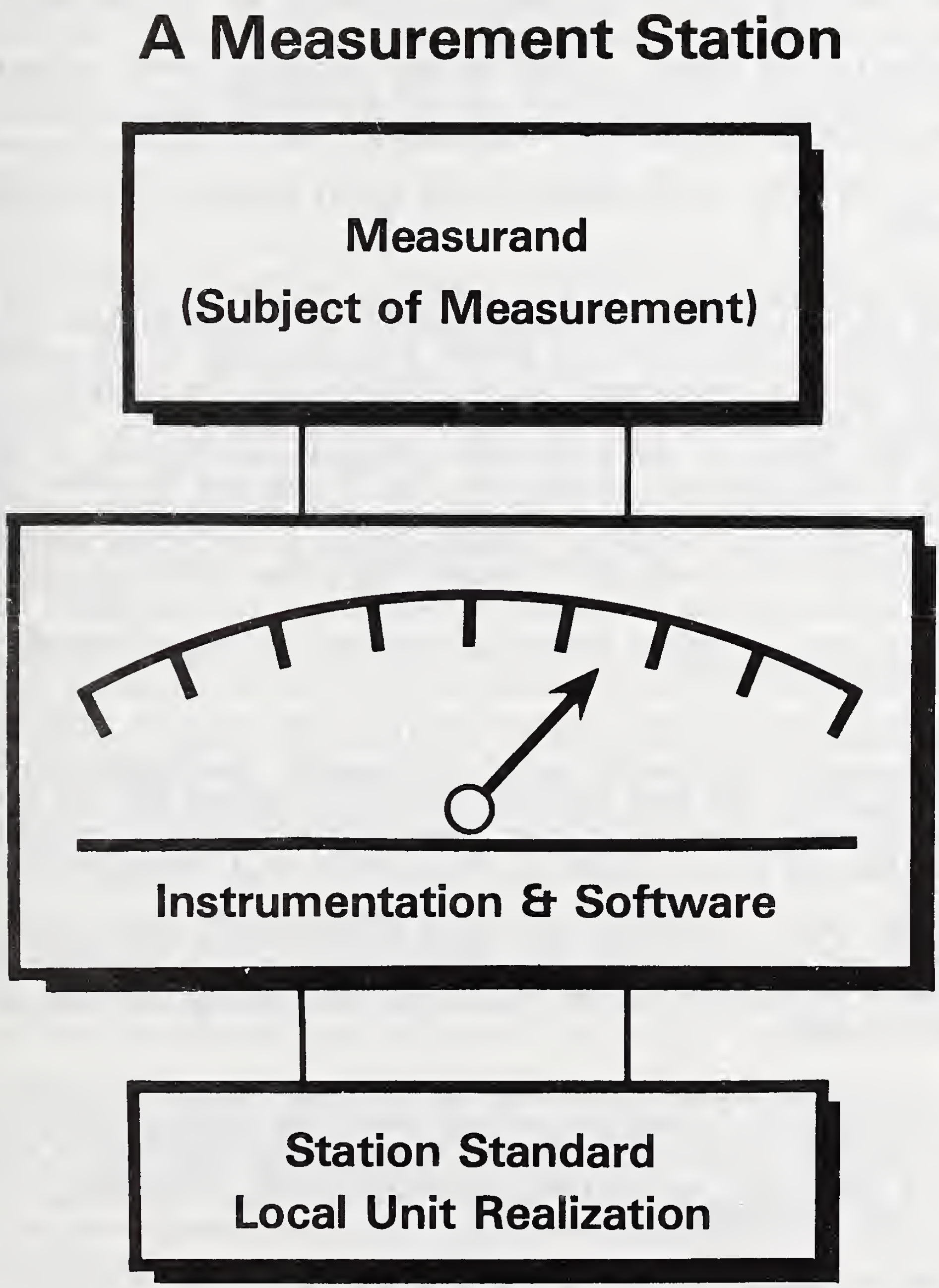

A Measurement Station
Measurand
(Subject of Measurement)
Instrumentation & Software
Station Standard
Local Unit Realization

Figure 1

Another initial requirement for proper measurement is a decision and declaration of: (1) what physical quantity is to be measured, (2) what unit will be used for expressing the result and (3) how many replications of the act of measurement will be made in arriving at it. Declaring the number of replications beforehand tends to avoid biases which creep in if the results of the measurement are allowed to influence the subsequent measurement process.

The next stage of the process, the act of measurement, includes four steps.

The first consists of making a proper coupling between the measurand and the instrumentation (comparator). It is crucial that this coupling be made in such a manner that the value of the measurand presented for measurement is not different in the presence of the equipment than it is in the absence of the equipment. Actually, of course, there is, and always will be, some difference. It is up to the station operator to see that this difference is either less than other uncertainties he is willing to tolerate, or predictable in magnitude. The integrity, competence and skill of the operator are crucial. If he arranges to measure something different than intended, all results become worthless, or even possibly disastrous. I am sure all of you can adduce experiences of your own where this miscoupling has caused trouble.

Next comes the realization of the local unit (local standard) or appropriate fraction (or multiple) thereof. For length measurements, for example, the gage block is the local standard and the feeler gage is the comparator. In another case, thread turns on a micrometer realize the unit, a sense of touch serves as a comparator.

By one means or another, the local standard will permit realization of the local unit for each measurement; and clearly the measurement result will be determined by the unit <u>as realized for that measurement</u>.

The function of the comparator is to permit comparison between unit (or fraction) as realized and the measurand as presented. By adjustment or by scale reading, it allows the operator to decide that x of his units, as realized, are equal to the measurand as presented to the comparator.

Upon completion of this comparison the result can be recorded as "measurand is x units". Replication of the process: (1) coupling, (2) unit realization, (3) comparison, and (4) recording, as many times as originally indicated completes the specified act of measurement.

The product of this process (measurement result) is called a measurement. The individual acts of measurement are never exactly the same when replicated, indicating inherent limitations in the process. Customarily the individual results are averaged for the replications to give one number for the measurement, i.e., the Result.

In addition, it is customary for the operator to assign an uncertainty to his measurement in the form of one or several probability statements indicating the acknowledged likelihood of differences between his result, as stated, and some type of real or correct result that would truly characterize the measure if all aspects of the measurement process were perfect. This assignment of uncertainty is based fundamentally upon the skill and integrity of the operator but also upon a chain of other factors over which he has no immediate control. The remainder of this discussion will be concerned with this chain of factors contributing to the station uncertainty. We will not give much further attention to the definitive part played by the operator. We will assume mostly that the operator has the necessary skills, experience, intelligence, and integrity to operate his station process. If the operator cannot be trusted, the remainder of the measurement system is of little value and there is no point in examining it further. We emphasize and pass on: Qualified operators are essential.

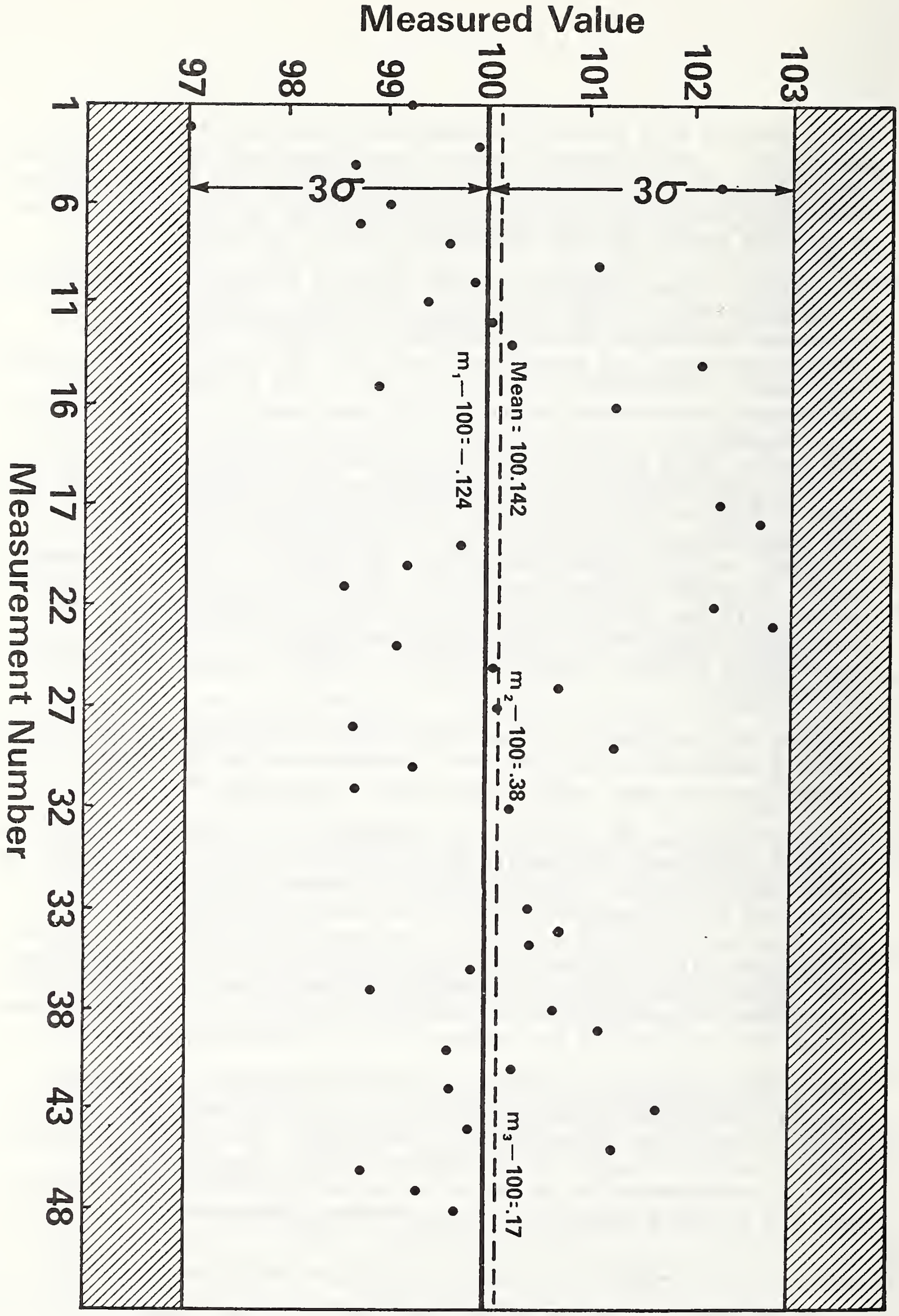
Assuming the existence of a qualified operator for the station, we now turn our attention to the products (measurements) of its process when applied over and over again to the same or identical measurands.

Figure 2 displays the results of a sequence of such measurements. The ordinate represents the results and the abscissa the time sequence in which they were made. These numbers were actually drawn from a randomized set of numbers in which the probability of occurrence of any given value follows a normal or Gaussian distribution, Figure 3, with a mean (m) of 100 and a standard deviation (σ) of 1.* We know that of the total population from which these numbers were drawn 68% lie between 99 and 101, 95% lie between 98 and 102, and 99.7% between 97 and 103, with 100 as the average of the total population.

Both theory and experience tell us that most properly controlled physical measurements tend to approach a normal distribution as the number of replicate measurements is increased. So we can take Figure 2 as a realistic example of the results we might expect from a physical measurement for which we had already established the above mean and standard deviation by many previous measurements. Of course,

---

* "Short Table of Random Normal Deviates", the Rand Corporation, 1955



Measured Value
97
98
99
100
101
102
103
3σ
3σ
Mean: 100.142
m1−100:−.124
m2−100:.38
m3−100:.17
1
6
11
16
17
22
27
32
33
38
43
48
Measurement Number

Figure 2

this implies that the measurand was stable and the measurement process non-varying, i.e., that the process was "in control", about which more later.

We note that all 48 measurements plotted in Figure 2 fall within ± 3 of the population mean of 100. The mean of these 48 is 100.142, differing from 100 by close to one standard deviation of the mean ($\sigma/\sqrt{n}$) which, for 48 measurements, is 0.144. If we divide the total into three groups of 16 measurements each, we find that the means of these groups differ from 100 by -0.124, 0.38, and 0.17 respectively. The standard deviation of a mean of 16 measurements from the population of Figure 3 is 0.25, so all three of these values are within the range of 100 ± 0.50 within which we would expect 95% of such averages to fall.

Suppose we continue the sequence of measurements for which the strip shown in Figure 2 is a beginning. Suppose the next group of 16 results has a mean displaced 0.95 units from 100. The chance of this happening with measurements characteristic of the distribution in Figure 3 is less than one in 5000. We must conclude something has changed and the distribution of Figure 3 no longer represents the situation. Similarly, if another group of 16 show a much greater scatter so that ten percent or more of the points fall outside the 3σ band, or if the points appear to scatter about a line or curve deviating progressively away from the central mean line of 100, we must conclude that something is wrong and the distribution curve of Figure 3 is no longer representative, i.e., we are dealing with a new system with different mean and standard deviation. So long as the successive measurements behave in an orderly manner, staying within the $\pm 3\sigma$ band, and the deviations of the means stay within the band ± 3 $\sigma/\sqrt{n} = \pm 3\ /4$, we say the measurement process is under control. If the faults like those we mentioned above are present, we say the station is out of control.

If the measurement station is to serve a useful purpose, it must perform meaningful measurements on measurands other than the one stable one used to acquire the dispersion curve, Figure 3, characteristic of the station process. Suppose, first, we are given another measurand identical to the first, and suppose we make <u>one</u> measurement on it of the kind plotted in Figure 2; what can we say about this one measurement?

If we turn to Figure 3, we can, with the aid of it, make statements like 95% of the time the next measurement will fall within the band 100 ± 2 or 99.7% of the time it will fall between the limits 100 ± 3. We, of course, cannot state exactly where it will be before the measurement is made. Afterwards we know. Note that we use Figure 3 to make such statements of estimate. If the station is "in control", we can use Figure 3. If the station is "out of control", we cannot

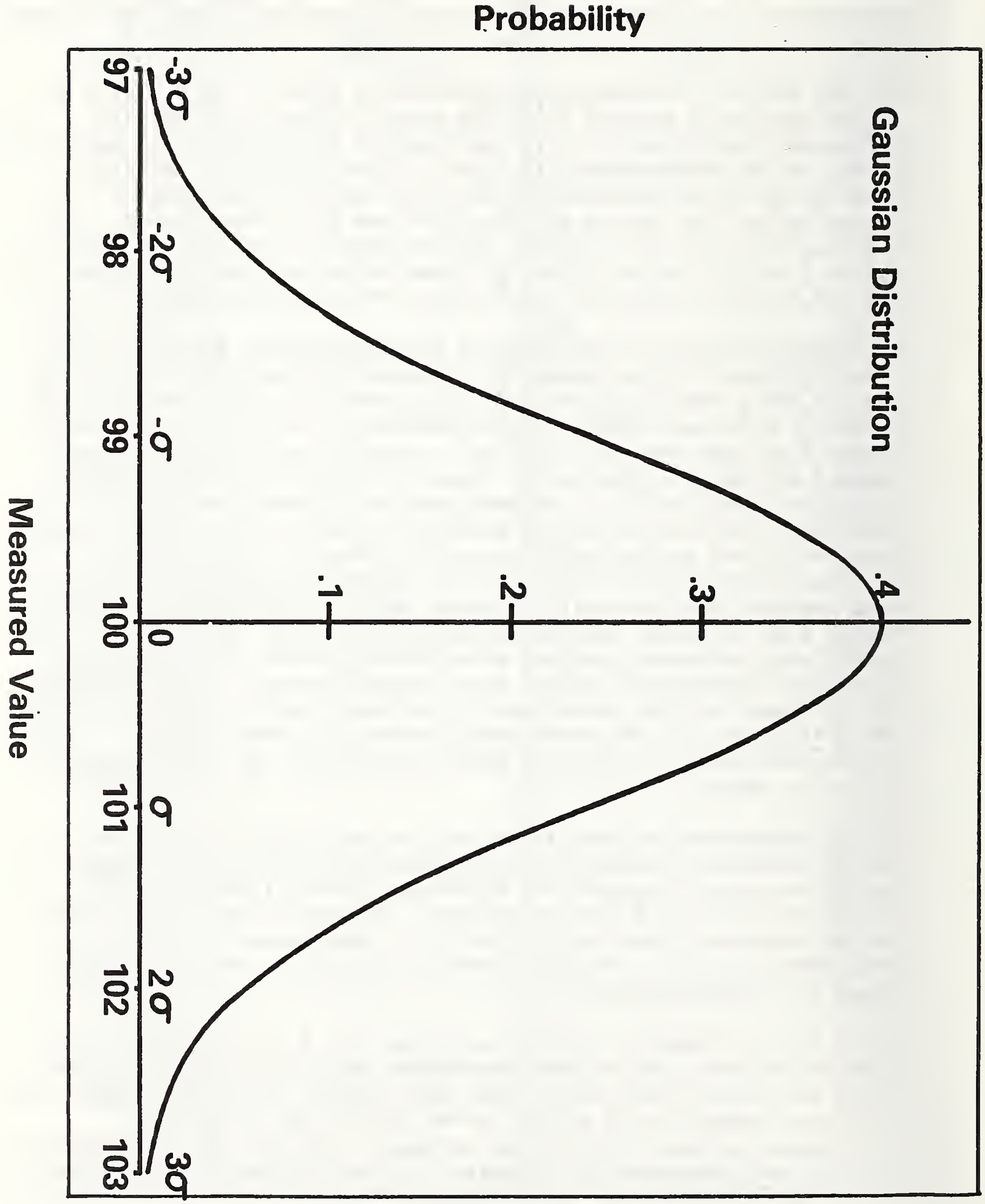

Probability
Gaussian Distribution
.1
.2
.3
.4
0
-3σ
-2σ
-σ
σ
2σ
3σ
97
98
99
100
101
102
103
Measured Value

Figure 3

make any very valid statements about the next measurements. Suppose all previous measurements showed the station to be in control. How do we know it was in control when this next measurement was made? Of course, we cannot know for sure. But if we make some additional measurements of the original measurand and find the station process is still in control, we feel "safe" about assuming a state of control for that measurement of the the new measurand. Of course, the operator might have misread it, or mishandled the equipment or "fudged" the result. If he did, we can make no valid statements. Thus, we see with abundant clarity why the station must be "in-control" and the operator both skilled and trustworthy, if we are to be able to make useful measurements with the station. For the remainder of this discussion, we will assume the station has its process in control and is being operated by a qualified operator. These are big assumptions but the whole argument rests upon the validity of making them.

Now suppose that the next measurand is not known to be identical to the stations control measurand. Suppose the additional measurement gives the value 101. What can we say about the magnitude of the unknown measurand?

If we assume control, we then can infer that extensive repetition of the measurement of the unknown would yield a dispersion curve like Figure 3 with a mean value we will call T.V. (true value). Our one measurement gives 101. Textbooks on the statistics of measurement show that T.V. will be within $\pm 3\sigma$ from 101 about 99% of the time and $\pm 2\sigma$ from 101 about 95% of the time. The most likely value is 101 but we don't know the true value. The best we can do is make statements like "the value of the new measurand is 101+2 with a confidence level of about 95%, or with an uncertainty of +2 at the 2σ level."

Repeating the measurement N times will reduce the uncertainty by $1/\sqrt{N}$, but this cannot be used to reduce the uncertainty indefinitely. In our example, values of N of 16, 20, 50, and 100 yield standard deviations of 0.25, 0.224, 0.141, and 0.1, a relatively small gain for the increased time and station stability required. It is seldom wise or efficient to use N greater than 20 in most physical measurements, and almost never effective to use N as large as 100.

We note for emphasis two things about this measurement of the unknown measurand. (1) We do give it a number which is likely not the T.V., and we know the band of uncertainty but not the exact magnitude. (2) This measurand, if marked 101 ± 2 although it, in fact, has an unknown T.V. of 102, will behave like a measurand of value 102 in all subsequent measurements. Yet we will consistently call its value 101. If this measurand is subsequently used to maintain control on another station, we introduce a systematic error of magnitude unknown to us but actually, in this assumed case, of value 102 - 101 = 1. Obviously, if the measurand were to be so used, we would undertake to reduce the uncertainty by basing our results on more measurements. This does reduce the uncertainty but does not alter the principle. An unknown systematic error follows the tagged measurand to be compounded into all other errors in any station it controls. This propagation of bias is an important characteristic of compatibility coupling.

We have observed that our measurement station, when in control, gives the value $100 \pm 2\sigma/\sqrt{n}$ its mean value for the measurement of its control measurand. If the measurand is a control standard marked at 100, we can then say that the station is in control and giving measurements accurate with respect to the control standard with uncertainties calculable from Figure 3.

If the control measurand has an unknown but stable value, then our station assigns the value 100 to it with uncertainties calculable from Figure 3 and accurate to such value in terms of the units of measure as realized by the equipment of our station. If we do not have a control measurand with tagged value, the measurements made by our station may or may not be of value outside our own station. So long as the measurements are used only in house, stability and control may be sufficient for our needs. But if our station is to measure parts and components to be used elsewhere in the society, or if it is to be used to make parts which must mate with others brought in from other manufacturers, we require that our measurements be compatible with measurements made in other stations. We now arrive at the important term compatibility which is the primary object of our discussion.

4. Compatibility

We define compatibility by the statement:

> If two stations get the same result within allowed statistical uncertainties when they measure the same or identical measurands at the same or different times, their measurements are compatible, to within a stated uncertainty.

Within this definition, the stations are compatible only for the physical quantities and at the magnitudes for which the compatibility has been verified. Thus, two stations can be compatible for, say, length measurements from 1 meter to 10 meters but not compatible for length measurements of a nanometer and not compatible for any range of time measurements. Statistical texts treat the matter.* Figure 4 illustrates the situation.

---

* cf. for example, An Introduction to Scientific Research, E.B. Wilson McGraw Hill, 1952, or NBS Special Publication 300 Volume 1, or NBS Handbook 91.

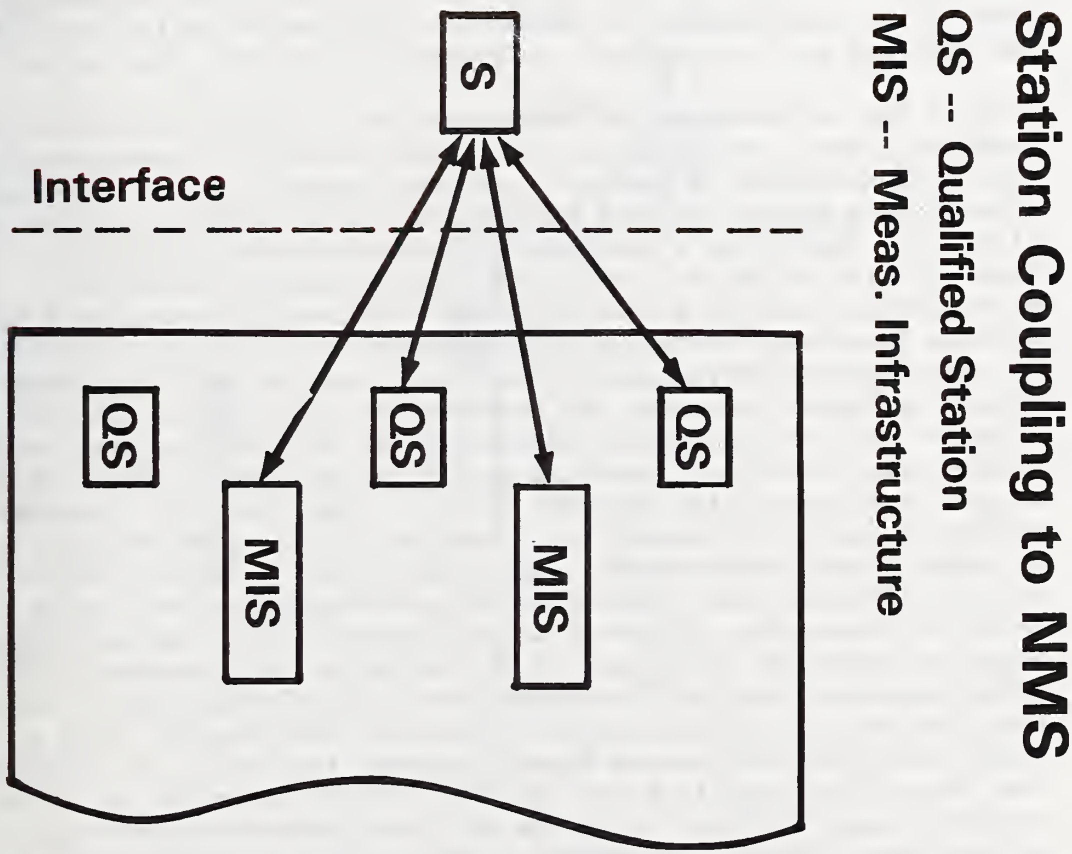

Station Coupling to NMS
QS -- Qualified Station
MIS -- Meas. Infrastructure
S
Interface
QS
MIS
QS
MIS
QS

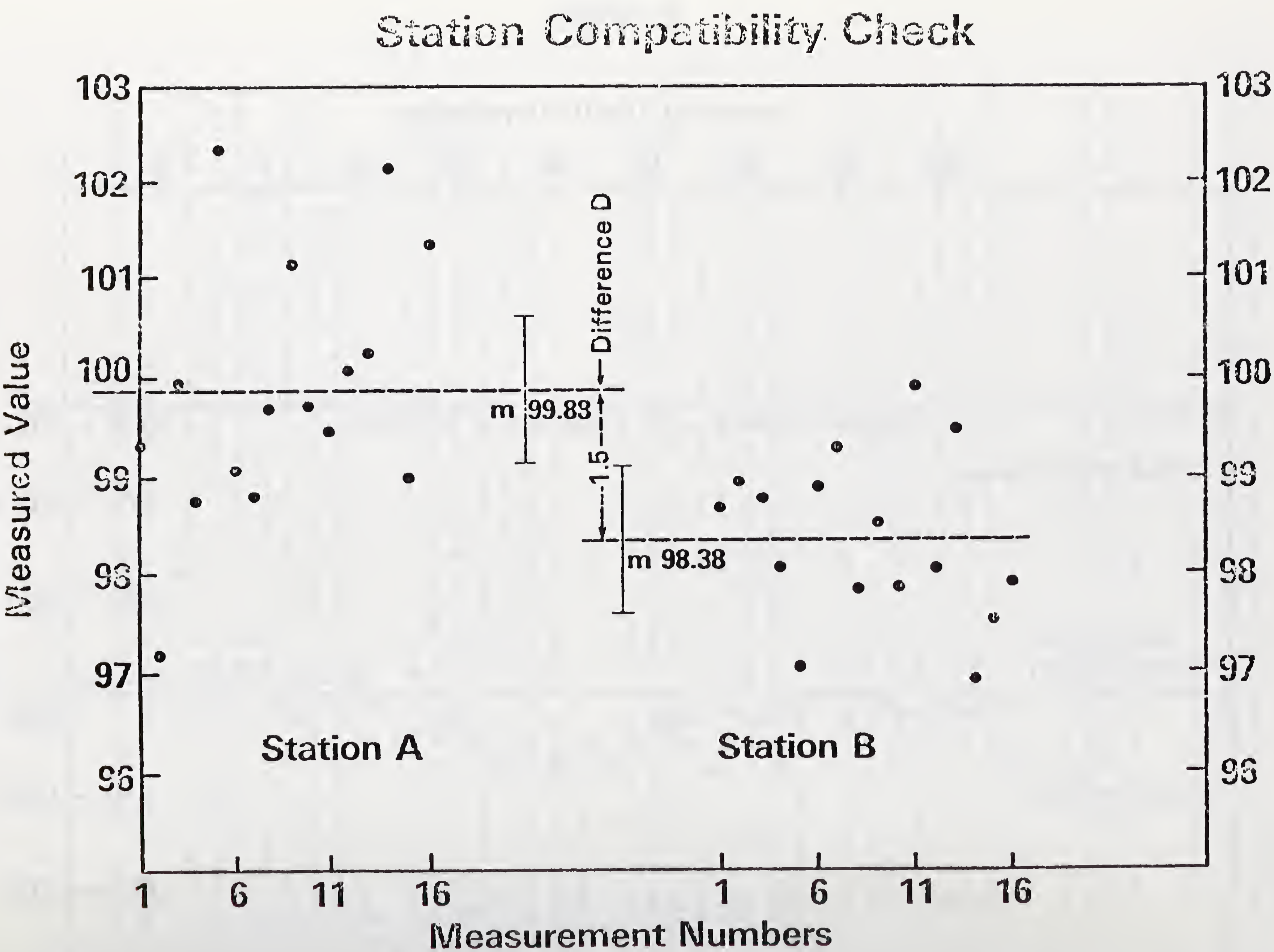
Figure 4

Station S, outside the interface which bounds the NMS, seeks to become a qualified station Q of the system by selecting a convenient qualified station within the system and establishing compatibility with it. The new station S draws upon the Measurement Infrastructure (MIS) for software and possibly hardware to develop methods and procedures for accomplishing the compatibility coupling to the rest of the network, thereby changing its label from S to Q , and moving inside the interface. The complete network of stations within the nation, linked compatibly, is called a compatibility coupled system. Within allowed limits, all stations within the system produce compatible measurements across the space spanned by the network, and across time also, if the stations remain in a state of measurement control.

Up to this point, we have explained what we mean by compatibility and some of the consequences of having it. But how do we in fact tell if two stations are compatible? We proceed to indicate one method.

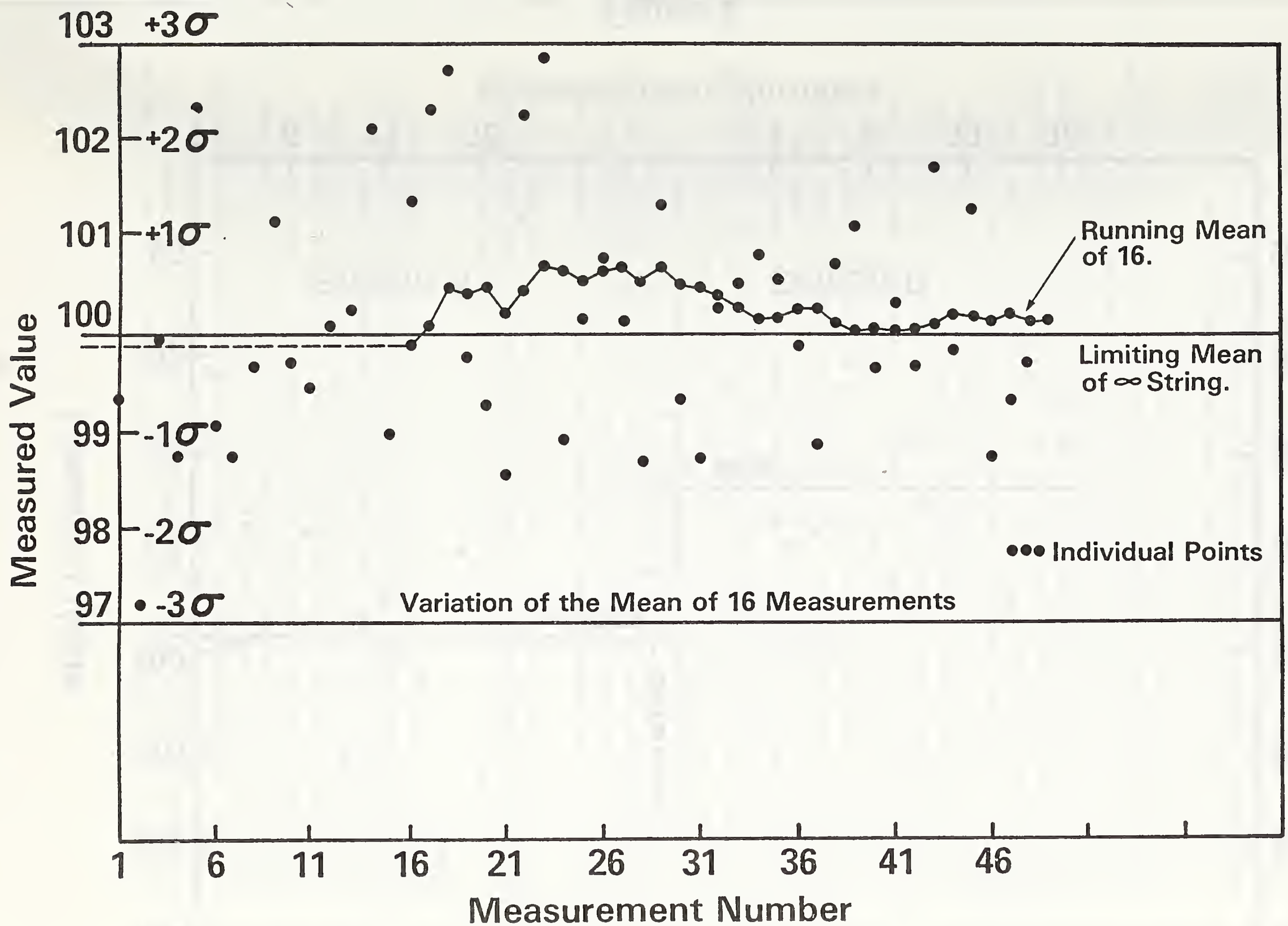
Suppose the two stations are designated as A and B, and suppose both stations, after demonstrating their state of control, measure an identical measurand to produce a sequence chart like the first part of Figure 2. A set of possible results for both stations are shown in Figure 5. Based upon a sequence of 16 measurements, A finds an average value of 99.88. Station B, with a similar scatter of measurements, obtains a mean value of 98.38, a difference of 1.5. By methods described in statistical textbooks, we assess the significance of this observed difference to find that there is only about one chance in 50,000 that the two stations are compatible. The two stations are not compatible, since they do not give the same results on the same measurand. Applying correction factors to the data of station A or B to bring the mean values m into line will make the results appear to be compatible. However, if the stations were each to repeat their measurements, each would obtain a new and almost always different mean. Repeating the adjustment of A or B data to bring the means into alignment would require a different adjustment. Figure 6 indicates the nature of the variation of the mean of 16 measurements by showing the running mean for 16 measurements starting with #16 and progressing to #48. Since the data for all figures were taken from tables of random normal deviates for m=100, σ= 1, we expect the data to fall within a band $\pm 3\ \sigma = \pm 3$ and the means of 16 to fall within a band $\pm 3\,\sigma/\sqrt{16} = \pm .75$. We see that the running mean stays within these limits. The vertical bars on each mean in Figure 5 shows this expected range of variation of the mean.

If the station compatibility check were made many times and the difference D computed for each comparison, the differences D could be plotted to give a frequency curve like that in Figure 3, with a standard deviation of $(\sqrt{2})(\sigma/\sqrt{n})=(\sqrt{2})(1/4)=.354$, and a 3σ band of



Station Compatibility Check
Measured Value
103
102
101
100
99
98
97
96
m 99.83
Difference D
1.5
m 98.38
Station A
Station B
1
6
11
16
Measurement Numbers

Figure 5



Measured Value
103 +3σ
102 +2σ
101 +1σ
100
99 -1σ
98 -2σ
97 -3σ
Running Mean of 16.
Limiting Mean of ∞ String.
Individual Points
Variation of the Mean of 16 Measurements
1
6
11
16
21
26
31
36
41
46
Measurement Number

Figure 6

+1.06. From such a distribution curve one could predict the relative chance of any single comparison being between any specified limits.

In general, of course, such extensive measurements upon which to base a compatibility statement are not realistic and feasible, so one has to be content with one or a few comparisons comparable with that shown in Figure 5. Since there is no knowledge which of the possible differences was actually obtained, the adjustment is made by making the two means coincide. (There are other more sophisticated means of processing this amount of data, described in the statistical textbooks, but this simpler examination will serve our purposes).

However, this adjustment of the means to give apparent compatibility introduces a fixed but unknown error into all subsequent measurements made by the station which adjusted its data or hardware. This fixed bias (commonly called systematic error) should be included in all statements about the compatibility of the two stations. The process of adjusting the data or hardware of a new station to make it compatible with an already qualified stations, we will call harmonization.

As far as stations A and B in Figure 5 are described, they are equal. The adjustment can be made by either or part by each. More typically the scatter sequence from one station, say A, is much narrower, i.e., smaller than for the other, and the wider one (B) does all the adjusting. This in effect makes A a master station and B a slave to it. Within statistical uncertainties, B's measurements will be compatible with A's and have incorporated into them all of the systematic or random errors inherent in all of A's measurements.*

This scheme of master-slave stations, characteristic of compatibility coupling, leads naturally to a hierarchical system structure. If, for example, A slaves to itself several stations, B_1, B_2, B_3,-------B_n, and each B station slaves to itself several C stations, C_1, C_2,-------C_n, then all stations, B, C, will be compatible with each other and with A. If B_1 and B_2 are not harmonized, either directly or via A, then the stations C which are slaves to B_1 will not be compatible with stations C which are slaves to B_2. Figure 7 illustrates this.

The left sets form compatible subsets and the right group forms a completely compatible set. It is important to note that the stations B and C are all slaves to A and all their measurements are no better than the realization of the unit of measure achieved by A. Master A

---

* We rule out mistaken readings and the like. They are truly important but not subject to prediction and relate to the skill and integrity of the operator.

COMPATIBALITY

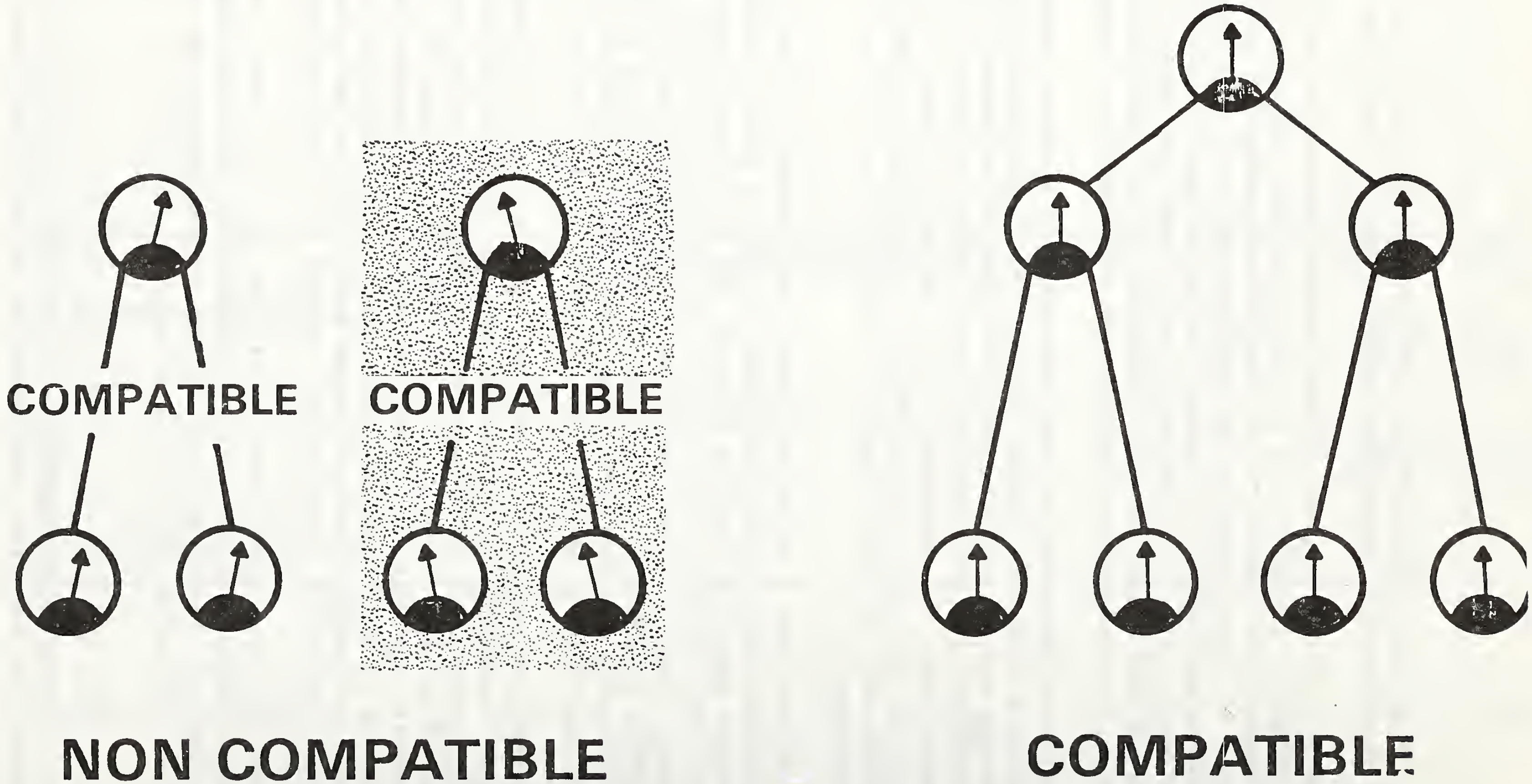


Figure 7.

is responsible for all the stations slave to it and A's hardware measurement standards become the standards for the group. This arrangement naturally forms a pyramidal structure characteristic of each physical quantity in our NMS. Figure 8 illustrates the pyramidal arrangement.

When the structure is extended to national scope the standards of the top station of the pyramid, which in fact realize the unit of measurement for the entire slave structure, become known as national prototype standards or national primary standards. The unit as realized by such standards in a national laboratory forms the de facto unit for the entire structure, whether or not it truly represents the accepted definition for the agreed upon unit of measure. Errors or uncertainties in the prototype become those of the entire structure. Since all the responsibility ultimately rests upon the top station, it becomes clear why so much care is given to the proper outfitting and nurturing of this station. We will see later that other aspects of the system provide checks and balances to prevent the top prototype from going far astray.

In a compatibility coupled system, the accuracy of measurements comes ultimately to mean accuracy in terms of the units as realized by the top master station and as represented by its standards. Establishment of a world structure with an IBPM in Sèvres, France, is an obvious extension.

The formalized picture of the pyramidal structure of a measurement system shown in Figure 8 should not be allowed to lead the reader astray. Modern measurement systems need not have so much of a pyramid. As we will see later, different schemes for harmonization exist, some of which make it possible to collapse portions of the pyramid two or three levels. The hierarchical structure of masters and slaves shown in Figure 8 tends to develop when the compativility coupling is built upon "passive calibration" as a predominant mode of harmonization. In earlier times, systems tended to develop this way. With more sophisticated understanding and wise choice of mode of harmonization, the pyramid can be greatly simplified and the accuracy requirements placed upon the top master station can be significantly eased. To see how this can be, we turn now to a more detailed examination of harmonization.

5. Harmonization

As we have seen, the essential idea of harmonization is to arrange for two stations to measure identical measurands, decide who is master and who is slave, and arrange corrective procedures to bring slave station measurements into line with master station measurements (with the aid of control charts). There are, of course, a number of mechanisms for

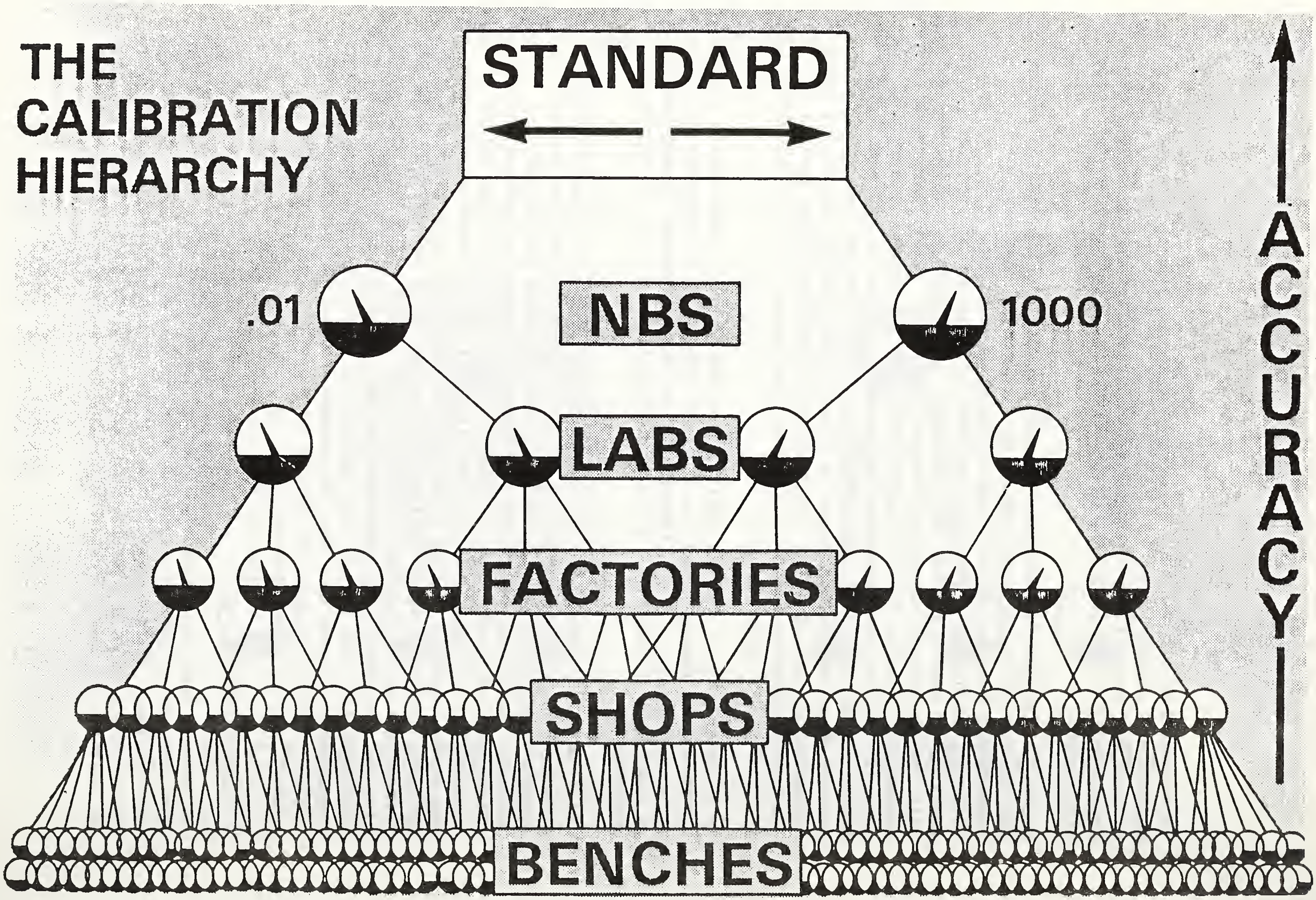

THE
CALIBRATION
HIERARCHY
STANDARD
.01
NBS
1000
LABS
FACTORIES
SHOPS
BENCHES
ACCURACY

Figure 6

accomplishing this. To see them first in perspective and relation, it is helpful to classify the different modes of harmonization. Table 2 shows this:

Table 2

Modes of Harmonization

I. Mutual
   A. Passive
      1. At Master
      2. At Slave

   B. Active
      1. Standard Reference Things
      2. Standard Reference Substances
      3. Standard Reference Data

II. Absolute - Self
      1. For Independent Reproductive Definitions
      2. Case of Prototype

We note first in Table 2 that, in addition to the mutual coming together for harmonization, there is one mode which involves only one station, i.e., the absolute or self mode. In this case the station turns to the definition of the unit of measure as accepted for the NMS and realizes it from fundamental laboratory measurements. This is, as you will immediately see, the mode whereby the top master station relates the whole compatibility-coupled structure to the defined unit. But such a mode is not only available to the top master, it is available to every slave station qualified willing to exploit it (provided the unit is defined in an independently reproducible way).

The more conventional mutual modes break into two categories, passive and active. In the passive case, commonly called calibration, the master station uses A and B instrumentation to arrive at correction factors or adjustments in B. In the active case, the entire slave station B, including operators, is involved. We turn now to a brief examination of each mode, bearing in mind that we make the implicit assumptions: (1) that every station involved is <u>in a state of control</u>, and (2) that all statements made carry the qualification <u>within allowed statistical uncertainties</u> where appropriate, so we need not belabor the repetition.

<u>Mutual Passive</u>

In this mode, the instrumentation of the two stations A and B are brought together at either station, i.e., At Master or At Slave, but under the control of Master station operators. The most common is At-Master, since the presumably higher quality more stable but less rugged equipment of A should not be shipped around. It will be assumed to be safer to ship B's equipment, since damage will affect B only and not cause problems for A's other B's.

At the comparison, the two sets of instrumentation can measure, possibly simultaneously or closely in sequence, the same but unknown measurand which need be stable only long enough to complete the comparison. This is done with A personnel usually. There results a correction curve or an adjustment of B's instrumentation to yield compatible measurements, assuming A is already compatible. B's equipment is returned to him with a tag or certificate or other means of indicating that A has calibrated his (B's) equipment with stated results as of date. This method, if A performs a professional quality job as expected, yields compatible slave equipment at station A as of the end of calibration.

When received at B, there is no guarantee, except a backlog of previous experience, that the returned equipment is in fact still compatible. Also there has been no demonstration that B operators know how to utilize the equipment to give compatible measurements like those obtained when A operators are using B's equipment. The fact that B is assumed to be in-control gives some important assurance, but does not remove the ever present threat of some systematic shift due to B's unique environment or operator bias. Still the method is used widely and quite successfully. Much of our NMS has grown up on this passive calibration basis of the at-A variety. As we will see, there is redundancy in the overall system to bring loss of compatibility to attention so that it does not go long unnoticed in most cases. For example, in the case of manufactured piece parts, those from a supplier whose stations are not compatible will not mate with other parts from suppliers whose measurements are compatible, and therefore, cannot be used and must be junked. This economic loss brings strong pressure to bear to keep all stations of the system currently compatible (and leads in the U.S. to military requirements for traceability).

An alternative passive mode arises when A calibrates a "transfer instrument" at A, carries it to B and calibrates B's equipment, then returns to A with it and recalibrates to make sure nothing changed during the trip. This is clearly an improvement as far as checking on equipment is concerned, but does not check out environmental shifts at B and leaves B operators unchecked.

As a variation, A can calibrate the transfer instrument, ship it to B, let B calibrate himself and return the instrument to A. A then recalibrates to check for changes during the trip. Now B operators are actively involved which is an improvement. However, when B gets actively involved, we move into the category of Mutual - Active. So we turn to it. Note before we leave, that the work involved at A for passive calibration limits the number of B stations which can be maintained effectively in a harmonized condition. This in turn leads to a multiplicity of levels (A, B, C, D-----) in the hierarchical structure, which can lead to fantastic station dispersion requirements on the top master station. We, of course, seek other procedures which do not lead to so many levels in the pyramid.

Mutual - Active

The fundamental principle behind this mode is to transfer measurands, not instruments. Measurands can come in many forms and can generally be much more transportation-stable as well as time-stable than instruments. Moreover, since the objective of a measurement station is to make compatible measurements, it seems wise to check it out on that basis. Thus, in principle, A measures some convenient measurand, tags it with the result, and sends it to B. Assuming the measurement made by A is valid, B's job is to measure the measurand again and adjust his procedures and equipment until he gets compatible results. Note that all of B is now involved in its normal process of measurement. If proper choices of calibration measurands have been made, B's actions will be much the same as for his usual measurements. He can measure the calibration measurand from time to time to check his state of control and even return it to A periodically to validate its stability in time. Note particularly that almost all of B's normal production operations are involved as they are when B is in normal productive operation. Thus, the actual compatibility of B for measurements is more clearly demonstrated. Traceability is established via the tagged measurands and their history in the system.

Also in typical cases, A can measure many calibration measurands on a production schedule and thereby monitor a much greater number of B stations than he could hope to do by the passive calibration scheme. The number of levels in the calibration hierarchy can thereby be reduced with attendant savings in the overall system and much reduced requirements on accuracy of the top master station measurements.

By working out mutual agreements on how to make adjustments, all the A stations, at one level of the hierarchy, can exchange calibration measurands to arrive at a mutually agreeable degree of compatibility without the establishment of another higher level master station in the hierarchy. This also brings important savings into the overall system and introduces welcome and effective redundancy as a check against error. Note that a flux of calibration measurands can be established on a temporary or semi-permanent basis as may be required to keep a myriad of cross-linked tie lines in operation to link the whole structure together. The power of the active harmonization mode is clearly impressive and it is not surprising that the measurement systems of the industrial nations show strong trends to ever increaing reliance upon the active harmonization mode. Developing nations should give careful consideration to the full exploitation of active harmonization in planning their own measurement systems. The organizational structure of the system should be made flexible enough to avoid rigid adherence to a pyramid of many levels and allow active harmonization to provide horizontal coupling wherever it is beneficial. Designation of laboratories as secondary or tertiary calibration stations tends to freeze in the pyramid and impede later moves to incorporate more flexibility.

The calibration measurands needed for the active mode can be classed into three main kinds: things, materials, and reference data. We pause for a brief look at each.

SRT - Standard Reference Things or Artifacts

We are all generally acquainted with some of these SRT. For example, standard masses, gage blocks, standard resistors, to name a few. The list continues to grow. Of course, gage blocks are long time members of the family. It has been found possible to make them in very stable form. They are simple to store and ship. At the master station, it is a relatively simple procedure to compare gage blocks with an almost identical master. Once the master has been carefully measured against the prototype, a large number of slave blocks can be easily monitored. The story is much the same for other physical quantities, varying in degree of ease of reproduction of the artifacts and comparison measurements. At NBS the extension of the active-mutual harmonization into other portions of the NMS is proceding under the name Measurement Assurance Program (MAP).

What has not yet been so commonly realized is that the artifacts upon which to base a harmonization can in fact be the very products themselves that a manufacturing plant is turning out. As a simple illustrative example, consider the case of a manufacturer which is making piston rings which are required to meet a certain norma. If this manufacturer is one of several already making such rings, he can, in principle, arrange with the other manufacturers to exchange rings which meet the specified measurements. He can then measure these exchange rings as a basis for monitoring the compatibility of his own measurement stations. Such a scheduled exchange can keep the whole group compatible provided:

(1) All the exchange items are clearly marked with their measured values and not just that they fall within the established normas.

(2) One, or preferably several, of the manufacturers maintain mutual-active harmonization with other stations of the NMS so that the whole group of ring manufacturers does not become a highly compatible subset of stations unharmonized with the rest of the system.

This intercomparison of products, even if not used to harmonize the stations, happens automatically in the market place to weed out any non-compatible manufacturers, and thereby introduces corrective measures to reestablish the harmonization. By this means, the market place in an industrial society introduces a beneficial redundancy to keep a running check on compatibility across space and time of its NMS.

SRM - Standard Reference Materials

Much of the NMS is involved in the measurement of the properties of materials to monitor their acceptability for manufacturing processes. For, just like things, substances must also meet a set of specifications or a norma to be acceptable for use. This norma is often referred to in the case of materials as a "characterization".

Here again it becomes convenient to select samples of an acceptable substance as artifacts for the harmonization of the measurement stations involved in the measurement of physical properties. Often one can also take advantage of a characteristic of substances, namely that subdivision does not alter the properties in question. A large amount of substance can be assessed for uniformity of relevant properties, measured carefully with respect to those properties, then cut up into convenient sample sizes and distributed widely as harmonization artifacts. The individual samples need not be measured. If the substance can be shown to be stable over time, in the properties measured, the samples become valuable harmonization devices. For example, fused quartz becomes a stable harmonization material for the measurement of dielectric constant, density, index of refraction, etc. Mixtures of oils have been used as viscosity standards, but they are not stable over long periods of time so fresh lots must be prepared and characterized periodically.

SRD - Standard Reference Data

Nature presents us with some universally available measurands, everywhere the same, and insofar as we can see, constant in time. These are the fundamental constants of nature such as c, h, k, m_e, m_p. Also nuclidic masses, atomic properties, molecular properties and some crystal properties form another class of generally available measurands which should present invariant* values to every measurement station. Some materials can be readily obtained from commercial

* but with characteristic uncertainties

sources or readily prepared by means of a state recipe so that the values for certain properties can be known with useful accuracy when prepared according to the recipe.

In these cases a single measurement station can measure the appropriate parameter or property and publish the results. Any new station can also measure these same properties, adjust its equipment to give results compatible with the published values, and achieve harmonization. Already qualified stations can make such measurements from time to time to check their continuing compatibility or assess their state of control. Nothing need be transferred between stations but published information. Each station acquires its own samples of physical matter and proceeds to make the necessary measurements.

Examples come immediately to mind. The speed of light in a vacuum, c, is probably the most measured constant of nature and is now known with an uncertainty of approximately 1 in 10^8 in terms of the basic units of length and time. The nuclear hyperfine transition frequency in ^{133}Cs forms the basis of the definition of the second. The optical transition frequencies of ^{86}Kr forms the definition of the length unit. Melting points of certain pure elements such as Hg, Sn, S, allow calibration of thermometers and the triple point of pure water establishes the temperature scale. In principle any station can become compatible by repeating the measurements. More importantly, repeated measurements in different stations widely scattered in space and time demonstrate that the whole system remains in a state of control and is not adrift from nature.

The published values of the best measurements for these classes of measurands form what is called standard reference data. SRD problems arise when examination of the literature shows non-compatible values for measurands which ought to be the same. A new station cannot harmonize to a multiple value (values outside normal statistical uncertainties). The existence of non-compatible values in the literature indicates one of the following:

(1) The stations involved are not compatible.

(2) The matter as prepared did not present the expected measurand, i.e., was not prepared as directed.

(3) The operators let their stations get out of control.

(4) There were mistakes in the measurement procedures.

The literature on properties of substances contains large numbers of conflicting results, i.e., non-compatible values. Experience with attempts to resolve the differences show:

(1) All 4 of the above difficulties have occurred.

(2) Two and four are most prevalent.

(3) The description of the measurement or the preparation of the material are not complete enough to allow the fault to be traced.

The National Standard Reference Data System was established in the United States in 1963 for the purpose of promoting the critical evaluation and dissemination of numerical data of the physical sciences. The program is coordinated by the Office of Standard Reference Data of the National Bureau of Standards but involves the efforts of many groups in universities, government laboratories, and private industry. This program is generating a growing number of benchmark data which can be used to provide harmonization within stated uncertainties if the substances are obtained in a certain way or characterized in the indicated manner, i.e., if the substance is properly characterized.

All of these Active-Mutual approaches to harmonization afford the possibility, in principle, of leapfrogging most of the hierarchical structure of the system, to couple a top echelon master station with a lowest echelon slave station. The implications of this for a newly developing system are important. If the system development moves toward extensive mutual-active coupling, the number of middle echelon stations diminishes accordingly, the overall system coupling has fewer links in the chain where errors can originate, and traceability is more direct and verifiable. Cost reductions may be significant in any particular case and should be studied.

Absolute or Self Harmonization

While the unit of measure to be agreed upon by the society using the measurement system is completely arbitrary for each physical quantity to be measured, the available arbitrariness is exploited in different ways in different parts of the system.

One guiding constraint in a modern NMS is that there should be only one unit for each quantity. This is not completely realized in practice. The English Customary System shows many lapses (even having the same name for different units). In length alone there are meter, feet, yards, miles, nautical miles, to name a few. The SI system does pretty well in this regard but some practical traditional problems have prevented complete compliance with the one unit per quantity constraint. In energy units, for example, the joule is the major unit but the electron-volt is so widely used in many areas of science that it is still permitted, as is the kilowatt hour.

Returning to the disposition made of the arbitrariness available in the selection of the unit for each physical quantity, we note that one historic mode has been the selection of an arbitrary sample or artifact as a measurand and declaring the value of it to be unity. This arbitrary measurand may well be the unit as realized by the top station in the master-slave hierarchy, i.e., the prototype standard already mentioned. However, since the stability of the system (compatibility over time) is so fundamentally important, there has been, since earliest times, an undertaking to relate the unit in some reproducible way with some characteristic invariant parameter of nature. Examples, which are well-known of course, were the cubit (length of Pharaoh's forearm), the inch (4 barley corns in a row), the rood (10 good men heel to toe), the second (1/86400 part of the average rotational period of the earth), the metre (10^7 earth quadrant), the kilogram (mass of a cubic decimeter of water at maximum density), Centigrade degree (1/100 of the temperature difference between ice point and steam point), and so on.

The essential point to note here is that we seek to use up the arbitrariness in the selection of a unit by construction of a recipe which, when applied to the physical world, will yield a unit of measure. Today we seek recipes which are of general validity so that any laboratory can, in principle at least, duplicate the determination by following the established recipe, and thus realize the accepted unit all on its own. Stations which are capable of realizing the unit directly from the recipe will, if no mistakes are made, find their measurements to be compatible with the others who have done likewise (all within statistical uncertainties, of course). The recipe definition of a unit provides what we call an independently reproducible unit, for any laboratory can realize its own unit independently of any other laboratory.

Any station which realizes its unit from the recipe can be considered to have accomplished absolute (or self) harmonization. However, only in the case of the independently reproducible unit can self-harmonization be undertaken. Clearly if an arbitrary sample is declared to be the unit, only mutual harmonization between stations will provide the compatibility coupling.

Because of the complexity, cost and requirements for special skills, absolute harmonization usually is done only in the top master stations of an NMS. However, there remains always the possibility that other stations may undertake it.

An interesting situation arises when several stations accomplish absolute harmonization and then seek to evaluate their compatibility via the mutual modes. They may learn that compatibility coupling via the mutual modes will lead to better agreement between stations than absolute harmonization will provide. Suppose the self realization achieved by one station is declared to be the system unit, and all other stations harmonize with it by mutual modes. The station-station uncertainty now will be much less than the station-station uncertainty when each is self harmonized. In those cases where compatibility coupling shows much less uncertainty than self harmonization they can be used to prepare a dispersion curve for the realization of the unit. This, of course, is the pattern which emerges when the National Master Stations intercompare their results at Sèvres (the International Bureau of Weights and Measures). The question immediately arises "Whose unit shall we select?" To avoid all manner of international political and status crises or international anarchy of measurement, a system has been been worked out for blending the results into one averaged out effective realized value, which all signatory nations agree to use. Correction factors are assigned to each National realization to make it compatible with the average-effective one. Each nation usually then proceeds to use its own realization for its own national unit applying the appropriate international correction factor, where necessary, for international trade.

When mutual harmonization artifacts such as SRT's, SRM's or information such as SRD move around in the worldwide system, apparent anomalies in compatibility arise unless proper precautions are taken to correct each nation's realized unit to the agreed upon international value.

The worldwide system and the national sub-systems emerge as compatibility coupled systems dependent upon mutual modes with prototype standards standing at the apex in each nation. The units as realized by the prototype standards are checked from time to time against the independently reproducible units to insure that the whole structure stays in control, within the uncertainties inherent in the "realization-by-recipe". Thus in feeding the compatibility chain downward into the system, the top master station often is required to state two kinds of uncertainties. The top station can tag its active-mode artifacts, substances or information to be disseminated with a statement of uncertainty with respect to the unit "as realized and maintained" by the top master station or "with respect to the independently reproducible unit as defined". The latter uncertainty is usually but not always larger than the first.

Whenever the compatibility achieved via the absolute mode can be shown to be less uncertain than the compatibility achieved via the mutual modes, the mutual comparisons can be dropped between master stations and used only at lower levels in the hierarchy, where cost becomes more crucial or more uncertainty can be tolerated.

Among the important measurement quantities of the SI system, only one, mass, does not have an independently reproducible definition for the unit. All others have it. This is because no recipe has been invented which will yield a realization of the unit with an uncertainty that, as yet, comes close to that for the compatibility coupling from the prototype standard artifact, the Master Kilogram of Sèvres. Compatibility of kg measurements approaches 5 parts in 10^9. Until very recently the best recipes for a kg would lead to uncertainties in realization of about 25 parts in 10^6. A recent breakthrough described in the October, 1974, issue of Dimensions NBS (Superintendent of Documents, Catalogue #C13:13:58/10) would reduce this to 1 in 10^6 with hopes of further refinement to 1 in 10^8. Thus the kg may soon cease to be the last hold out.

Interestingly, the realm of mass measurements presents an example of the advantages to be gained by allowing another unit to be defined and used. Those who measure atomic masses have found it helpful to define an Atomic Mass Unit to be 1/12 the mass of the ^{12}C nuclide. All other nuclidic masses can be measured in terms of this AMU with uncertainty of approximately 1 in 10^8 in their compatibility. Today Mutual Harmonization modes provide compatibility with relation to the kg having an uncertainty of roughly 25 parts in 10^6.

In this instance, nature presents to every laboratory identical measurands of great stability to serve as the top-master standard for all collaborating laboratories. This, of course, is not the sole case. Nuclear cross-sections afford another, and there are others. The ^{12}C case illustrates the point nicely. In this case the harmonization chain shows weak links in the chain between 10^{-26}kg and 1 kg. Removing them is a challenge for the future.

We have seen that it is essential for a measurement system to have system-wide units of measure and that the size of the unit can be arbitrary so long as there is agreement on one unit for each quantity, and some allowance for the inclusion of special but related units when practical considerations of compatibility require them. We have seen also that mutual harmonization leads directly to a pyramidal structure with the unit, as realized from the prototype standards of the top-master station, in control of the whole sub-structure for that unit. This leads naturally to the agreed upon unit being the one as realized by the top master station. How then is the unit selected, by or for the top master station?

The first consideration is that the unit should have a magnitude, convenient for everyday measurements, such that the uncertainties associated with the measurement process will be least. This still leaves a wide range for selection in most cases. Thus the top station could pick some convenient, stable, readily measurable measurand and declare it to be the unit. In the absence of actual faulty measurement, the results of the top station are correct by definition (with due regard for allowed statistical uncertainties). In this case we pick the standard and define it to be the unit (kg for example).

Yet we have also seen that the desire to relate the measurement units to constants of nature, and a fear that the system might otherwise be "adrift in time" lead to the definition of the unit first in relation to natural parameters (geometry of the earth, or solar system periods of the planets, atomic constants, atomic wave lengths, nuclear properties and the like) followed by a prescribed set of laboratory measurements to realize the standard from the defined unit. This is done despite the additional uncertainties introduced as a consequence of the conceptual unit-to-standard step.

An additional advantage of the unit-standard approach, not heretofore mentioned in spite of its great importance, is that it permits the establishment of what we call coherent units. These coherent units greatly improve the utility of the whole measuring system in the development of science and engineering and thus, the advance of technology. We turn now for a brief look at coherent units.

6. Coherent Units

Suppose, just for the sake of argument, that we have a complete compatibility coupled system with arbitrary chosen units, one for each quantity, and the requisite prototype standards for the top master stations. Suppose further, in this hypothetical system, some of the units are as shown in Table 3.

Table 3

Quantity	Unit	Definition*	Symbol
Time	Second	Usual	T
Length	Yard	.9144 m	L
Mass	Pound	453.6 g	M
Acceleration	Yank	500 cm/s^2	A
Speed	Knot	1.85325 km/kr	S
Force	Push	The force of gravity exerted on 10 $in.^3$ of water where $g=9.8 m/s^2$	F

*Definition given in terms of conventional units as a means to illustrate the point of the table.

If we undertake to investigate nature, with this measurement system as both tool and language, we will find:

(1) A relationship between distance, time, and speed which we can write

$$L=k_1ST \qquad (1)$$

which expresses the observations that distance (in yards) is proportionate to speed (in knots) and time (in seconds). More careful investigation shows that k_1 has the value k_1=xxxx and the equation can be written

$$L=xxxxST=.563ST$$

where xxxx is a number to be determined by measurement and can be considered a physical constant of nature which should remain constant if our measurement stations are in control. Estimated experimental value is the number shown.

(2) A relationship between speed, acceleration, and time which we can write

$$S=k_2AT \qquad (2)$$

which expresses the obervations that speed is in proportion to the acceleration and the time the acceleration continues. Again with more care we can observe in terms of the units of our measurement system

$$S=yyyyAT=9.7126AT \qquad (3)$$

where yyyy is another constant of nature similar to xxxxx and a number to be measured and recorded. The estimated value is also shown.

(3) A relation between force, mass, and acceleration, i.e., Newton's law, which in terms of our units we can write

$$F=k_3MA=zzzzMA=1.4123MA \qquad (3)$$

and k_3 =zzzz, another physical constant to be measured and recorded.

By now we begin to see that our developing science will have a new physical constant for every new physical quantity included in our structure, and that the magnitude of this constant will depend both upon nature and upon the unit arbitrarily chosen for the new physical quantity. Referring to equation (1), we observe that selection of the unit of speed to be just that speed which traverses unit distance in unit time would change the xxxx to exactly 1, and the new equation (1) would become

$$L=ST \qquad (1a)$$

with no more constant k_1. The number xxxx has, by some magic, become exact and no longer a natural constant to be measured and remembered. What has happened? Looking back at what we have just said we note that we have used the arbitrariness available to us in selecting the unit of speed to make an independently reproducible recipe for a unit of speed (yards per second). The experimental measurements which were needed to determine the constant xxxx are now needed to realize the unit of speed and the physical standard representing it. The equation L=ST has become exact but the unit of speed now has uncertainties based upon the uncertainties in doing the realization experiments.

The speed unit thus defined in terms of L and T units is called a derived unit derived from L and T units) and a [coherent unit of speed, coherent with equation (1a).]

Similar arguments can be used to derive a coherent unit of acceleration (yard/s^2) and of force (pound yard/s^2) which makes equations (2) and (3) exact, and provide independently reproducible units for A and F. The principle can be extended to cover additional units for additional physical quantities as they are added to the system.

Reexamination of equation (1) shows that we could equally well have adjusted the unit of length or of time instead of S to make the equation exact. We could keep the arbitrary units for any two of the quantities and use the equation to obtain the definition for the coherent unit for the third. When we have completed the definitions possible with equations (1), (2) and (3), we find we have fixed 3 coherent units and have 3 arbitrary ones left. The question naturally arises "How far can we go this way?" The answer seems to be that we can define coherent units for all but 4 quantities. At least it has been possible to do so with the quantities now in our system. We can let any 4 of them have arbitrary units and derive coherent units for all the rest. Historically and for practical reasons the system has developed around the set of coherent units which follows when $MLT\Theta$ are left arbitrary. Θ is temperature.

In this scheme, then, we have a set of exact equations, we have eliminated the constants to remember, and we have arrived at a complete set of independently reproducible recipes for realizing the set of coherent units required. The price? All the uncertainties of measurement reside in the realization of the coherent units instead of in a set of measurement constants. Once understood, there seems to be general agreement that the convenience of having coherent units is worth it.

Figure 9 shows pictorially the utilization of the three equations to derive coherent units of S, A, F. Extension of the picture to cover more of the quantities in our system leads to a structure which could be called the genealogy of a measurement system. Figure 10 shows how it looks.

Our English system of measurement is clearly not a coherent system nor does it have just one unit for each quantity. Any student of engineering will attest to the confusing complications which arise. Even those who deal only in the commercial market place find difficulties among the mix of units. The new SI system undertakes to allow but one unit for each quantity and works with decimal multiples or sub-multiples to give convenient handles for other sizes. The

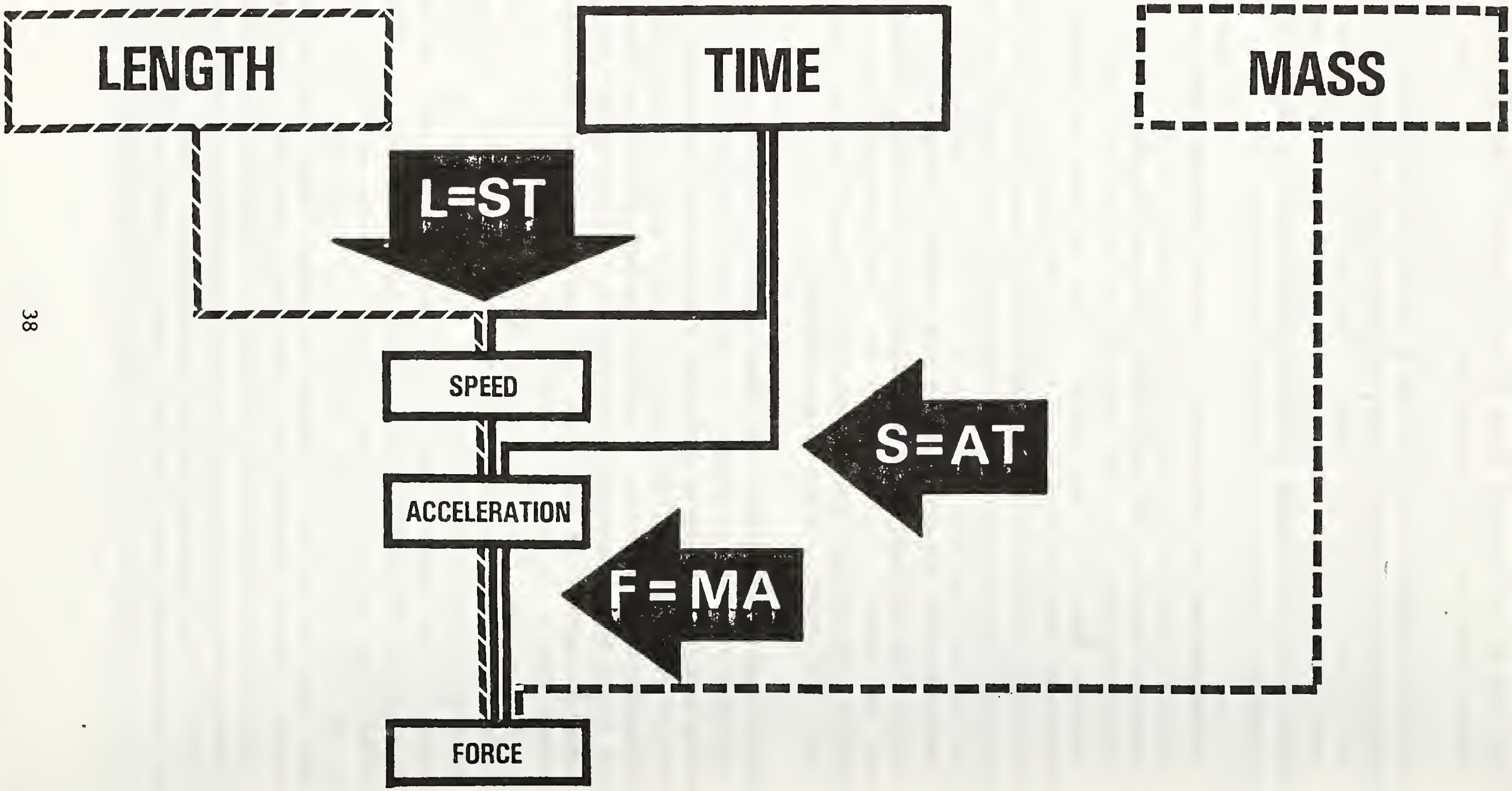


Figure 9

Figure 12

GENEALOGY OF A MEASURING SYSTEM

(RELATIONSHIPS SHOWN ARE TYPICAL, MANY IMPORTANT QUANTITIES SUCH AS ANGLE, INDUCTANCE, CAPACITY, VISCOSITY, ETC., ARE OMITTED TO KEEP CHART SIMPLE)

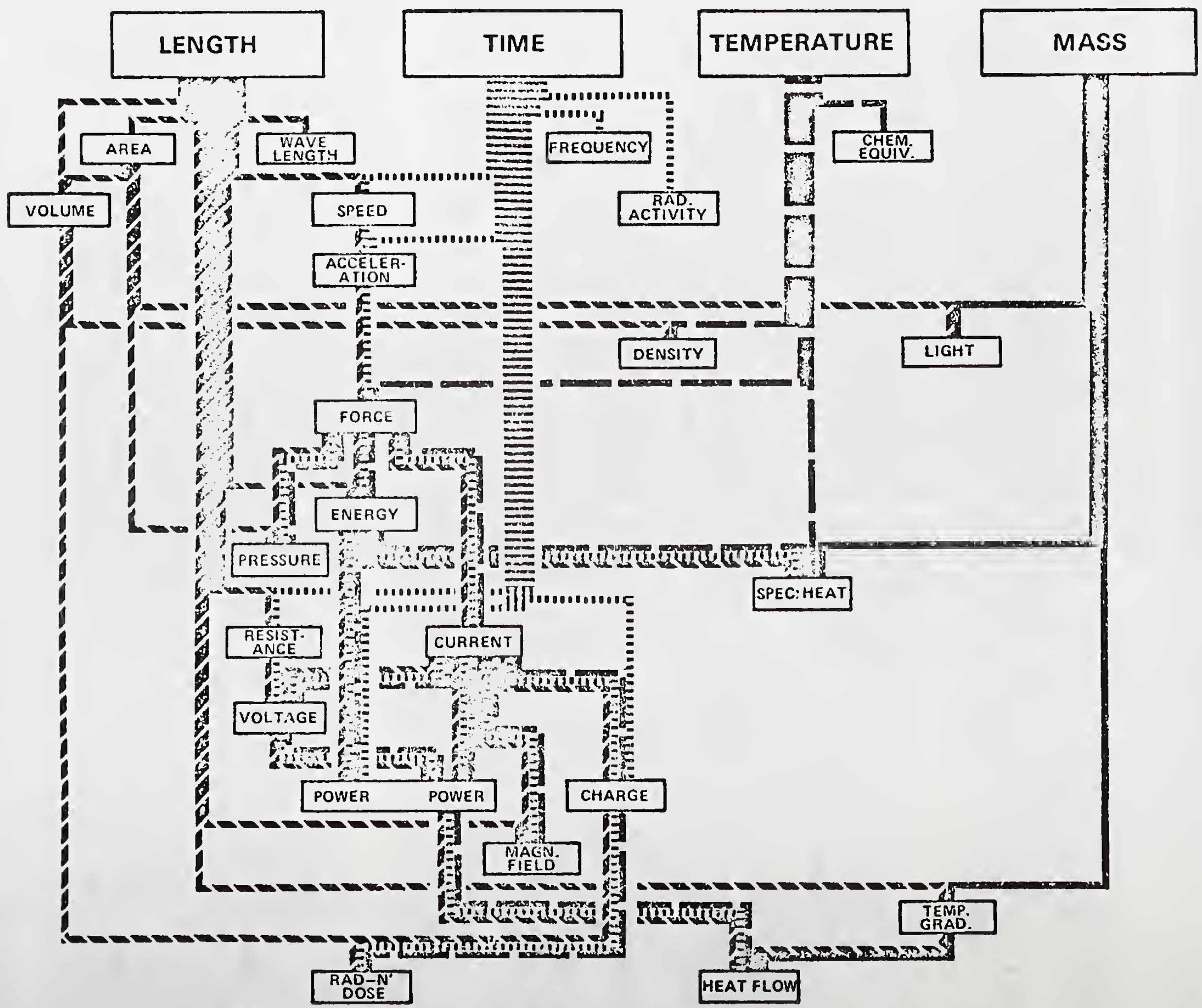


Figure 10

resulting simplicity in communication and use is one of the major reasons for the supremacy of the SI system in today's world.

But now, what about the four remaining quantities which are still arbitrary. The whole coherent system of units depends upon them. Any change in one of these "base" units, as they are now called, changes all the coherent units deriving from it. The responsibility for having stable, precise, physically invariant units becomes multiply terrific. The SI units as realized from the early definitions, which were independently reproducible, were embodied in physical standards. Subsequently it was learned that these standards were in error. The definitions were dropped and the standards became the units, i.e., the system reverted to the standard-unit scheme. Each standard became the prototype for the top master station for each quantity. The system grew around the meter (a bar in Sèvres), the kilogram (a cylinder in Sèvres), the second (1/64800 part of a mean solar day), and the centigrade degree (1/100 of the temperature difference between freezing and boiling water).

Subsequently it became possible to specify much better recipes to define the units more precisely, and to relate them to invariant natural constants, and to realize the unit with much reduced uncertainty. In each case the new definition was adjusted to make the new unit fall within the zone of confusion (uncertainty) of the old one so that all previous measurements require no correction. It follows that new definitions were not made until the new unit could be realized with less uncertainty than the old one. As you know, the length unit is presently defined in terms of optical wavelengths from ^{86}Kr radiation, the second in terms of radio frequency transitions in ^{133}Cs, the kelvin in terms of the triple point of pure water and the Kg still remains as the cylinder in Sèvres. No recipe better than 5 in 10^9 (present Kg uncertainty) has been developed. An independently reproducible recipe for a kg based on a natural invariant physical constant remains as a challenge to all metrologists the world over. In this respect the SI system remains incomplete.

As we have seen the values for the 4 base units remain close to the ones defined in 1790, but not exactly the same. When we use them to measure the fundamental physical constants, we get inconvenient numbers like 2.998--- for c, the velocity of light. None of them come out in nice even numbers. From this we see that we have not used the available arbitrariness to best advantage.

Since the value we obtain for any physical constant depends upon the units in which we express the results, we could have selected our four units to have such sizes that c, h, m_e, k, the velocity of light, Plank's constant, the mass of the electron and the Boltzmann constant respectively, would be unity. This would form an independently reproducible definition for each of the 4 base quantities and would give the added convenience of making the 4 most widely used constants have the value of 1.

Such definitions have not been adopted because they violate the requirement that the new unit be more precisely realizable than the old. At the present state of the art the new definitions would fall short by several orders of magnitude. Moreover, the resulting units would have impossibly impractical sizes for everyday macroscopic science and engineering, although they would be welcomed by some atomic and nuclear scientists. Table 4 shows the sizes of the units which would result. We call these "new" units "natural units".

Table 4

Time: 1 second = 1.235×10^{20} natural time units
1 natural time unit $h/m_e c^2 = 8.09 \times 10^{-21}$ sec.

Length: 1 metre = 4.12×10 natural length units
1 natural length unit $h/m_e c^2 = 2.426 \times 10^{-12}$ metres

Mass: 1 kg = 1.098×10^{30} natural mass units
1 natural mass unit $m_e = 9.109 \times 10^{-31}$ kg

Kelvin: 1 Kelvin = 1.69×10^{-10} natural temperature units
1 natural temperature unit $m_e c^2/k = 5.93 \times 10^{9}$ Kelvin

Although these constants are now allowed to have basically the same value they have always had (except for important refinements as the state of the art advances), they do provide a running check on the state of control, internal consistency and compatibility of our measurement system. The efforts in many fields to improve our knowledge of these constants shows that the system is not adrift, that compatibility has in fact reached all the involved measurement stations, and that different approaches which, according to theory, should give the same results, do in fact do so.

7. Range Extension

Establishment of the definitions for the units of measure, the realization of each unit in the form of a physical standard for the top master station and the dissemination of this unit throughout the system by way of compatibility coupling represents only the beginning of a truly useful NMS.

At the working level it must be possible to measure, in terms of the agreed upon unit, magnitudes ranging from tiny fractions of the unit to vast multiples of it.

In length, for example, at the small end we are concerned with the sizes of subnuclear particles and at the large end with galactic distances and beyond. In mass we again go from the nuclear particles to the galactic masses, all to be expressed in kg. In time the range is from nuclear lifetimes to the ages of the galaxies. In the electrical quantities, the range is equally fantastic, with the added complication of frequency since each magnitude ohms, amperes, volts, must also be measured from zero frequency to many gigahertz. It appears that, for each quantity, there is a range of 30 - 50 orders of magnitude or more over which there must be a chain of measurement relating the measurements at any magnitude to the defined or realized unit. The question immediately arises, "Should the top master station establish the chain and provide anchor points at every magnitude for a compatibility coupling to reach outward to the operating stations? Or should the operating stations obtain the unit via compatibility coupling from the top master and locally generate their own chains outward from the unit?" The answer to this fundamental question is crucial in the establishment of a national system and should vitally concern each of you attending this Workshop. Unfortunately, there is no simple answer; trade-offs must be made. Clearly the establishment of a complete chain across the whole span of magnitudes for all the quantities is beyond the scope of any national laboratory, and likewise unnecessary because all portions are not needed at all times. Without due regard in this respect, it would be possible to set policies for a National Laboratory, which if in fact were carried out, would represent an insupportable budget drain.

As a general rule, the extension of the chain of measurement from unity outward toward the extremes of the range, for a given quantity, is accompanied by increasing percentage uncertainty in measurement. This relationship is displayed conveniently in the form of a useful device commonly called an accuracy chart. An idealized one is shown in Figure 11. The orders of magnitude of the measurand in terms of the unit quantity are displayed along the abscissa. The ordinate is in terms of decreasing uncertainty (one part in 10^y in the station to station compatibility with y increasing) or increasing "accuracy".

The solid curve represents in a general way the increasing uncertainty (decreasing accuracy) as the chain is extended. Another general tendency is that the loss in accuracy will be less on such a chart when it represents work at the top master stations than when it represents the work of less well equipped operating stations (but not always so).

RELATIVE COMPATABILITY
(one part in)

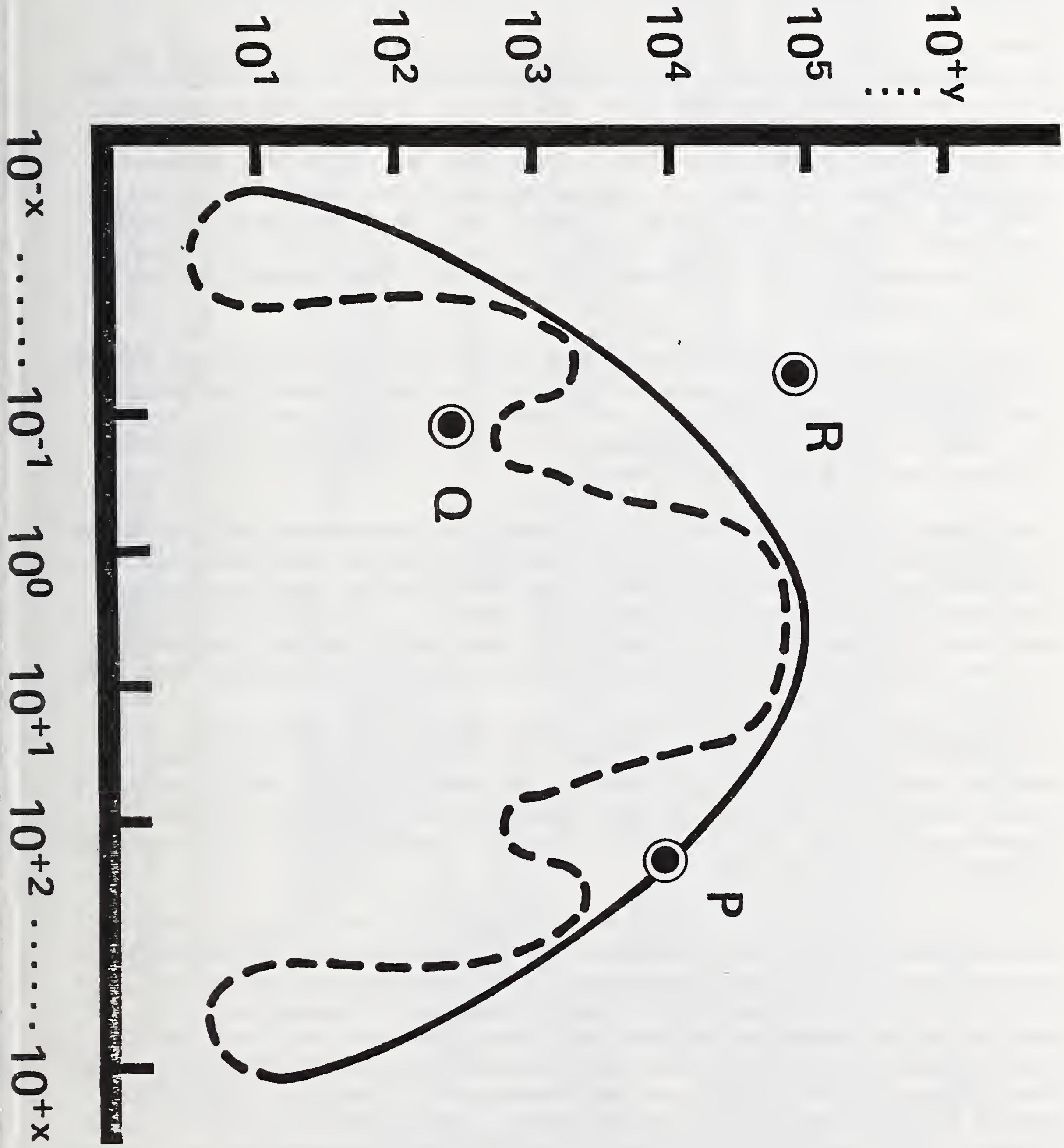


Figure 11

Such an "accuracy" chart can also be used to display the capability available at any station for compatibility coupling to its slave stations. Of course, service is not available at all points. A more realistic curve might look more like the dotted curve in Figure 11.

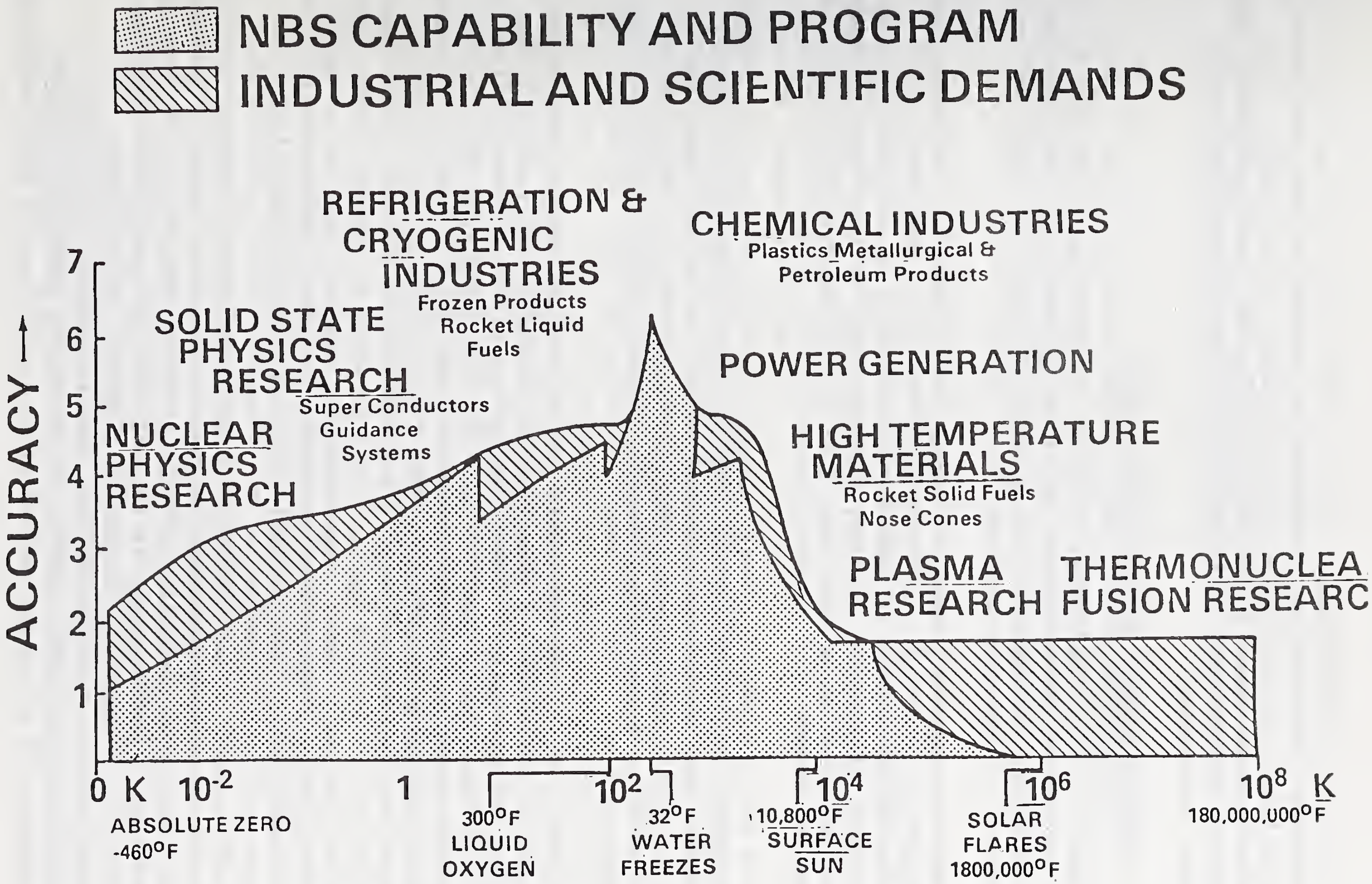
These charts are also helpful in planning a station or a system and its program. Points such as P represent services at the state of the art at the station represented by the chart. P might also represent an incoming request for service. A point such as Q shows that the request is well within the state of the art, or it could represent a special service available at reduced delay or less cost, where full state of the art is not needed. Points such as R represent requests for service beyond the state of the art at the station represented. Or it can equally well represent the goal of a new research effort to extend capability.

Figure 12 shows a real NBS chart for temperature prepared about six or seven years ago to help plan a program. The dotted area represents NBS capability and the shaded area shows demands for service beyond the state of the art. The helpfulness of such displays as an aid to thinking and planning is evident.

The answer to the basic question of where to locate the capability for range extension appears to be that some well spaced points should be provided by the top master station and that working stations should make their own extensions around these points. The number of points and their ordinates on the chart will have to develop as the nation's industry develops and it becomes clear where the main effort will lie.

We can call the points P,Q on the chart tie points, when they represent the level at which compatibility is available for slave station use. Note that any point on or under the real curve says to a slave station "I can provide you compatibility coupling at this magnitude and this uncertainty". What it does not show is the mode of harmonization to be used.

We have seen some of the relative advantages of the various modes of harmonization. Here the merits of SRM and SRD and SRT become much more evident. If a large number of harmonization devices, stable measurands, at outlying ranges can be produced, measured and made available for distribution, extended measurement chains need not be kept functional all the time. Any station needing capability can seek out a tie point based upon active harmonization devices, obtain the proper ones, construct his own equipment, establish compatibility and proceed. The magnitude of standby service and equipment in the system is greatly reduced, but the devices must be stable and available in adequate supply.



NBS CAPABILITY AND PROGRAM
INDUSTRIAL AND SCIENTIFIC DEMANDS
ACCURACY
7
6
5
4
3
2
1
0 K
10-2
1
10²
10⁴
10⁶
10⁸ K
ABSOLUTE ZERO -460°F
300°F LIQUID OXYGEN
32°F WATER FREEZES
10,800°F SURFACE SUN
SOLAR FLARES 1800,000°F
180,000,000°F
NUCLEAR PHYSICS RESEARCH
SOLID STATE PHYSICS RESEARCH
Super Conductors
Guidance Systems
REFRIGERATION & CRYOGENIC INDUSTRIES
Frozen Products
Rocket Liquid Fuels
CHEMICAL INDUSTRIES
Plastics Metallurgical & Petroleum Products
POWER GENERATION
HIGH TEMPERATURE MATERIALS
Rocket Solid Fuels
Nose Cones
PLASMA RESEARCH
THERMONUCLEA FUSION RESEARC

For a properly functioning, efficient NMS, there must be close continuous communication throughout the network so that tie points can be available to meet needs without excessive idle capacity. The mutual interaction and efficiency grow as the system components learn to suit their actions to the needs and availabilities from other system components.

8. The Measurement Infra-Structure (MIS)

Today no nation should feel alone as it undertakes to develop its NMS. The systems of other nations and their interaction in the existing International Measurement System provide a basis for the growth of new systems in developing nations.

There is a rapidly growing and expanding literature on constants and properties of matter and materials which can be used for active harmonization which will tie new measurement stations compatibly into the world structure. However, this data must be used with knowledge and discretion to be sure that it meets the requirements for the job assigned to it.

SRM's are becoming more available both in kind and range and quantity available. These can and do cross national boundaries to become international harmonization devices. And, as we have seen, the technological based devices produced to agreed upon standards for worldwide sale also afford available harmonization checks for a new producer.

This whole suffusing atmosphere of information, devices, materials, backed by the extensive production of measuring instruments in the highly industrialized nations, brings a sort of nutrient solution to all new measurement stations wherever they may spring up. This we call the World Measurement Infra-Structure (MIS).. Any given station finds numerous alternatives within the MIS open to it, to achieve compatibility with the world's adopted units and physical standards. These are not limited just to those provided by the MIS of the home nation (unless by law). Some operating stations may find it more advantageous to make use of the world MIS, which in my experience is most surprisingly open and free of international constraints.

A word of caution to those who are active in the development of a new system. It should be helpful in your thinking and planning to visit and put yourself mentally into the place of the operator at front line operating stations. Ask, if you were free to move, where would you turn and how would you proceed to establish the necessary compatibility. It might well be that the service is already available, such as for example the worldwide time and frequency broadcasts of all major nations or by the SRD now in the literature or available upon request from National Laboratories or manufacturers, or by calibration devices available from instrument manufacturers, or by SRM's available on a worldwide basis.

You would then need to ask, "If I undertake to supply him a service, will it help him, will he use it, will it be competitive or will he likely use the alternative services already available?" History shows examples of national laboratories, established in developing nations, which find their services largely unused because the needs are already being met through established channels.

A National Laboratory heading up a National Measurement System will grow and prosper if it meets those needs felt as deficiencies by the slave stations or if it supplies in some areas a competing service at lesser cost. Of course, national stature and prestige play a role too and the National System may incorporate, because of these social requirements, some activities which practical economical operations would otherwise rule out.

In its early phases a new National Laboratory could probably best begin by serving as a central channel to obtain information for its constituents on where to turn to find the best tie point in the world MIS for the services required, and <u>most important</u>, to get for them information on how to couple to those tie points and how to achieve the state of control and compatibility needed. Experience over a period of time with the flow of this information, both in kind and magnitude, will provide a meaningful basis for determining what services should receive top priority for home development. Coupling quickly to the existing MIS will allow expeditious industrial development, will provide an overall perspective to allow leapfrogging over unnecessary historical stages of past development, and will provide time for the National System to evolve to mesh properly with national needs.

There is plenty of room for advance in measurement science and one interesting facet of the compatibility-coupled system is that any improvement in unit realization or in determination of constants and properties of materials propagates throughout the system. Thus any station when it finds a need exceeding the capability displayed on some overall system "accuracy" chart, can, if it is capable, improve the world's MIS. This opportunity to help the whole system grow is a challenge which the MIS places before all NMS members. It thus poses a dynamic challenge to all metrologists wherever th y may be working. Compatibility-coupling thus opens channels for progress throughout the entire system.

THE COMING SURGE IN REGIONAL PLANNING

Albert Waterston
Professor of Economics
The American University
Washington, D.C.

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies
National Bureau of Standards

November 4, 1974

I. THE TREND TOWARD REGIONALIZATION

A. The Regional Awakening

1. When many observers are convinced that the nation-state is outmoded in a greatly shrunken and inter-dependent world and must give way to partial or universal integration of nations if trans-national problems of trade, economic development, overpopulation, defense, pollution and the quality of life are to be resolved, it may seem anomalous that there should be increasing pressures for regional and local autonomy within many countries. Yet, there is much evidence that such sub-national regional pressures have intensified in recent years and that they will continue to do so.

2. In the extreme form, these pressures manifest themselves as separatist movements the world over which would fractionate rich and poor countries alike. These manifestations may be seen in French-speaking Canada; Puerto Rico; the Baltic Republics of the U.S.S.R., as well as the Ukraine; the Flemish north of Belgium; Northern Ireland in the United Kingdom; Yugoslavia's Croatia and Kosovo-Mitohiyan; Ethiopian Eritrea; the three southern provinces in the Sudan; Eastern Nigeria; Indonesia's West Irian; Muslem-populated towns in Western Burma, Malaysia's Sarawak; the Indian State of Nagaland; and what was East Pakistan, where Bangladesh has made separation a reality.

3. Even where separation is not at issue, minority or localized groups in many countries agitate for greater economic, social, religious, linguistic, or political self-determination. The Kurds in Iraq; the aborigines in Australia; the blacks in Ovamboland in Southwest Africa and Rhodesia; the blacks and Chicanos in the United States; and the Jura Mountain French-speaking minority in Switzerland's German-speaking Canton of Berne, all stress a revival of

ethnic and cultural identity and a desire for independent social development. There are noticeable reversions to older groupings which, until recently, were thought to be weakening. Cadres of patriots who want to preserve or revive their culture, their language or their autonomy can be found in enclaves within countries everywhere from Kenya and Nigeria -- where there is a noticeable drift back to tribalism largely centered in specific localities and regions -- to the United States, where American Indians are resisting absorption or assimilation into the melting pot and insisting on the right to determine their own destinies.* The Canadian Cities of Jasper and Banff, formerly resigned to being governed from the distant capital in Ottawa, now actively seek the right to govern themselves; and in the United States, continuing pressures within the Capital City of Washington are bringing about a gradual but steady transfer of governmental power from the U. S. Congress to city authorities.

4. Fissiparous tendencies, often attended by regional and local complaints of differential treatment, have led governments in Colombia, India, Iraq and Nigeria to expand the number of their geographical political units by subdividing the existing ones. Others, including France, Guyana, Senegal, Tanzania, the United Kingdom and Venezuela have divided their countries into regional and, sometimes, subregional areas. Still others, among them Argentina, Cameroon, Chile, Colombia, Ethiopia, Ghana, Iran, Italy, Peru and Tanzania, are talking about doing so.

5. Sometimes these moves are prompted by a desire to facilitate governance of a country through administrative decentralization, but

---

* At the Third Annual Indian Ecumenical Council, held at Alberta, Canada in August 1972, Indians saw themselves as "grasping for some kind of structure and identity". Said one Indian: "The white ways are crowding in...". Said another: "We were in a Garden of Eden when the white man came in 1492, but now we have been destroyed. We must go back to the way our forefathers worshipped. We must pray to the Great Spirit the way he wanted us to." And a third Indian, a Roman Catholic priest, used the Cree Indian language when he recited the Lord's Prayer to his congregation, preferred a tepee to a church when he said mass and "spoke of Jesus Christ as a 'Holy Man' sent to put men in contact with the Great Spirit". A fourth Indian summed up the attitude of the delegates at the Conference as follows: "Our people are beginning to realize that we have a religious faith that is as good as any other. After many years of seeing it condemned as pagan -- and accepting such judgements ourselves -- we are ready again to take pride in it." (New York Times, August 23, 1972, p. 35.)

more often they are accompanied or followed by statements and measures which promise greater regional and local autonomy. This is as true for countries with unitary governments, like France and Italy, as for those with federal governments, like India; and it is true for large countries with great physical and social diversity, like India, as it is for small ones with little diversity, like Guyana. In the last few years, there has been a tendency for regions to link their political and economic aspirations and to advocate planned regional or subregional development. Recognizing the surge in subnational regional aspirations in the countries of Africa, a recent Conference on Regional Planning recommended that African countries "(i)...adopt regional planning as a permanent strategy of development;" and "(ii) integrate regional planning into national socio-economic development planning as of equal importance to sectoral planning;".*

6. The increased interest in regional development in recent years appears not to spring from real or imagined successes of planned development for specific regions in such countries as Belgium, Brazil, Canada, Colombia, Greece, Italy, Mali, Mexico, the Philippines, Puerto Rico, Spain, Thailand, Turkey, Venezuela, the United States and Zambia. Nor does it seem to arise from regional and subregional planning covering an entire country which has been a part of national planning procedures in countries like India, Israel, Malaysia, Norway, Poland, U.S.S.R. and Yugoslavia.

7. It appears, rather, to be the result of a political evolution which manifests itself, among other ways, in increasing political awareness of formerly docile or quiescent groups long shackled by self-doubt. With increasing political awareness has come the realization that governments play important roles in the development of regions when they allocate public investment funds and adopt policies and programs which stimulate or restrict investment. Regional leaders, complaining of unfair treatment, are increasingly seeking to influence investment decisions by national governments and obtain more favorable resource allocations for their constituents.**

8. As local economic and social problems remain unresolved or multiply, regional development pressures grow. Although the reduction of regional economic differences has been an established objective of

---

* Faculty of the Social Sciences, University of Ibaden, (Nigeria), Report of the International Conference on Regional Planning and National Development in Tropical Africa, March 20-25, 1972 (mimeo.),p.16.

** See, for example, Nath, V., "Regional Development Policies," Economic and Political Weekly, Vol. VI, Nos. 30-32, July 1972, p. 1603.

policy in many countries, disparities have continued and have sometimes grown greater. Regions within a country which have done well may be as intent as those which have not fared as well on exerting the greatest possible pressure on their national government to protect their interests. Thus, the Valle del Cauca, one of the more advanced regions in Colombia, has aggressively sought to add national and international resources to its own assets to develop its power, water and other facilities.

9. Sometimes, the social costs of regional unbalance are so evident that a national government will not wait for regional pressures to mount before taking steps to prevent the concentration of industry in one or two regions. But, more often, the shoe is on the other foot, with the regions taking the lead. Even in Tanzania, where the Government is working hard to develop cooperative (ujamaa) villages in rural areas, President Nyerere has said that the problem of rural development in his country is not one of "galvanizing the people but rather that of galvanizing the Government".*

10. There is no scarcity of examples of countries where long standing social and economic grievances, exacerbated by government inaction, are intensifying regional aspirations. Using unfairness or neglect by the government as an argument to support demands for increased resource allocations, regional pressures on national governments are increasing steadily. Argentina is typical of countries where such arguments are heard to justify regional demands for increased resources for development. Thus, there has been much agitation among the people of Patagonia, who feel that their region -- which supplies much of Argentina's oil and natural gas -- is being exploited for the benefit of Buenos Aires, leaving Patagonia with little to show for its contribution. There are also those in the Mesopotamia Region who contend that their region has been isolated from surrounding areas by the absence of a suitable transportation system, and that the national government has generally neglected the region; while some in Salta and Tucuman Provinces, where the sugar industry is dying and the attendant unemployment problem is being worsened by an influx of Bolivians and Paraguayans seeking work, argue that the Government is not doing all it might to help locate new industries in their depressed area.

11. Competing regional claims for increased allocations of financial and other resources, demands for special programs and the location of projects financed directly or indirectly by national governments in specific regions, tend to promote a regionalized approach to

---

*The Tanzania Standard, December 11, 1971.

development. The growing interest in rural development and the recognition of the symbiotic relationship between rural and urban areas are also intensifying the trend toward a regional, in contrast to a largely national, view which has prevailed in most countries until now.

B. Pro's and Con's of the Regional Approach

12. Indeed, the national view is under attack. Thus, the International Conference on Regional Planning held in Nigeria, previously referred to, contended that national plans in African countries, "generally represent no more than the interest and opinions of small groups of people.... Too often, these plans in their formulation ignore regional disparities, besides themselves creating such disparities...." contending that "This has made a spatial dimension to national planning all the more necessary..." and that "...many African Governments are therefore already adopting regional planning as a means of reducing the disparities between the richer and the poorer regions in their countries."

13. The Conference contended that regional planning, besides promoting national integration, helps:

a. develop natural resources by directing investment, services and population to sparsely settled areas, thereby reducing population concentration in other parts of a country;

b. develop depressed regions;

c. establish "growth poles" to counterbalance excessive concentrations in one or a few metropolitan centers (e.g., the construction of Malawi's new capital was mentioned as an incentive for opening up and settling that country's interior);

d. develop river basins through flood control, hydroelectic facilities, irrigation and conservation programs, and the colonization of agricultural areas; and,

e. orderly growth and development of metropolitan areas, especially with regard to their infrastructural equipment and organization.

14. While some of these benefits are obtainable through a national approach, experience has shown that a development plan for a country as a whole cannot be realistic unless it takes account of the requirements of different regions. This is particularly true of agriculture because production in this sector is closely related to temperature, rainfall, humidity, soil, water resources, drainage, topography and altitude. This requires that national plans and sector programs be regionalized, partially if not entirely, to a greater

extent than in the past. Where national development plans and sector programs have not been subdivided geographically, they have often failed to achieve their aggregative targets, not only because each region is unique, but also because of the inherent interdependence of inputs in determining output. Thus, the yield from irrigated water supplied in one place, fertilizer in a second and improved seed in a third will almost certainly be lower than the same quantities of all three inputs applied to the same acreage. Because of the complementarity of inputs, it is important that input and performance targets be set for each region, and within each region, for each of the smallest feasible geographical units.

15. But the regional approach has its disadvantages. For example, the requirements for regional development in poor countries are usually greater than the indigenous resources of the regions. This often means that the national government must accept prime financial responsibility for accelerating regional development. In these circumstances, there is no denying that rival regional development claims on national resources can lead to prolonged controversies and delays in locating projects and high costs from uneconomic locational decisions. The evidence also reveals that attempts to induce growth in a lagging region by locating projects there, when the region lacks the minimal physical and human infrastructure required to support the projects, are likely to yield only modest benefits.

16. Yet, because regional development pressures arise from the dynamics of political development, it would be a mistake to regard them merely as disruptive tendencies which threaten economic efficiency and impose strains on a country's economic resources and political system. It is essential to the success of planning in any country that the people of every region believe that resources are allocated fairly and that the national government aims to develop the potential of their region no less than that of others. In setting regional development policy, therefore, governments must try to achieve an acceptable compromise between the desire to maximize national development and the need to satisfy regional aspirations.

17. The two aims may conflict, but they need not. The question of industrial dispersion has positive as well as negative aspects, and much depends on the extent to which a long-term rather than a short-term view is taken. Again, in situations where there are many unemployed or underemployed persons, policies oriented to regional welfare can contribute significantly to both national economic development and regional welfare by encouraging greater utilization of idle and ill-used manpower resources for development projects and programs.*

---

* Nath, V., op.cit.

18. But whether or not the disadvantages of regionalization outweigh the advantages, there is likely to be little that national governments can do to stop a trend which arises from a worldwide political and social awakening. Given the force of subnational regional aspirations, it appears prudent for governments to accept the thrust toward regionalization as a fact, as many are, and formulate policies and institutional arrangements for dealing constructively with it. The need for such measures has been underscored in recent years when unsatisfied regional development aspirations have led to counter-productive activities.*

II. KINDS OF REGIONAL PLANNING

19. The growing attention which governments are giving to regional development in their countries portends an increase in regional planning. The kind of subnational regional planning thus far undertaken varies among countries. It is possible, however, to group the different types under four headings:

A. Global Planning for all Regions

20. The first type is planning of the economy of each region in a country as part of the procedure by which a national plan is formulated. In the socialized countries, planning at regional and local levels constitutes an integral part of the process by which a national plan is prepared. Thus, under reforms instituted in recent years, the central planning authority of the U.S.S.R. (Gosplan) sets quotas for products in each sector to be delivered by each region. Within each region, local planning bodies prepare their own plans which are deposited with their regional organizations. These are then transmitted to the planning authorities in their respective republics, from whence they are passed up to the central planning authority. Generally, similar procedures prevail in other Eastern European countries.

21. A different system is in force in Yugslavia, where republics, districts and communes prepare plans which do not necessarily add up to the total at the next higher hierarchical level. Thus, the total investment, output and other targets of communes do not necessarily add up to the targets in their district plan; the targets in the district plans do not necessarily add up to the targets in their republic's plan; and the targets in the republic plans do not necessarily add up to the targets in the national plan. The discrepancies in the targets arise because each geographical unit has resources of its own which it is free to use as it wishes within some generally-applied constraints.

---

* Nath, V., op.cit., p. 1601

22. In the mixed-economy countries, planning for all regions of a country as part of the national planning process is usually less systematized than in the socialized countries. Thus, in India, planning in the states is an uneven procedure with mixed results. This is likely to change for the better as a result of steps the Government is taking to decentralize the planning process. In Malaysia, planning at regional levels (Malaya, Sarawak and Sabah) has been going forward since the establishment of the Federation. France has established 21 regions but regional planning is still incipient. By and large, this is also true in other mixed-economy countries where planning for all regions takes place.

B. Regional Planning for One Sector

23. A second type of regional planning involves the preparation of a national program for a single economic or social sector, composed of subprograms for all regions in a country, and coordinated in accordance with national development objectives and strategies. Theoretically, this form of regional planning can be carried out either by aggregating regional programs for a sector into a national program or by disaggregating national to regional sector targets. Israel has been more systematic and successful than most others in incorporating regional programs for agriculture for the entire country into a national agricultural program.

24. Some European countries have begun to set some sector regional targets within what is still essentially a sector program for the country as a whole. France is, perhaps, the most prominent example. Starting with its Fourth Plan, targets for public and private investment and for levels of employment were set for the agricultural sector, among others, in each of the country's 21 regions.

C. Regional Planning for Selected Regions

25. A third kind of regional planning covers only selected regions within a country. The argument usually advanced in favor of this approach is that the concentration of resources is likely to yield higher returns than is possible if the same resources are spread more thinly over an entire country. Thus, in Spain, regional development policy dating from 1964 calls for the creation of development poles (polos de desarrollo) decongestion centers (polignos de descongestion) and zones of preferential location with a view toward developing selected regions of the country.

D. Planning for a Specific Region

26. A fourth kind of regional planning is for a specific region. This kind of planning is sometimes adopted when an important region of a country is lagging behind others, as in Brazil's Northeast and in Southern Italy; when it is considered desirable to develop natural resources located in a region, e.g., a river basin for irrigation or other purposes, as in the case of Venezuela's Guayana Region; or when resources are so limited that it seems best to concentrate investment resources where returns are likely to be highest.

III. FUTURE REGIONAL PLANNING

27. Whether regional development plans have been prepared by national, as against regional, bodies has generally depended on several factors, of which the most important have been the stage of economic development of the region(s) concerned, the availability of regional planners, and the size of the country. As a rule, the earlier the stage of regional development, the greater the shortage of planners and the smaller the country, the greater the likelihood that regional plans were prepared by the central planning agency or by a planning authority established for the purpose by the central government. Conversely, the more advanced the region, the greater the availability of regional planners and the larger the country, the more likely that the plans were prepared by the regions themselves.

28. Since regional planning in most countries has been for economically backward areas, with special problems and shortages of financial and human resources, most regional planning has been conducted by central planning agencies or by special authorities created by national governments. Frequently, regional plans have been prepared outside the regions, usually in the national capital, with little participation by people in the regions. Many plans have consequently failed to reflect regional conditions and needs. Not surprisingly, people in the regions have shown little interest in helping implement these plans.

29. The time is rapidly passing when outsiders will be able to plan for regions as they have in the past. Indeed, it is becoming apparent in many countries that people at regional and local levels are increasingly insisting on having a voice in planning for their areas; that planning must be "from the bottom up", in practice as it is in theory, as well as "from the top down", to which it is too often limited in practice, if it is to meet social needs in the regions and localities; and that accurate definition of what are the social needs can only be provided by the people at regional and local levels. This

means, among other things, that the idea that planners can, or think they must, plan <u>for</u> people must give way to the idea that they must plan <u>with</u> people.

30. Regional plans formulated in a national capital on the basis of the general or average situation in a country's regions, e.g., with the same projects, work patterns or allocations of funds for each region or subregion, are therefore bound to prove unsuitable or inapplicable in varying degrees for particular areas. This approach to regional planning, aside from errors of commission, may also lead to serious errors of omission. For example, when it was used in India, no project or other provision for dealing with the 35,000 waterlogged acres in one state was included in the plan for that state's agriculture.*

31. To be effective, a regional plan must have a high degree of specificity to take account of the basic variations in conditions among regions and localities.** This cannot be achieved merely by disaggregating national output or input targets regionally without determining for each region and locality the particular conditions which farmers and businessmen face and their capacities to utilize inputs (e.g., cultivators' ability to utilize improved seed and fertilizer) and increase production. Where planning for regions and subregions has been primarily based on the disaggregation of national targets, great discrepancies between expectations and achievements have often arisen.

32. Experience shows that the best way of dovetailing national output and input targets with regional and local capacities is to derive the national targets mainly by aggregating plans originally framed regionally and locally rather than disaggregating plans and estimates framed at the national level. Only when each region and where appropriate, each subregion, has a carefully prepared plan which includes input and output targets designed to take adequate account of available physical resources (with their limitations), and human resources (with their dispositions and motivations in each region and locality); and where these plans become the basis for framing the national plan, can it be said that the national plan has been formulated realistically. This is especially true for agriculture.***

---

* Gadgil, D.R. "Planning for Agricultural Development in India", <u>Readings in Agricultural Development</u>.A. M. Khusro (Ed.). Allied Publishers, Bombay, 1968, p. 565

** Gadgil, D.R. "Opening Address: Successive Steps in Planned Agricultural Development," in: <u>Rehovoth Conference on Comprehensive Planning of Agriculture in Developing Countries</u>. Rehovoth, Israel, August 19-29, 1963, p.2.

*** Gadgil, D.R. "Planning for Agricultural Development in India," op.cit., pp. 564 & 566.

33. Of course, a national plan must be more than a summation of local and regional plans. If a local or regional plan is prepared without the general framework provided by a national plan, it may be inconsistent with national development objectives. Planning must therefore be seen as a two-way process in which national objectives, strategies and policies, as well as the coordination of regional and local plans with national input and output targets, is determined at the national level; while the extent and manner of the development effort in each region or locality is determined in the area concerned. Thus, while estimates of input and output possibilities for the nation must be a totality of the estimates in each region or locality, the estimate of what should be attempted in each region or locality should be made in relation to national objectives and directives. It is only by such a process of mutual interaction that a national plan can be formulated which is sufficiently detailed to meet the requirements of each region, subregion, and if need be, each village.*

IV. PROBLEMS POSED BY THE REGIONAL APPROACH

34. But more regional planning will raise serious technical, political, social, administrative and financial problems.

A. Definition of the Region

35. There is, for example, the problem of defining what a region is. What is called a region tends to vary from country to country and within a country. Where, as in India, state governments are responsible for implementing state plans, a region is often synonymous with a state or, on occasion, two or more states. Within the states, plans have been divided into plans for districts, communities and villages. However, experience in India and elsewhere has shown that there is a productive limit to the degree of disaggregation. It is a valuable incentive to localities to have them establish and try to realize their own production targets within a state or national plan. If however, the local plans are to be phased, coordinated, and aggregated into state or national plans, the effort involved may be greater than it is worth.**

---

* Ibid., pp. 566,567

** FAO. "Programming for Agricultural Development, "State of Food and Agriculture, 1960. Rome, 1960, pp. 119-120. In the U.S.S.R., attempts used to be made to draw up detailed local production plans down to the level of state and collective farms which were combined in plans for districts, republics and the entire country. But these plans, formerly made in the center, are now prepared locally, and are far less detailed than they used to be. (Ibid., p. 120)

36. For this reason, and also to avoid too circumscribed an approach to the development process, it is undesirable to set separate targets below the level of the largest geographic area where conditions are relatively homogeneous. This applies especially to agriculture. For example, where a district includes several villages with essentially similar supply, sale and other marketing conditions, it is unnecessary to have targets for each village if targets are set for the district.*

37. In general, the appropriate size of a region is one which is not so small as to lead to undue fragmentation of the national planning effort, yet small enough to permit rapid feedback between individual farms and enterprises, on the one hand, and regional planners, on the other. In Israel, the appropriate regional size has been determined to be one which contains a number of villages that can be linked effectively to an urban community. This connection between villages and urban area may be direct or it may be indirect through a rural service center which provides only basic health, educational, social and economic facilities for the villages. The rural service centers are in turn linked to the urban community center, which provides facilities that the rural service centers are not equipped to furnish. The Lakhish Region is an example.** In contrast, the entire Island of Mindanao was established as a region in the Philippines; in Italy, the southern part of the country was constitutued as a region; in the Netherlands, it was an area reclaimed from the sea (polder); in Colombia, it was the Cauca Valley, the Sabana on which Bogota, the capital, is located, or a department (i.e., a state); and in the Sudan, the Gezira Region was set up on the basis of the irrigation possibilities.

38. It is apparent, therefore, that a region may be defined in different ways. Its boundaries may be determined (1) geographically, e.g., a valley or river basin, (2) demographically, e.g., an area inhabited by a specific population group, e.g., a tribe, (3) administratively, i.e., one or more political subdivisions of a nation, (4) functionally, e.g., an area in which it is considered that desired goals can best be achieved, and (5) geo-functionally, e.g., an area within the sphere of influence of a particular urban center.*** Since regions defined in any one of these ways may sometimes have uncertain boundaries, it may not always be clear where a region

---

* Gadgil, D. R., "Planning for Agricultural Development in India", op.cit., p. 579

** Weitz, R. and Landau, Y. "Comprehensive Agricultural Planning on the National, Regional and Individual Farm Levels." Rehovoth Conference on Comprehensive Planning of Agriculture in Developing Countries, Rehovoth, Israil, August 19-29, 1963, p. 4.

*** Ibid.

begins or ends. While the limits of a region are frequently determined in practice by political boundaries, the ideal region for planning purposes is one which is either homogeneous with regard to one or more important features, or one which incorporates areas which are interdependent in one or more substantial ways.

B. Definition of Needs

39. A second problem which arises in an approach to regional planned development oriented toward planning with rather than for people, involves definition of the basic social and economic problems to be resolved. Everything depends on who does the defining of the problems and the setting of their priorities. While it is conceivable that central, regional and local officials will define basic social problems and priorities in the same way that the people on the spot will, it is unlikely. The probability of divergence among the different levels, as well as between them and the population, is greatest if regional and local problems are identified and the priorities for them are set by central authorities. But the probability is also great that regional officials will define the basic problems and set priorities differently than will the local officials and the local population. And even if local officials select the problems and determine their priorities, these may also turn out to differ from those the people themselves will identify.

40. It is easy to see why officials in the national capital may not be in a good position to define priority social needs for the regions in a country, especially for those that are remote or inaccessible; it is less apparent that regional, and especially local authorities, may also lack sufficient information to define basic problems and their priorities in the same way as the regional or local population. Partly, divergence at regional and local levels is explainable because there is almost always a barrier between officials and the public which inhibits communication; but mostly, it is because officials and the people they deal with tend to look at things in different ways.*

---

* For example, in many countries, licensing and other regulations connected with the start up of an enterprise require would-be entrepreneurs to deal with several licensing and control agencies before they can begin to do business. The officials in each agency usually see only a part of the would-be entrepreneur's problem; only the would-be entrepreneur can see the whole. For this reason, officials in each agency may not consider their agency's regulations as particularly onerous, although the would-be entrepreneur may see them as part of a disastrously time-consuming and costly process which impedes the start of his business. He may then define as a great need an administrative rearrangement which could permit him to deal with a single agency, a need which might not even occur to the officials in each agency.

41. Many officials do not see the need to consult the population in a region or locality about their basic social and other needs. Officials at the national level frequently consider it sufficient to talk to officials at regional or local levels.* But if regional or local officials see the problems differently than the people do, regional and local plans are likely to be formulated to solve problems which the officials rather than the people consider important. If planning is to be directed toward resolving basic social and economic problems as the people see them, it must involve participation of the people, not only to ensure that definition of the problems and their priorities conform to those of the people, but also to ensure the population's active and willing support of the plans prepared to solve the problems. People's participation should be sought through their own leaders**, wherever possible, and not through government officials who visit the area occasionally, or through officials stationed in the region or locality by remote governments.

C. The Lack of Regional Information

42. Planning at the national level has been seriously hampered in most developing countries by the scarcity of reliable statistical and other information. Indeed, the lack of quantitatively and qualitatively adequate data on such basic series as the size and

---

* How difficult it is for some officials to engage in direct consultation with local populations was revealed in a confrontation between the U.S. Secretary (equivalent to a minister in most other countries) of Housing and Urban Development and a spokeswoman for the group in the City of Wilkes Barre, in the State of Pennsylvania, whose members had had their homes damaged or destroyed by a storm some six months before the Secretary of Housing and Urban Development visited the City in August 1972 to find out why little had been done to alleviate the plight of these who had suffered losses. According to the Washington Post of August 10, 1972, the following exchange occurred: "Why don't you talk to the people? The people come first." demanded the irritated spokeswoman, "These guys, (i.e., the group who accompanied her) came here to tell you the truth." To which the Secretary of Housing and Urban Development replied, "...It's not necessary to talk to the people...It's necessary to talk to the /State and local officials/ who are trying to meet the problem." If this exchange could occur in a country where the population is relatively well-educated and articulate and where people have access to elected officials and government functionaries at every level, one may imagine how great must be the communication gap in countries where conditions are less propitious.

** E.g., In some African tribes, the eldest member of the tribe is considered its leader.

growth of national populations, production, investment, consumption and employment has frequently cast doubt on supply and demand projections, as well as parameters included in national planning models. The fact that regional and local statistics in most poor countries are generally much worse, where they exist, than national data, makes it especially difficult to plan effectively at regional and local levels in these countries. The lack of good land use, water resources, and manpower data constitute especially great handicaps. The data gap therefore is a third problem confronting those who would expand regional and local planning. The magnitude of this problem and the fact that it will take much time to resolve should make it evident that regional and local planning may have to proceed at a lower level of technical sophistication than prevails at national levels and that, for the time being, advanced mathematical formulations of regional and local plans are likely to be impractical in most poor countries.

43. However, if regional and local planning is to become an effective development tool, steps must be taken as quickly as possible to set up suitable systems for the collection of data (a) on a continuing basis, (b) for clearly defined regional and local areas, (c) which employ uniform units of measurement to allow intra- and inter-regional combination and comparison of the data. To set up a suitable data-collection system for regional planning purposes requires considerable discussion by statisticians and planners of the country, as well as the areas for which data are to be collected about the types of data required for planning and other purposes and the form in which the data should be collected.

44. Consideration should be given to the preparation of a multiannual statistical-collection plan, including a system of financing its implementation, which sets forth the types of data to be collected and the priorities to be given to each. Since the task of carrying out such a plan is likely to be beyond the capacity of existing central statistical organizations in most poor countries, consideration needs to be given to their reorganization and expansion, as well as to the possibility of dividing the task between them and regional statistical organizations in a manner which would promote the most efficient use of scarce manpower and statistical equipment. The work of central and regional data-collecting agencies must be coordinated to avoid duplication, gaps in data collection, or the use of non-comparable units of measurement, and in addition, to promote cooperation between statistical and non-statistical agencies in the public and private sectors which collect social and economic data.

D. Coordination

45. The need for coordination goes beyond the realm of statistics and constitutes a fourth problem in countries which seek to expand their

regional and local planning effort. Regional planning requires coordination to ensure encouragement of regional specialization based on comparative advantage, as well as regional cooperation in realizing national objectives. Without proper coordination, regions tend to give priority to regional instead of national goals. Coordination is also required because there is always danger that competing regional claims may get out of hand and exceed available resources.* There is need, in addition, to establish communication bridges between national and regional planning bodies which provide channels required for information to flow "from below" as well as "from above". These informational bridges provide the necessary feedback for formulating plans and, during the implementation stage, for making timely adjustments in the plan as required.

E. Regional Planning Organization

46. The need to establish suitable information systems for effective regional planning raises a fifth problem: What kind of institutions are needed to prepare and implement regional and local plans? There is in most developing countries a dearth of subnational planning entities. This means that in most countries, suitable regional and subregional bodies must be devised and established if effective subnational planning is to take place. Some countries have planned for their regions through national planning agencies, but aside from the fact that this approach has not been very successful in most countries, it is less likely to be used in an era of increasing regional political awareness.

47. The institutional problem is a two-fold one of finding the right structure and the right mix between centralized and decentralized authority and decision-making. Unless appropriate institutions are set up with the right mix, there is danger that the most logically consistent regional plans will not be operationally feasible.**

---

* Since most regions in a country must look to their national government to finance at least a part of their plans, national governments can use finance as a means of coordinating regional and subregional plans. Properly used, finance provides governments with a powerful device for bringing regional and subregional plans into line with national development objectives. But the regional pressure for funds is often so great that national governments are sometimes unable to maintain the administrative controls required to achieve the necessary coordination.

** Op.cit., Report of the International Conference on Regional Planning and National Development in Tropical Africa, p. 15.

48. While every country will have to establish planning bodies suited to its own institutional arrangements and stage of development, it may be said that, in general, organizations at the local level should be simpler in form than those at the intermediate subregional level, and that intermediate bodies need be less complex than those at the regional level. For example, at the village level, development planning committees may suffice, while at the intermediate level (e.g., a district), one or two planners in a small planning unit may be adequate. However, at the regional level, a regional authority, appropriately staffed with planning technicians, is likely to be essential for effective planned development.

49. While structural problems can be difficult, they are likely to be easier to resolve than questions relating to the degree of autonomy to be granted to regional planning units and the extent to which these units should be advisory or supervisory in carrying out regional plans. In some countries, these questions have been resolved by the establishment of a regional authority with considerable power and independence. These authorities are generally responsible to the central government, and have authority to act in lieu of regular central ministries, departments and agencies in the region over which they have jurisdiction. The Tennessee Valley Authority in the United States is a frequently-cited example of this type.

50. Another kind of authority is advisory in nature, prepares regional plans but relies on regular government ministries, departments and agencies to implement those portions of the plan which fall within their functional jurisdiction. Where this type of authority is established, there is need for the ministries, departments and agencies to decentralize responsibility for taking action to their regional representatives, and for the regional authority to coordinate their activities to ensure well-phased implementation of regional plans. Otherwise, all questions must be referred for decision to ministries, departments or agencies in the capital. Not only is this a time-consuming process, but it may yield the wrong answers because civil servants in the capital are not usually aware of the nature of problems in different regions of the country. The Settlement Department of the Jewish Agency, which is responsible for rural development in Israel, is an example of the second type of authority, although it has some direct responsibility for rural development, as well as the funds for carrying them out.

51. The extent of a regional authority's effectiveness often depends on the financial resources put at its disposal. Equally important, is the way in which funds are allocated to it for implementing plans. The authority is likely to have the greatest independence in implementing plans if funds are allocated to it directly by the

central government. The authority is likely to have somewhat less freedom of action if it has to rely on transfers of funds allocated to the various ministries, departments and agencies for projects and programs within its region for whose implementation it is responsible. The authority is likely to have the least independence if it must apply to the budget authority for funds every time it needs them for a project.*

52. The location of the headquarters of the regional authority is also significant. To carry out its functions effectively, the authority should be based in the region. Since it is usually more difficult to staff an authority located in a region than if it is located in the capital, there is a tendency for regional authorities to establish themselves in the capital. But this is a mistake, as experience has shown, because the authority's staff loses touch with regional problems, while the people in the region tend to view the authority as alien. In contrast, where the authority has been established in the region at the start, the population of the region tends to view the authority as its own, and the staff of the authority is in position to take prompter action on problems than if it were in the capital. Experience also indicates that regional authorities located in rural areas can be adequately staffed if regional development is made sufficiently challenging, and higher status, pay, living arrangements and wider opportunities for professional training are offered to technicians than are available to those in the capital.**

53. The relationship between the regional authority and the local population and authorities may assume a variety of forms. Where regional organizations exist, and especially where these represent the people rather than the national government, the most suitable arrangement is to base the regional planning authority on the existing organizations. If this is done, there is greater likelihood than otherwise that regional and local plans will come close to representing prevailing views at regional and local levels. France has followed this approach.

54. In contrast, a central government may create a regional authority

---

* Weitz, Raanan and Applebaum, Levia, "Administrative and Organizational Problems of Regional Development Planning in Israel", Annual Meeting of Directors of Development Training and Research Institutes, Montpellier (France), 7th - 12th September, 1967 (mimeo), pp. 4-5.

** Ibid., pp. 9 & 10

as an arm of the government in a region to be developed. With this approach, there is a greater possibility than in the first that there will be difficulties in communication between the authority and the people. SUDENE in northeastern Brazil is an example of an authority created by a central government as its representative in a region.

55. A third variety of regional authority includes representatives of both the central government and the regional businessmen's farmers' and other groups. This pattern has the advantage of utilizing existing institutional arrangements to establish a communication link between local and central government representatives. Crete and Israel have adopted this approach.*

56. Since the first and third approach seek to relate the regional and local authorities directly, they are preferable to the second. But regardless of which approach is adopted, the regional authority must still take measures to ensure adequate participation of the people in defining the basic economic and social problems to be resolved by the planning process. While every country will wish to create regional planning authorities in a form suitable to its needs, successful regional planning will depend on the degree to which regional plans are formulated and implemented with the participation of the people in the regions or subregions concerned.

F. Training Regional Planners

57. Since regional planning is still in its infancy in most developing countries, regional skills and expertise are in short supply. If regional planning is to expand to the extent required, means of training those needed for the purpose will have to be devised. This is no easy matter and constitutes a sixth problem for regional planning.

58. Because of the variety of skills demanded, training for regional development will have to be problem-oriented. This implies a multi- rather than a uni-disciplinary approach. While much has been written about the need for a comprehensive approach to development problems, little as yet has found its way into training materials and courses. The same is true about planning "from the bottom up".

59. Another training constraint has to do with the "labor-intensive" way in which planning, as a discipline, has been taught. Teachers in the field are generally highly-trained specialists whose teachings reach only a few students each year. Moreover, would-be planners are required to undertake a lengthy course of study to provide them with

* Ibid., pp. 10-11

the ability to formulate sophisticated plans based on mathematical models. As a result, the training of planners has proceeded so slowly in the last two decades that there is still a great shortage at the national level in developing countries, and even more, at regional and local levels.

60. If regional planning is to expand at the rate required to meet urgent demands, a more "capital-intensive" approach to training regional planners will have to be used than has been used thus far. If, for example, the information which planning specialists have accumulated were incorporated in "programmed" form* in teaching materials, teachers in training centers in the developing countries could use these materials to train individuals within the subnational regions to prepare and implement regional plans. Only by some such method will it be possible to spread available knowledge about regional planning as broadly and as rapidly as is required to meet the demand for regional planning.

61. Some work along these lines is already going forward. One project, involving the preparation of programmed materials for training regional and national officials in developing countries in the management and implementation of programs in agriculture and rural development is being carried out by the Governmental Affairs Institute in Washington, D.C. under a contract with the U. S. Agency for International Development (AID). Governmental Affairs Institute and AID hope to prepare and test training materials in the field which can then be widely used by teachers in developing countries in the training of rural planners in the numbers required.

---

* By which is meant a detailed exposition of the objectives, approaches and methods used to transfer substantive knowledge about planning in the form of individual sessions and groupings of sessions, utilizing lectures, case studies, workshops, formal work groups, and other modern techniques which reduce the amount of preparation required for teachers of the subject, and permit them to transfer planning techniques by methods worked out by specialists in the "programmed" materials.

THE IMPORT FOOD STRATEGY OF THE FOOD AND DRUG ADMINISTRATION

Benjamin M. Gutterman
Assistant Director for Coordination/Technology
Bureau of Foods, Food and Drug Administration
U.S. Department of Health, Education, and Welfare

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies
National Bureau of Standards

November 4, 1974

It is a distinct honor to represent my country and particularly the Food and Drug Administration of the United States Department of Health, Education, and Welfare before a group such as you from other lands. I see amongst you some that I have met before and I am happy to say that although our time together was brief, lasting friendships have developed. I know a number of you represent countries that export foods to the U.S.A. The others, I am certain, will consider doing so in the future. Tonight I shall talk to you about certain aspects of our food imports - some of our problems - and what we are prepared to do and are doing about them.

The FDA is, of course, a domestic agency. Our first obligation is to the United States consumers of food. That obligation is to provide them with safe, nutritious, and properly labeled foods and our efforts concerning our own food processors are intended to accomplish it. We must provide the same degree of protection to our consumers whether the foods are imported or domestically produced, and therefore, in addition to our domestic program we operate an extensive import sampling and analytical program on foods offered for entry at our ports. Imported foods are coming to our ports in increasing volume. They have increased by over 65 percent within the past decade. Currently our consumers spend over 15 billion dollars for imported foods.

In recent years significant changes have occurred concerning the products you export to us. Whereas your exports in the past were, in large part, raw materials that received further processing at a plant in the U.S.A. and subsequent inspection by the FDA, today they consist more of ready-to-buy consumer products that receive no further processing in the U.S.A. The volume of ready-to-buy products is ever increasing.

FDA does not inspect foreign food firms at their manufacturing sites as it does domestic ones, and therefore, the coverage or inspection of food imports is restricted to the product itself. In view of this fact, it has become necessary for us to expand our efforts for our import food inspection program and to seek more effective ways of assuring that the foods coming to this country comply with our laws and regulations. All imported food products are subject to inspection by FDA at the time of entry through U.S. Customs. Shipments found not in compliance with our laws and regulations are subject to re-exportation or destruction or, under bond, the importer may recondition the product and it will then be reconsidered for entry. Our requirements, that is, the laws and regulations, are available to every exporter and his government. Equally available are a number of our action guidelines. It is expensive and wasteful to your exporter and your country if a product must be reexported, destroyed, or reconditioned after the expense of shipping. Further, it is a loss to the U.S.A. if it is the kind of product our consumers desire.

Before I discuss what we may do to promote our mutual interests, I would like to discuss my agency's increased activity in the area of imports. Let me assure you that there is no intent on the part of the United States Government to place restrictive barriers upon imports other than to insure that the imported foods meet the same requirements as those placed upon foods produced in this country. As a result of the increasing import traffic and changes in foreign commerce and shipping techniques, the FDA has been exploring new methods of increasing coverage of imported foods. In the past we would preselect consignments on file with the U.S. Customs Office. This sometimes resulted in inspectional and analytical manpower being allocated to non-violative products while unobserved non-complying products may be released without examination. A new method is ship-to-ship coverage. With the ship-to-ship method, the inspector at all times is at the point of discharge - a pier, airport, or container terminal. He views the cargo as it is being unloaded and can more readily detect noncomplying products and thereby be more selective. We are also using more mobile laboratories at dockside. They are operated by inspectors and inspector technicians who have been trained to perform sanitation and economic examinations of samples. A larger number of inspections may thus be conducted and more rapid decisions can be made. In addition to our finding more noncomplying products, there is a resultant benefit to the importer of complying foods. Foods in compliance are released more quickly and the probability of needless demurrage costs are reduced.

Further, we are experimenting with another method which is already showing encouraging results. This is the use of so-called "import circuit riders". These men travel through a number of lesser used import entry points. By means of this intensified activity, we are detecting an increased number of noncomplying imports. We are also developing more positive results through saturation sampling of suspect products, foods coming from problem suppliers, and an improved coverage of containerized cargo.

As I previously stated, it is expensive and wasteful for all concerned when a food is denied entry at our ports. That includes both you as the exporting country and my country as the importer. What can we do about reducing this expense and waste? It must be a mutual effort. Also, as I stated previously, my agency's first obligation is to the consumer in the U.S.A. However, through joint effort and what we learn from each other, your food industry as well as ours plus the consumers from both of our countries will benefit. We are very much aware that our regulatory actions, programs, and policies have a pronounced effect on the industries of your countries and on international trade. We are also aware of their effects on your food control programs. Therefore, we have a positive objective of providing your exporters and particularly your governments with timely and pertinent information.

We have a number of ways to move toward the accomplishment of the objective of fostering a mutual understanding concerning our compliance policies, our standards, and our procedures relative to the foods we regulate. Our State Department advises our embassies abroad of those policies, standards, and procedures of importance for transmission to your governments. We maintain contacts with your commercial and scientific attaches here. We are developing closer working relationships with your consular officials in our port cities. We find them eager to assist in ensuring that products offered for entry are in full compliance with the requirements of our food laws. For example, at the New World Center in Los Angeles, we are holding our second briefing session for consular and trade officials. Another very important way to accomplish the objective of mutual understanding is our desire to participate in meetings like this. Further, we have found very beneficial our visits to our counterpart officials in your countries. We are prepared to travel at your invitation on the basis of the personnel and time that we have available.

A program which I recommend highly is one whereby you may request that one or more of your technical or administrative officials may come to this country for work and study in our laboratories and administrative offices, travel with our inspectors in their visits to our food processing plants and to our ports of entry, and so forth. They will learn not only by study but also by actually observing our techniques and, most importantly, by participating in all aspects of our activity. A very important additional benefit is that these people will undoubtedly leave the U.S.A. as capable teachers of their own colleagues for those aspects of our activities which may be used - with or without modification - in their own country.

In passing I would like to say that for this program we ask that your requests be sent to us well in advance of the desired visit so that we may tailor specific programs for your representatives commensurate with their needs, education, training, experience, and your planned future assignments for them. Since they will be working along with many of our own people, we request that they be fluent in the English language. We make no charge for this program. However, we do expect you to be responsible for the salary, travel, food, and lodging expenses of the people you send. For those of you who might find yourselves unable to support this type of activity, I suggest that a number of international organizations are prepared to consider your needs. In addition, there are many food science, food technology, and food engineering schools which offer "short courses" in many fields.

A method of reducing the probability of imported foods being denied entry through our ports is by the development of cooperative agreements between my government with your governments and industry groups. Formal international agreements, which spell out the responsibilities of each party, will promote voluntary compliance with our requirements and reduce FDA coverage of the articles under agreement because we will be better assured of the acceptability of the foods you ship.

Based upon our personnel availability and appropriate funding, we are also seeking to encourage consultative type inspections of your food manufacturing operations whose products are intended for export to this country. These inspections are arranged upon your request in those food areas where specific problems such as multiple detentions exist. Of course, many details must be resolved in advance. FDA foreign consultative inspections offer advantages to exporting nations. Resolution of violations at the source can, through helpful recommendations, bring about rapid correction. A well-planned consultative trip can reach a whole industry, country, or area and thereby broaden coverage. Mutual exchange of information and cooperation with foreign government counterparts of FDA can be enhanced.

The objective of the FDA cooperative agreements program is to reduce the need for our surveillance of products under such cooperative agreements and to share responsibility with the official control agency of the exporting country. All agreements are formal, national in scope, and set forth the specific responsibilities of each party. We presently have agreements with a number of countries. A most significant benefit in addition to reducing economic losses is the upgrading of the foods in both our countries.

Recently, I joined Mr. Peiser and some of his associates, along with experts from other countries, in a visit to Bolivia and Ecuador. Our hosts in Bolivia and Ecuador were most interested in how the FDA of the U.S.A. exercises its mission of protecting the consumer. We discussed food laws, food standards, adulteration and misbranding regulations, laboratory methodology - its development and use - and enforcement practices. We considered these areas from national and international viewpoints. We also discussed what my agency is prepared to do, particularly to arrange for on-the-job training for technical and administrative personnel from other countries. Negotiations and arrangements are being carried out now. It should be emphasized that the training mentioned above is beneficial not only to exporting countries but also to those countries which are desirous of improving their own food supply by adopting or adapting those portions of our ways of doing things to their own needs. We want to help if we can and if you ask us.

Further, we have had an excellent rapport with our northern and southern neighbors - Canada and Mexico. We meet frequently at both the policy and operational levels. Many problems have been resolved. For significant problems with particular foods intended for export to this country, our experts have visited a number of countries at the request and expense of the host countries or some international group. For example, a problem arose with aflatoxin contamination of pistachio nuts from Iran and Turkey. Our expert team visited the harvest and processing areas of those countries and made a number of suggestions to reduce mold contamination which results in the development of aflatoxin, a cancer producing substance. We also trained their analysts in chemical procedures to detect the aflatoxins. This activity was most helpful to those countries.

We have to admit that we had problems with pesticide residues found in products from Mexico. We provided technical training to the Mexican analysts so that high pesticide residue foods are detected at the source and not exported. The Mexican Government certifies that the foods analyzed by their technicians are within this country's tolerances and, except for an audit program on our part, they are permitted entry without further examination by us. However, I must emphasize that we do reserve the right - for that matter it is our obligation to our own citizens - to audit the products being imported.

I could continue and relate a number of additional examples of ongoing working relationships we have with a number of other countries, but we need not go into them at this time. However, I should say that the number of individuals who have already come here for training is quite large.

I have spoken at some length of what we are doing to prevent foods not in compliance with our laws and regulations from passing through our ports and thereafter being sold to our consumers. I also spoke of what you can do to see that foods that do not comply with our laws and regulations are not shipped to us in the first place, thereby avoiding unnecessary expense to all concerned. I also spoke of what we can do in the way of mutual efforts to promote the shipment of only acceptable food products.

However, let us note that much of what I have been speaking about is what we may call an after-the-fact activity. How much more advantageous to all - that is, the food processors, the governments, the exporters and importers, and most importantly the consumers - if the food has been grown, prepared, processed, packaged, and shipped in such a manner that there is no reason to prevent either its exportation through your shipping points or its importation by us. In our country - and I believe it is so in yours - the ultimate responsibility for the wholesomeness, the integrity, the packaging, the handling, and the labeling of foods lies with industry. As government people, our responsibility is to assure consumers that no manufacturer, packager, labeler, or shipper of foods has neglected to assume his responsibility and thereby jeopardizes the public health or is cheating or otherwise damages the consumers' welfare. To avoid unnecessary expenses, what better way is there than to grow the food properly, see to it that no toxic residues are in the food, and that it is correctly labeled and transported. If this is done, then neither you nor we are required to destroy it or, if practicable, to spend extra money - which is ultimately passed on to the consumer - to see that it is brought into compliance. There is no question that the prevention of problems is much less costly than any cure. Further, who can affortd to destroy foods when there are so many hungry with us?

In this country, we are promulgating "Current Good Manufacturing Practice Regulations" often called CGMPR's" or GMP's". We have long had regulations which specify the end product requirements that food processors must comply with in order to meet their obligations to the consumer. However, we are now adding to these the GMP's. We are specifying for those in food processing and handling the minimum requirements that they must comply with as they handle raw materials, process, and package food so that the finished product is not prepared, packed, or held under insanitary conditions whereby it may have become contaminated with filth or may create a public health problem. Some of the requirements are general and are applicable to the food processing industry as a whole. Some are specific and apply to a particular industry, for example, the low-acid canned food industry, the confectionery industry, the baking industry, and so forth. Some of the requirements must be complied with, whereas others are simply suggestions. These regulations may concern:

1. conditions to be maintained for the plants and grounds;
2. requirements for the equipment and utensils;
3. sanitation facilities required for personnel;
4. provisions for the cleaning and sanitizing of equipment and utensils;
5. the necessary processes and controls - these cover not only the instrumentation with its calibration and the checking of required accuracy, but also the critical control points and how they should be regulated;
6. the need for coding of the containers; and
7. record keeping for ingredients, processing used, and distribution.

The last two - coding and record keeping - are not to be minimized. With the best of intentions sometimes something may go wrong during food processing. Coding and record keeping are important for locating any offending food so that it may be readily found and isolated. Codes are also important for helping to determine what went wrong so that similar incidents may be prevented next time. However, codes again only help after the fact. Adherence to the earlier parts of my listing will minimize the need for putting the last two to use.

Our food laws and regulations concern themselves with the provision of tasty, healthy, nutritious, and properly labeled food to the consumer whether he be a resident of our country or the food is imported to your country from the U.S.A. It is our obligation in the FDA to see that food processers and suppliers in the U.S.A. deserve the confidence of the consumer.

The packet of printed material which I distributed to the Workshop participants contains one or more GMP's. Let us assume you do not intend to export to my country. I suggest that you look at those regulations anyway. Examine them. Can you adopt them for your own use as written or, because of different problems, must they first be modified in order to meet your needs? That is, can you use them directly, or somewhat modified for the benefit of your consumers? Can we afford to provide consumers - yours and ours - less than the best our industries can do? Obviously, I do not believe so. I am certain that you agree with me.

Let me briefly discuss one problem area which those of you involved in the canned food control effort in your country should be aware of, if you are not already. I spoke a moment ago of the GMP's and referred to low-acid canned foods. In view of the recent detection of Clostridium Botulinum Toxin in some commercially canned low-acid foods, the FDA promulgated regulations for the preventive control of this problem. They are identified as 21 CFR 128B. Those may be found in the distributed packet. We have no reason to believe that the incidence of "Bot" toxins in canned low-acid foods is any different in your country than ours. We are confident that should you review your canning industry status and capabilities you would identify the same deficiencies as we did. The regulations we recently promulgated are now in effect and apply not only to our domestic industry, but also to those manufacturers in your country who ship to us. All firms in your country which are affected by these regulations must first register with us using the appropriate forms. Examples are found in each packet. All processes which are used for foods exported to this country must be demonstrated as producing a safe food, taking into consideration such things as its form, for example, solid or creamed; the ratio of solids to packing medium; the quantity of food in a particular size container; and the kind of heat, chemical, or other sterilization procedure used. The safety of the process must be acceptable to those qualified to judge and must be adhered to. Changes in ingredients, source of supply, formulation, and other factors may require a change in the process. I cannot overemphasize that all processors who wish to ship to us must register and file their processes. This is no more than we require of our own food canners. Any imported foods covered by the registration and process filing portions of the regulations but not complying with them may be refused admission.

It should be noted that an important requirement of the regulations is that supervisors of retort operators and can seam inspectors must have satisfactorily completed a course of instruction in retort operations, aseptic processing and packaging system operations or other thermal processing systems, and container closure inspections at a school approved by the Commissioner of Food and Drugs. The regulation does not specifically exempt supervisors of the retort operators and can seam inspectors of foreign firms from this training but we feel that attempted enforcement would be impractical. Accordingly, in lieu of such training, my agency will accept a statement from the appropriate officials of each of your governments whose function would include quality control of food processing plants that supervisors of registering firms under their jurisdiction are properly trained.

There is so much more that I would have liked to discuss with you. For example, how we develop and adopt analytical methods and use them to determine whether or not a food is in compliance with all applicable regulations. How we obtain, train, and utilize our inspectors. How we obtain, train, and utilize our analysists. These analysts are chemists, microbiologists, toxicologists, pharmacologists, food technologists, engineers, statisticians and so forth. How we adapt our efforts to meet the needs of the problems we face. How we develop priorities for our money and time. How we actively participate in international regulatory food programs such as the United Nations WHO/FAO Codex Alimentarius program. By the way, I strongly urge you who are interested not only in the international food market, but also in obtaining additional benefits in the field of food technology and regulations, to participate actively in the Codex Alimentarius effort. By actively participating, your needs will be more readily considered and probably provided for. Also, you establish and maintain commercial, technological, legal, and regulatory contacts with other countries. A better understanding of the reasons for and benefits from use of the standards is thereby achieved.

There is much to discuss concerning such things as our food additive regulations, our labeling regulations, or our nutritional guidelines to name only a few. In any event, even though I would like to discuss these things, space does not permit me to do so here. However, I shall make myself available - at all times - to you and Mr. Peiser - in a group or individually - for amplification of what I have discussed or those things to which I have referred but not discussed. By hearing from one another, on how we each develop and enforce our own food laws, we all can benefit from those features which are useful to ourselves directly or with some modification.

SOME VIEWS ON SCIENCE AND FOREIGN AFFAIRS

Herman Pollack
Consultant, Former Director
Bureau of Scientific and Technological Affairs
Department of State

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies
National Bureau of Standards

November 7, 1974

Late in the summer of 1974, the author completed ten years of service as the officer in charge of international scientific and technological affairs in the United States Department of State. Although he has retired from that post, he retains a connection as a consultant. In that capacity, in the fall of 1974, he made a quick visit to Venezuela, Colombia, Mexico, and Guatemala to discuss Latin American relationships with the United States in technology transfer. Although this paper will make a few observations on technology transfer, it is concerned mainly with reflections on the developments of the past ten years in governmental relations in international science and technology and a few speculations on the directions of the future.

In reviewing the behavior of governments in dealing with one another over the past decade in science and technology, there are several impressions that emerge with some strength.

First, in marked contrast to the situation prevailing in the 50's and early 60's, it has become "fashionable" for governments to enter into agreements for cooperation in science with each other. Whereas in 1964 the United States Government was a participant in only one such agreement, today the number approaches 20 and is rising rapidly. A comparable remark might be made of many other governments. As an aside, it should be mentioned that agency to agency agreements, as distinct from government level agreements, have become very common. U.S. Government agencies such as the National Aeronautics and Space Administration, the National Bureau of Standards, and the National Science Foundation are now a party to at least several hundred such agreements.

The second impression relates to why governments have become "science" conscious. Governments throughout the world have come to believe that a sound scientific and technological infrastructure and a strong capacity to develop, acquire, adapt, and utilize technology is of critical importance to their economic welfare and development. As this belief evolved, governments devoted increasing time, effort, and money to the creation of governmental capabilities to control their destinies in science and technologies. I have in mind the creation of Science Councils, CONACYT's, parliamentarian committees and studies of science and technology, declarations of science policies, 5-year plans for engineering and scientific manpower, creation of international bodies and programs such as the Committee on Science and Technology of the United Nations' Economic and Social Council, Organization for Economic Cooperation and Development's Science Secretariat, and the Organization of American States' Regional Scientific and Technological Development Program. There are literally dozens of other illustrations to be taken from the preceding very active 10 years.

Since foreign offices deal with internationsl extensions of domestic policy, another phenomenon of the past decade is that foreign ministries developed staffs specializing in science and technology and sent scientific attaches and counselors abroad in goodly numbers.

Today, there is no question but that relationships in science and technology have become an important factor of international diplomacy and that there is no government in the world that does not today attach priority importance to developing strength in science and technology.

The term "Science and Technology" ranges from the purest and most basic scientific research to production of hardware and the development of "know-how" for the industrial implementation of a technical discovery. Government cooperation covers this entire spectrum, but it is far easier to put together a governmental-level cooperative program on the mid-Atlantic Ridge than on the mineral characteristics of the sea bed in a coastal area. International cooperation in the polar regions, such as the Antarctic, prospers until the research suggests the possibility of oil in the area. At that point, eyebrows and questions begin to be raised. That is to say that the past decade has demonstrated that the more fundamental the research, the easier it is for governments to cooperate. The closer the linkage of the research to commercial application, the more difficult it is to establish the cooperation among governments. However, the self-interest of industrial enterprises will sometimes lead them to cooperate in research and development across international lines. Thus, an analysis of the subjects of the many thousands of international cooperative activities in science and technology now under way under governmental auspices, would find that they cluster heavily in the area of basic science and are sprinkled only lightly in the technological research area and only sparsely in the technological development area.

Another impression of the past decade is that in those countries which are richer and more advanced in scientific manpower and institutions, the basic scientists tend to manage their international affairs with relatively little reliance on their governments. While they may look to their taxpayers and to their governments for financial support, they prefer to make their own arrangements for international cooperation through direct contact or through their specialized international but non-governmental organizations. On the other hand, in the lesser scientifically developed countries, the dependence on government participation and sponsorship is much greater and the role of governments is therefore more visible in international cooperation in basic science.

Governmental motivation in arranging international cooperation in science and technology is a mixture of many things, but by far the most important is the symbolic political value of the agreement of the ongoing cooperation itself. It signals friendship or a desire to develop closer relationships. On the whole, scientific relationships are a non-controversial and proven way of establishing ties between countries even in the face of strong political differences. Idealism, appreciation of the international character of science and technology, and the value of intercultural contacts are certainly present and at times predominantly so. However, on the whole, governments continue to identify their interests in political terms and their international behavior is determined accordingly.

At the same time, the scientific, social, and economic benefits of international scientific cooperation are insufficiently appreciated by governments, especially of the technologically advanced countries. Cooperation does produce tangible benefits - in better health, more food, better use of scientific resources, and so on. Early this year, the State Department published a pamphlet on this subject in order to help convince our own skeptics that international cooperation in science does indeed pay off in materialistic terms. I am sure that a separate text on this could be written in the standards field alone.

Another impression, which is widely shared, is that just as cooperation becomes more difficult to arrange as the subject moves from the basic science to the commercial technology, so too, but much more dramatically, does the difficulty rise as the partners in cooperation increase in numbers from bilateral to trilateral to multilateral. This, of course, is a generalization to which there may be one or possibly several exceptions.

International organizations have played an important role in international scientific relations. Their performance, however, has varied greatly. It is not entirely clear why this is so. Is it safe to say that the quality of output is dependent on the caliber of staff, the availability of funds, the interest and support of member governments, and the nature of the subject matter? Some of these, of course, interact. It is rare that all of these are maximized in one organization.

International organizations have in common the traits of organizations elsewhere. They tend to become more rigid with age, vehicles for retention of the status quo, and much concerned with self-preservation. Organizations created to solve problems perceived immediately after World War II may not be totally relevant to the problems perceived by the international community today. I think this is suggested by the attitude - indeed resistance - of existing international organizations to the creation of the UN environmental organization now headquartered in Nairobi. Similarly, their scramble for a role on energy approaches the undignified.

One development that came forcibly to the fore during the past 10 years was the increasing devotion of the energies of international organizations concerned with technical matters to the problems of development. Indeed the objective of economic development and the provisions of technical assistance to those in need of such, has come to dominate the agenda of many such organizations and is an increasingly central factor in most of the others. In many of these organizations political polemics have been more noticeable than sound technical programs.

A final impression is that during the past 10 years there has crystallized the desire of most governments to concentrate their science and technology cooperation in the technological arena. While especially the objective of developing nations in their relations with the more advanced countries, it is by no means limited to them. In their relation with each other, the advanced countries also frequently prefer to deal with technological subjects. In this, it might be observed, they do not do very well.

Now, what about the future?

First, it is likely that, with one exception, the direction events have taken in the past decade will continue into the future. Governments will attach even more importance to science and technology than they do now. They will increasingly seek ties and support with each other in science and technology and these linkages will increasingly be in topics relevant to national problems - i.e., in applied science and technology.

The exception to past behavior, may be in governmental motivation. Here there is a good chance that the perceptions of governments will be different in the future. For example, in another decade the population and related food crisis may be so aggravated, the threat of nuclear mishaps so great, the possibility of environmental calamity so near, the need to manage and control global technologies such as weather modification and outer space applications so clearly understood that the concept of interdependence will become not a slogan, but a reality of international life. International cooperation in many fields may become the preferred route, because there may be no other. These are the fields that pose problems threatening a nation's true security, but which are not capable of solution at the national level.

If this is right, another conclusion follows. It will become evident as the world community begins to grapple with the problems of interdependence that international institutions are ill-suited to deal with them. The most obvious point is that organizations with sharply defined responsibilities and programs in meteorology, oceanography, food, environment, and so on are not well equipped to deal with problems characterized by their interdependent and inter-disciplinary nature. So one can envisage a growing dissatisfaction with existing structures and a great deal of trouble in doing anything about them. It is not beyond the realm of possibility that the world community will leave existing structures alone, because it will be too much trouble to reorganize them. Instead, new organizations or new mechanisms will be adopted.

If it is correct that the solution of applied, or technological problems will increasingly be the subject of cooperation, and that interdependence will become increasingly the order of the day, we will have to see some imaginative innovations take place. Reliance on traditional modes of international relations and traditional institutional forms will not be adequate. For example, programs of international organizations today are determined in a democaratic manner - by majority rule based on one country - one vote. In the future this may have to be changed to give more weight to absolute and proportionate degree of effort made and the benefits received. Government financed private consortia may have to be used in ways not now visualized. It may prove necessary to provide international organizations with income earning capacity, possibly those with assignments in the management of the oceans, outer space, nuclear energy, and the polar regions. These may be given functions to perform unsuited to national governments or beyond their capacity. The most difficult task governments may have to face in the next ten years is the necessity to work together in the development of technology necessary for survival, as may be the case in energy, food, and possibly the environment. Despite - should one say as demonstrated by the example of the Concorde - governments do not do well in cooperation on technological ventures. Industry does considerably better. However, in both cases, the tradition is not yet established and the specter of competitive disadvantage is a major deterring force.

Definitions of national self-interest continue to be narrowly defined and to be conceived in short range terms. The latter may be credited not so much to native stupidity, but to an understandable desire on the part of political leaders everywhere to be concerned about their reputation in history, and to their proclivity to keep an eye on the next election. There may be satisfaction in berating these circumstances, but it would be better to learn how to be responsive to this attitude if long-term science and technology are to continue to receive across the board support.

It is suggested, that as the prospects of threats to the well being of all governments approach reality, governmental perceptions of self-interest will change and so will the criteria for and condition of cooperative undertakings. Relationships now not feasible may become common.

In all of this the author remains an optimist. There has been a tremendous growth in the past decade in the international level of understanding of science and technology - what it is, how it is fostered, its potential, and its limits. We are better equipped than ever by experience as well as with understanding to apply science and technology capabilities to the solution of the major problems confronting mankind and our capabilities will continue to grow. The human ability to respond to challenge and threat - when they are fully recognized - is impressive. Fortunately, both the recognition and the response to the threats posed by depleted resources, over-population, food shortage, and maldistribution of wealth are rapidly maturing. The hurdles and obstacles should not be belittled for they are very real - but they are not overwhelming and they should not be treated as if they were.

METROLOGY AT THE ARGENTINE REPUBLIC'S
NATIONAL INSTITUTE FOR TECHNOLOGY

Rafael Steinberg
Chief, Physics Department
Instituto Nacional de Tecnologia Industrial
Buenos Aires, Argentina

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies
National Bureau of Standards

November 4, 1974

The Metric System was adopted by Law in the Argentine Republic as early as 1863, and instances of its use date back to still earlier times. This early adoption, later strengthened by the signing of the Meter Convention in 1875, brought about the complete elimination of the use of units of other systems then in force.

Enforcement of the Law has been the responsibility of the Bureau of Weights and Measurements. For quite some time the services rendered fully met the needs of Argentine business, especially for the commercial exchange of goods and the production of raw materials (cereals, meat, hides).

The advent of manufacturing industries, as well as many types of new products, modified this situation. Changes became especially noticeable upon the establishment of the automobile industry after World War II. The wide diversity of products required by end users caused an unprecedented proliferation of small and medium size industrial organizations. This process has deeply changed the social and economic situation in Argentina.

The creation of the National Institute for Technology (INTI) was thus not a casual incident. Established in 1957, after a prior attempt ten years earlier, INTI was the Government's answer to the large number of problems and difficulties caused or aggravated by the lack of efficient technical support for Argentine industry. INTI's present range of activities is wide. It may be said that nothing happens in industry's scientific and technical activity that is foreign to INTI.

INTI maintains a strong bond with the country's productive system, which funds it through a .25% tax on credits granted to industry by the Banco de la Nacion (Nation's Bank) and the Banco Nacional de Desarrollo (National Bank for Development). In turn, INTI is required to operate so as to support effectively all realistic industrial projects.

Within this frame of reference, metrology has been considered from the start as part of the infrastructure required, and thus INTI has since 1960 provided strong support for the implementation of an appropriate metrological program developed at INTI's Technological Park located in Miguelete, near Buenos Aires.

An Agreement for Cooperation in Metrology, operative between 1965 and 1972, helped to link the Physics Department of INTI with the Physikalisch-Technische Bundesanstalt (PTB) of the German Federal Republic. The Agreement provided for fifteen professionals from INTI to go to PTB and for six PTB experts to come to INTI. The success of the metrological operation made a second stage possible. This stage is at present being approved by both governments.

At present there are forty persons concentrating their attention on metrological subjects in the following six fields in the Physics Department at INTI:

i. Mechanics (dimensional engineering, mass and energy)
ii. Electricity (A.C. and D.C.)
iii. Electronics
iv. Heat
v. Acoustics
vi. Optics

About one half of the staff members entrusted with responsibility in these fields of metrology have done research work at large laboratories, such as those of the National Bureau of Standards, the National Physical Laboratory, the Physikalisch-Technische Bundesanstalt, the Laboratoire Central des Industries Electriques, the Bureau International des Poids et Mesures, etc. Members of INTI's metrological team share in the work of the International Electrotechnical Commission and the International Lighting Commission.

The presence of intensive industrial concentration in Argentina's up-country has been attended by some development of associated metrological activities, usually at local university institutes. The idea of using the available human resources, equipment, and instruments as efficiently as possible has motivated INTI's project for the "Sistema Argentino de Mediciones" (Argentinian Measurements System). INTI's authority to create supplementary calibration centers has its legal basis in Act 195.1.1./72 and its implementation orders. INTI's administrative structure is flexible enough to let it conclude agreements with other organizations, such as:

for metrology of process control with the Facultad de Ingenieria de la Universidad Nacional de Tucuman (Tucuman National University's Faculty of Engineering);

for electrical metrology with the Facultad de Ingenieria de la Universidad Nacional de San Juan (San Juan National University's Faculty of Engineering);

for large magnitude mechanical metrology with the Facultad de Ingenieria de la Universidad Nacional de Cordoba (Cordoba National University's Faculty of Engineering);

for mechanical metrology with the Facultad de Ingeneria de la Universidad Nacional de Rosario (Rosario National University's Faculty of Engineering);

for basic electrical metrology with the Facultad de Ingeneria de la Universidad de Buenos Aires (Buenos Aires University's Faculty of Engineering);

for geodesic metrology with the Institute Geografico Militar (Army Mapping Institute);

for the Center for Ionizing Radiation Dosimetry and Calibration, operated under the auspices of the World Health Organization with the Comision Nacional de Energia Atomica (National Commission on Atomic Energy).

All those will be even more effectively used through the coordination process envisaged under the Argentinian Measurements System project.

Act 195.1.1 was promoted by INTI. Its enactment in 1972 helped to update legislation on metrology. The Argentinian Metric System includes the units of the International Metric System (SI). Responsibility for legal metrology rests with the National Legal Metrology Bureau, within the framework of the State Secretariat for Commerce. Industrial and scientific metrology is the concern of INTI, within the State Secretariat for Industrial Development. There is also a National Commission for Metrology which forms the Ministry's technical advisory organization.

I would not like to end this summary without mentioning that familiarity with measuring methods and instrument calibration promotes highly creative activities. Only with such familiarity is it safe to permit departures from established measurement routines. Thus, the fact that by 1965 INTI possessed a group experienced in temperature measurement helped with the satisfactory resolution of a problem posed by the State Secretariat for Housing regarding building materials.

The work of this original group has led to the Habitability Department becoming an important INTI section concentrating on research in the use of non-traditional building materials.

METROLOGICAL SERVICES FOR THE REPUBLIC OF BOLIVIA

Orlando Donoso T.
General Director of Standards and Technology
Ministry of Industry and Commerce
La Paz, Bolivia

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies

National Bureau of Standards

November 4, 1974

Introduction

In every day activities man comes across the necessity to evaluate quantitatively surrounding objects, phenomena and processes. The only method to obtain quantitative information about the material world is by measurement.

During the whole history of mankind, people learned to measure and passed on the accumulated knowledge and experience from generation to generation. At the present time of modern society, measurements have assumed great importance in science, technology, industry, trade, transport, public health, in planning of the national economy, estimation of material wealth, in mutual trade balances, estimation of quality of products, adjustment and maintenance of technological processes, in scientific researches, occupational safety, disease diagnostics, preparation of medicines, and in medical treatments of patients. Many problems can be successfully solved on the basis of using information from measurements.

Metrology and the Bolivian Directorate-General of Standards and Technology (DGNT)

The Bolivian Directorate-General of Standards and Technology (DGNT) is a State Bureau subordinated to the Ministry of Industry and Trade. It deals with standardization and technological research at the national and international level. Although Bolivia has a Law dating from 1893 adopting the decimal metric system, units of the most diverse origin are still used. They cause difficulties in trade, technology, and education. Measurement data constitute the basis of all commercial affairs. Their accuracy promotes expansion of commercial exchange and prevents misunderstanding and conflicts, which otherwise may cause mutual distrust. Consequently, it is necessary to ensure the uniformity of national units of measures. This can only be achieved by mastering the fundamental principles of metrology.

A general definition of standardization is work on establishing and applying rules aimed at regulation of activities in a given field for the benefit and with the help of all interested parties in order to achieve the best general economic benefit. In this particular paper, standardization is to be considered as the development and application of rules aimed at regulating activities in the field of metrology. One has to develop standard methods for determining properties, such as the composition of substances or materials or for defining their purity, for instance, that of drinking water. In all these cases one must specify acceptable properties in standards.

Any standard that specifies parameters or sets requirements for dimensional characteristics should be applied with pre-set accuracy, which may require wide use of measuring techniques. These techniques may depend on definite measuring operations and be linked to a system of calibration. This system expressed in a calibration hierarchy should also be standardized.

DGNT, being aware of the importance of metrological standardization, decided to set up a Standardization Committee devoted to the study of units and symbols. The aim is the conversion to a single system, the metric (decimal) system or, more precisely, to the international system of units (SI) which was recommended for universal use by the Xth and XIth General Conferences of Weights and Measures. The Committee should pay special attention to traditional commercial relations with countries, where different systems are current.

The experience of many countries has shown that the problems of economic development can be successfully solved only in a country that has an effective metrological service. Such a service must assure uniformity of size of units and of measurements throughout the country. Correct results from measurements carried out in different parts of the country must be obtained with various measuring devices. Traditional national measuring systems penetrate deeply into everyday practice and into the consciousness of people. Specific quantitites, their perception and comparison with other quantities, form habits which take root in early childhood. Establishing a single system and its standardization, requires not only technical but also explanatory and informative work incorporated into teaching programs and primary education.

The importance of a metrological service in Bolivia, according to plans of DGNT, justifies the creation of a Department of Metrology within DGNT and consequently, under the Ministry of Industry and Trade.

Activities of Metrology

The activities of the Department of Metrology should:

Determine the need of the country, in order to establish the metrological service.

Provide uniformity of measurements throughout the country by the most effective and economical methods.

Specify in standards the rational nomenclature for the units of measurements.

Specify in standards of measurements scientifically substantiated rules and regulations for metrological procedures for making and presenting the results.

Calibrate measuring instruments and check measurement practices.

Develop rules for legal metrology including those for permitted measures and the methods for transferring the physical quantities which represent the units from standards to measuring instruments.

Test new measuring instruments and methods and certify the quality of industrial products.

Train metrological staff to serve the nation.

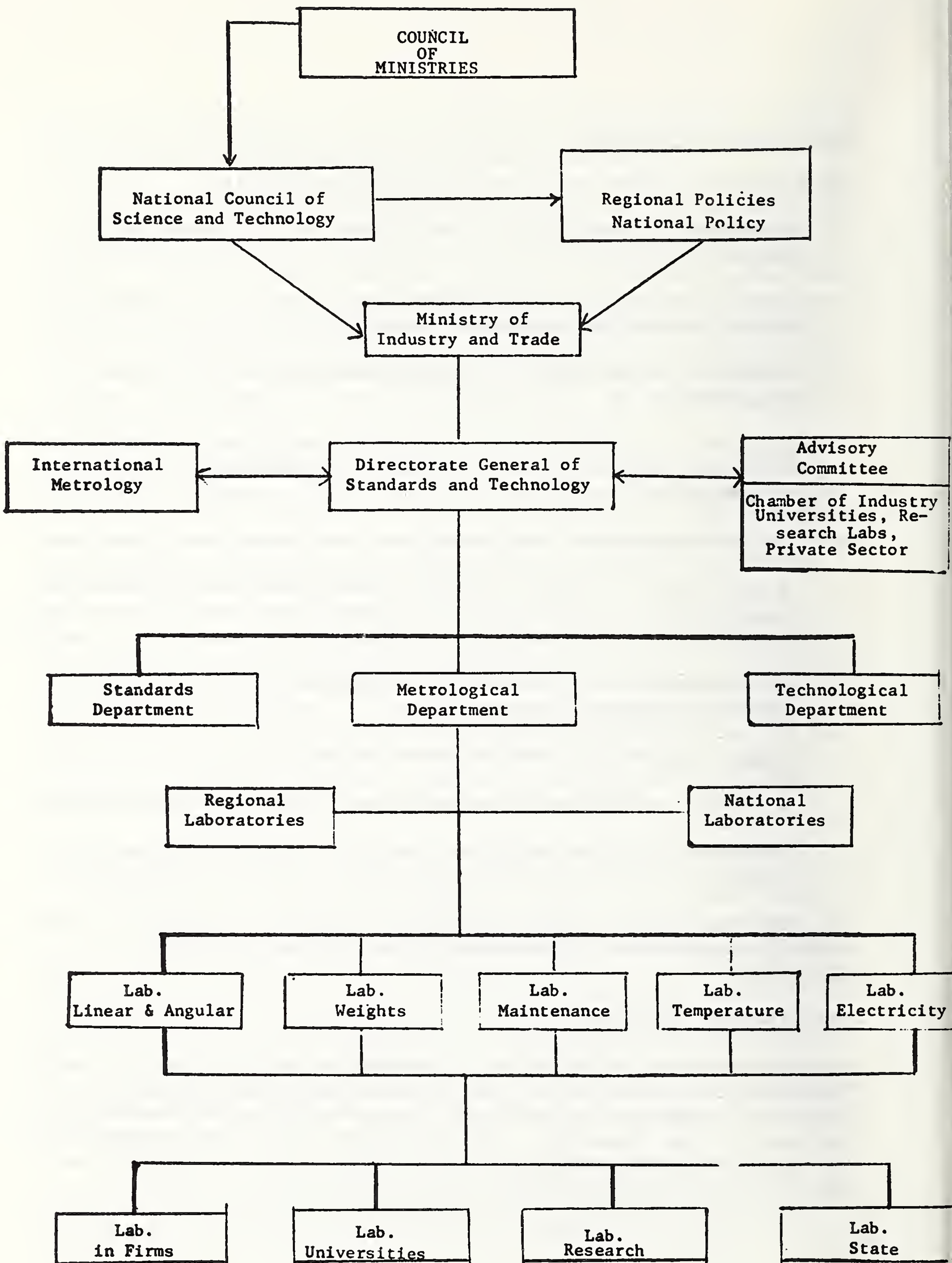
Guide and control metrological activities in firms and factories.

Cooperate internationally in metrology and the associated technology.

The Department of Metrology must solve a complex of problems to ensure uniform measurements. The result of its work is of national importance.

Organization and Structure

The extremely wide scope of the Department of Metrology and its great impact on the development of the national economy and science, make it necessary to pay much attention to the special organization and structure of the Department. By the nature of its task centralization of the metrological service is needed. The structure should be as shown in the following chart:


COUNCIL OF MINISTRIES
National Council of Science and Technology
Regional Policies National Policy
Ministry of Industry and Trade
International Metrology
Directorate General of Standards and Technology
Advisory Committee
Chamber of Industry Universities, Research Labs, Private Sector
Standards Department
Metrological Department
Technological Department
Regional Laboratories
National Laboratories
Lab. Linear & Angular
Lab. Weights
Lab. Maintenance
Lab. Temperature
Lab. Electricity
Lab. in Firms
Lab. Universities
Lab. Research
Lab. State

The Department of Metrology, as the central national institution, should aim to solve all metrological problems. It must be suitably equipped with technical instruments and staffed with highly qualified persons. The Department of Metrology must begin with their specialized training, otherwise planning of the metrological work for the country will be poorly founded.

Training of Personnel

In Bolivia training of staff in metrology is impossible. Therefore, this training should be carried out in countries where well-organized metrological institutions and faculties of colleges dealing with metrology exist. Leading workers and specialists in metrology must have wide physical and mathematical education because metrology is connected with many branches of science. Metrologists must take part in planning and designing complex systems, different complex metrological apparatus, and in solving questions in calibration, its automation, etc. Specialists in metrology must know the problems of standardization and primary standards, of metrological elements, unification, unitizing, and of the main directions of instrument making. Furthermore, specialists in metrology are supposed to develop national standards and measuring units, maintain their level of accuracy and intercompare them with international standards.

The need for specialist staff in metrology depends on the volume of the planned metrological activity and on the structure and functions of the Department of Metrology.

For an initial period and later activities, specialists in the following three categories are required:

1. Specialists of highest qualification (metrological engineers) capable of leading the work on the national scale. They must be trained in special metrological-scientific research institutes, faculties, etc., (such as the High School for Metrology in France). They must possess long-time experience in industrially developed countries. It is important that these specialists are aware of economic problems. This understanding is needed for proper evaluation of the economic effects on the country and the industry, and for proper planning of the metrological work. A future task of these specialists will also be the training of personnel in the country.

2. Specialists of average qualification (metrological technicians) who can directly participate in metrological work. They can specialize in separate branches of measurements. Their practical and theoretical training must be sufficient for reasonable performance of measurement duties and elementary processing of measurement data.

3. Specialists of minor qualification who can work in factories and firms. Their task is to perform correctly measurements and calibrations necessary in production. They can be trained by the specialists in the Department of Metrology.

Laboratories and Equipment

According to the needs of the country, the following laboratories are being planned:

Linear and angular measurement laboratory.
Mass measurement laboratory.
Force measurement laboratory.
Laboratory for the measurement of mechanical properties of materials.
Volume measurement laboratory.
Pressure measurement laboratory.
Temperature measurement laboratory.
Electrical measurement laboratory.

Medical Instruments

Special attention should be paid to the calibration and repair of medical instruments, since all specialties of medicine are closely connected with measurements with instruments for diagnosis, prevention, or research.

Maintenance Service of Instruments

A maintenance service for instruments is also subordinated to the Department of Metrology. This service should be provided by a section for maintenance of metrological instruments. It should be provided with:

a well-equipped shop for mechanical and electrical repairs (milling and drilling machines, etc.);

with experienced personnel;

with plans for periodical repairs including preventive maintenance to avoid major unexpected repairs;

and with imported or homemade replacement parts.

Metrological Legislation

The introduction of metrological principles as standards in the country requires a legislative act by the Government, which should determinate the juridical basis for regulating the activities of the Department of Metrology.

In Bolivia two kinds of standards are used, voluntary and mandatory ones. The degree of compulsion of the standards ought to be regulated by a juridical act, which should be observed by all relevant organizations and persons in the country. It is recommended to make the following standards mandatory:

standards establishing the national measurement system, including the measuring units, the measurement methods, and the means of calibration;

technical standards of a general character comprising systems of perferred numbers, a system of technical documentation;

standards which provide interchangeability establishing tolerances affecting the fit of spare parts, etc.;

a standard classification and codification system for goods for import and national production;

and standards for determining quality-indices, in order to grant quality marks.

The legislative act should determine the responsibilites of the relevant parties in any violation of mandatory standards and the procedure for imposing warnings or penalties. In case of any conflict concerning metrology, the opinion of the Department of Metrology is decisive. For this reason also, it is necessary to settle the status of this Department by Law, defining its rights, responsibilities, and the scope of its power. The main judicial aim of the Department of Metrology is to support legally the uniformity and authenticity of measurement in the country.

International Cooperation in Metrology

In countries in which the concepts of standardization have been introduced recently, it is indispensable to request assistance from developed countries, where standardization is already an expedient instrument for developing the economy of the country. Various forms of assistance will be required, such as:

provision of help from experts to set up the Department of Metrology and to elaborate recommendations for introducing a unified system of units for equipping the metrological laboratories for maintaining national standards and for organizing international comparisons of the national standards;

in training of national specialists in metrology;

for technical documentation (standards, books, etc.) dealing with metrology;

by introduction to the activities of international organizations such as those of the International Committee for Weights and Measures, the International Organization for Legal Metrology, the International Organization for Standardization, and the International Electrotechnical Commission.

TOP LEVEL STANDARDIZATION TRAINING

Felix von Ranke
Executive Secretary
Associacao Brasileira de Normas Tecnicas
Rio de Janeiro, Brazil

NBS/AID Workshop
on Standardization and Measurement
Services in Industrializing Economies

National Bureau of Standards

November 4, 1974

At the request of Francisco Anusz, Director of the Railroad Department of the Ministry of Transports of Brazil, we at the Brazilian Association for Technical Standards tried in 1972 to plan a top level Standardization Training Program.

We had gained previous experience with information programs open to all by registration without condition. With technical assistance by experts from UNIDO, we presented in lectures and seminars the following list of topics:

- T1 - national standardization;
- T2 - international standardization (ISO, IEC, Codex Alimentarius, OIML);
- T3 - Panamerican standardization (COPANT);
- T4 - standardization in the U.S.A., the United Kingdom, France, Germany, Japan, countries of Latin-America and the U.S.S.R.;
- T5 - standardization at the level of companies or governmental offices.

The treatment of each topic consisted of lectures, discussions, and practical work.

After three training programs we reached a definition of time required for each phase:

TOPIC	HOURS			
	INFORMATION	DISCUSSION	PRACTICAL WORK	TOTAL
T1	2x2.5=5	2x1.5=3	2x3=6	14
T2	2x1.5=3	2x1.5=3	2x3=6	12
T3	2x1.5=3	2x1.5=3	2x3=6	12
T4	2x1.5=3	2x1.5=3	3	9
T5	2x1.5=3	2x1.5=3	3	9
TOTAL	17	15	24	56

The training program took one month. Provision was made for an alternate for each lecturer in charge of exposition, for each coordinator of the discussion, and for each leader of the practical work. After the 1 1/2 hour lectures, there was a little break followed by related discussion. The lecturer of each topic was present in the related discussion, but the discussion was coordinated by another expert.

The exposition concerned with T2 was divided essentially in two parts: ISO and IEC, with two different lecturers.

The order of lectures, discussion and practical work was as follows:

T	INFORMATION	DISCUSSION	PRACTICAL WORK
T1	1	1	7
T2	2	2	8
T3	3	3	9
T4	4	4	10
T5	5	5	6

The experts invited for lecturing, coordinating and leading of the practical work were:

Rodolpho Born Jr., Technical Administrator, at that time working in standardization at Petrobrás, Course in Standardization (AFNOR)

Luiz Carlos Martins Pinheiro, Engineer, at that time working in Railroad Standardization, Course in Standardization (AFNOR)

Luiz Alberto Palhano Pedroso, Engineer, Technical Assistant of ABNT, Course in Standardization (AFNOR)

Florentino Cunha Mello, Engineer, working in standardization at Eletrobrás, Course in Standardization (AFNOR)

Paulo Maurício Guimarães Pereira, Engineer, Director General of the National Institute of Technology and Director of COPANT

Franklin Claudio Rache Souto, Engineer, Chief, Comission of Standardization of Petrobrás

Luiz Wilson Marques de Souza, Engineer, formerly Director ABNT

Alberto Cotrim Rodrigues Pereira, Engineer, Chief of Department of Standards and Industries at Eletrobrás and Director ABNT

Felix von Ranke, Engineer, Executive Secretary ABNT

The training program was given in the facility of the "Escola de Engenharia" of the Federal University of Rio de Janeiro, under coordination of Prof. Paulo William Maciel, and a certificate was given by the authority of the University to participants with 75% attendance in the training program and completion in the assigned practical work.

The number of participants was restricted to 12 (twelve) for reasons of availability of working documents and other facilities. Lectures and discussions (except for T4) took place in the University. All practical work and the lectures concerning T4 were given at ABNT because of the availability of documentation. We observed that a reduction of the number of participants to eight improved the quality of the program. Participation in the program was by authorization and restricted to those with a previous university degree in engineering, chemistry, administration or economics.

Such training programs (three to date) confirm the possibility of top level training in standardization in Brazil, and this paper was given with the intention of stimulating similar programs in other countries or regions.

Participants are able to develop standards or participate in standardization at all levels. The cost of one training program was evaluated as U.S.$700.00 for each participant.

STANDARDIZATION IN CHILE

Patricio Sierra
Instituto Nacional de Normalizacion
Santiago, Chile

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies

National Bureau of Standards

November 4, 1974

Historical Review

In 1944 the National Institute of Technical Research and Standards (INDITECNOR) was created in Chile by Decree No. 1987. One of the objectives of this organization was to draw up technical standards to regulate commercial transactions. It had produced approximately 900 documents for this purpose by 1973. In 1946 INDITECNOR became a member of the International Organization for Standardization (ISO). In the meeting held in Petropolis, Brazil, in 1949, the need to create a Pan-American Committee for Technical Standards (COPANT) was discussed. INDITECNOR had an active part in its eventual creation and in establishing the basis for its operation. INDITECNOR carried out its work until 1973. Since that year the National Standardization Institute (INN) has become its legal successor.

Present Situation

INN has the following main objectives:

a) To develop standardization;

b) To promote quality certification; and

c) To organize a central office of metrology.

Standardization is the process through which norms are applied. By a "norm" we mean the standard of reference that unifies and simplifies procedures or products.

Quality certification gives assurance that a product has the minimal characteristics of quality consistent with the norm.

Metrology is the science associated with the measurement of these characteristics.

From the above statements and definitions it follows that an interaction exists between these three functions. If we assume that our purpose is to improve the product quality and if by this concept we understand the appropriate balance between product price and users' satisfaction, it can be seen at once that the following conditions must be met:

a. Standards must establish appropriate requirements on product quality.

b. Quality certification must be granted only to products that meet standard specifications.

c. Quality certification must be based on reliable measurement techniques established on the basis of legal and applied metrology standards.

Consequently, we see how in applying a standard to the certification of a product by quality, an interaction is established between the standard and the quality certification itself. The development of new measurement techniques may show the need to improve the standard itself. (See Figure 1.)

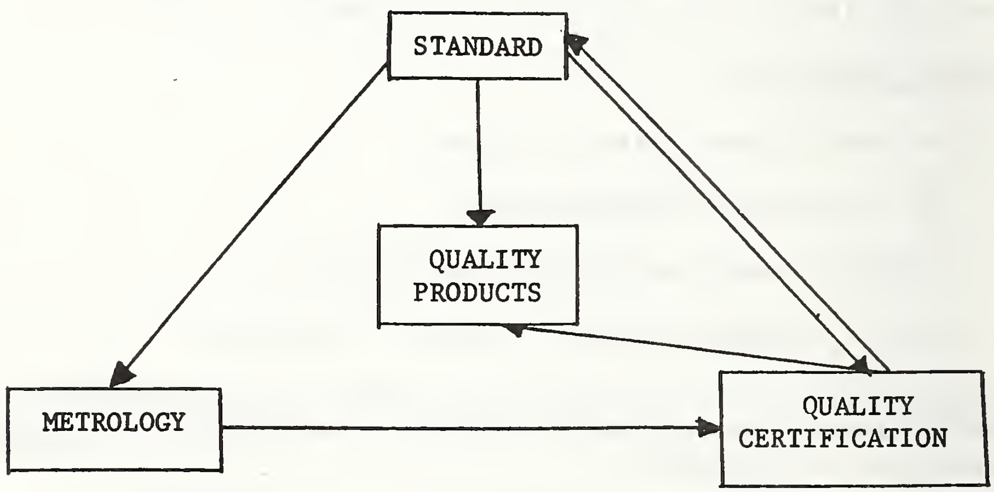


Figure 1

The joint and harmonious development of these three elements is necessary. For this reason, they are included in the statutes of the National Standardization Institute in Chile.

Yet, this does not imply that a single organization like INN must develop all the details that these functions imply. The mandate of INN calls for the "best exploitation of scarce resources". Therefore, INN coordinates all the work that these functions imply, obtaining help from the appropriate sectors.

For the above reasons, the organization of INN is based on the following three divisions: standards, technical services, and metrology. This is illustrated in Figure 2.

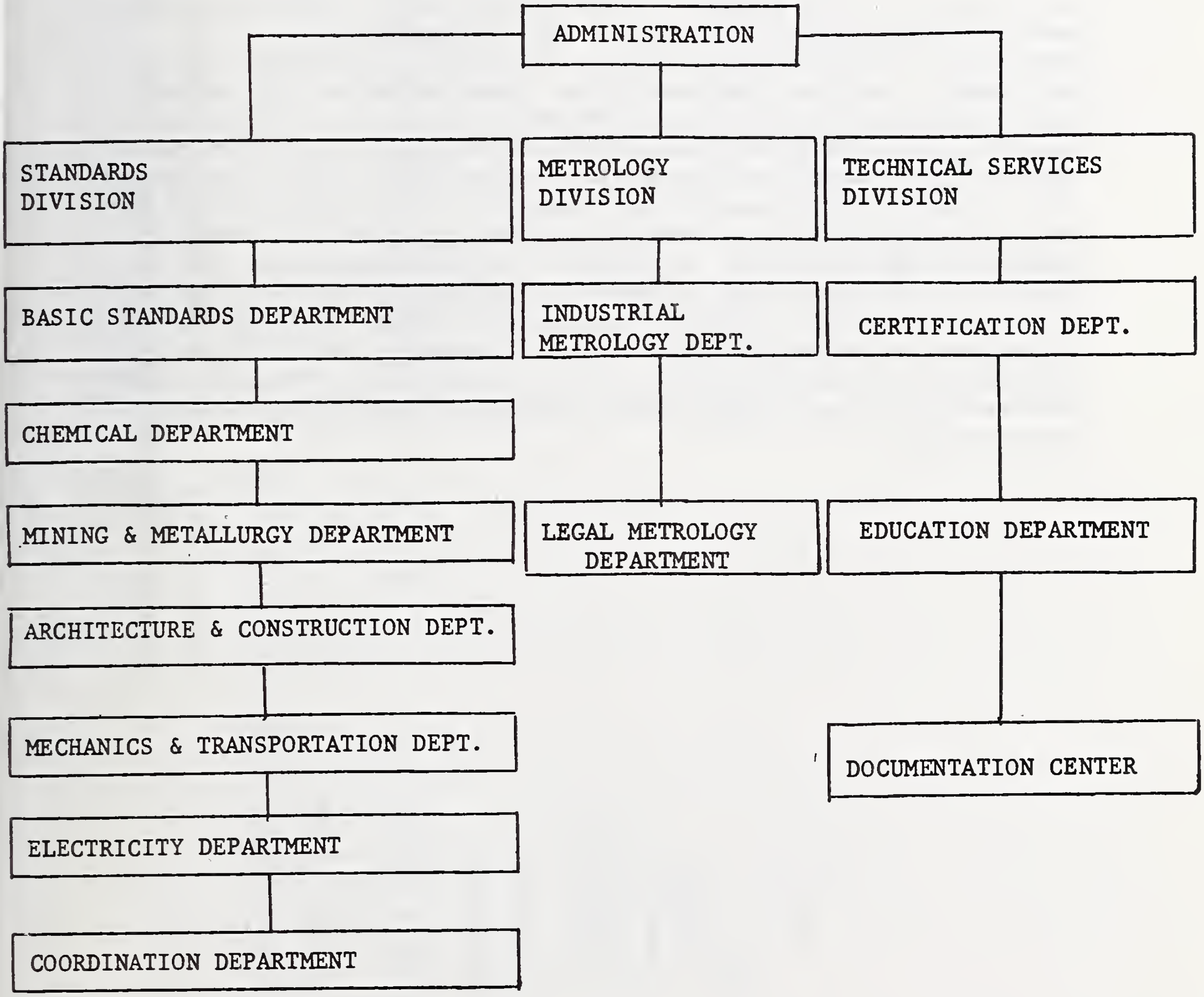


Figure 2

Considering that the principal objective of INN is that the Chilean products are quality products, its policy has been oriented to attain this objective. Nothing is attained merely by establishing technical standards if these are not applied. Their application requires a technically qualified national infrastructure among other factors. For this reason, since 1969, INDITECNOR and later INN have carried out an intensive educational program in quality control, standardization, and - to a lesser degree - in metrology. The information is summarized in Table 1. INN also has encouraged the creation of a national system of quality certification guided by all the effective and appropriate laboratories existing in the country. The objective will be for the products to carry a single stamp of quality.

The above is a brief summary to give a superficial look at what has been an arduous task for 32 years. The establishment of standardization in underdeveloped or developing countries is not an easy task. I believe that one of the characteristics that defines underdevelopment is disorder and inharmonious growth. Technical standardization does not constitute "the solution", but it is one of the effective tools that lead to the acceleration of the development of a country. The standardization models of a developed country are hard to apply directly to developing countries since the market conditions are different. In effect, a substandard product has no chance of competing in the market of a developed country. This is not true in a developing country. The standardization organizations in the developing countries should concern themselves mainly "with application of the standards". This is not true in general in highly developed countries in which this function is carried out almost automatically.

GENERAL STATISTICS, QUALITY CONTROL COURSES, 1969-1974

COURSE NAMES	NO. OF COURSES					NO. OF STUDENTS ENROLLED					NO. OF STUDENTS PASSED				
	1969 1970	1971	1972	1973	1974	1969 1970	1971	1972	1973	1974	1969 1970	1971	1972	1973	1974
Quality Control Level 1	4	4	5	-	2	84	77	84	-	48	68	66	63	-	42
Quality Control Basic Level	5	7	11	5	10	103	118	226	99	197	86	108	175	69	167
Reliability	-	1	-	-	-	-	25	-	-	-	-	17	-	-	-
Zero Defects	-	1	-	-	-	-	17	-	-	-	-	14	-	-	-
Quality Control Indicators	-	1	-	-	-	-	9	-	-	-	-	7	-	-	-
Mathematical Grading	-	-	-	-	2	-	-	-	-	42	-	-	-	-	24
TOTAL	9	14	16	5	14	187	246	310	99	287	154	212	238	69	233
TOTALS			58					1,129					906		

Table 1

SUMMARY ON THE APPLICATION OF THE SINGLE UNITS OF MEASUREMENT SYSTEM IN COSTA RICA

Rodrigo Lopez A.
National Institute of Standards and Uniformity of Measures
San Jose, Costa Rica

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies

National Bureau of Standards

November 4, 1974

Background

Since September 18, 1884, Costa Rica has had a law, with corresponding regulations, establishing the compulsory use of the decimal metric system. This was the first attempt to displace the Spanish and English measurement units which were deeply entrenched among the people. In practice, the system established by law did not gain acceptance. From that date on, the law was complemented by various executive agreements, but it was not possible to establish the metric system in everyday use. In 1926, there was a more formal attempt to reject the Spanish and English units of measurement. However, all these laws, decrees, and regulations, in almost all cases, fell into disuse, so up to the present, in Costa Rica, we have had the simultaneous and combined use of four systems of units of measurement:

a) The traditional Spanish (the vara, the square vara, the city block, the 460 g pound, the 28.75 g ounce, the Spanish foot of 1/3 vara, the 25 pound arroba, the 46 kg quintal, the 920 kg ton and the 87 cl bottle).

b) The English (the inch, the foot, the 2.8317 m^3 register ton for air cargo and sea freight, the 1016.047 kg long ton, the 4.546 liter imperial gallon, the quart (1/4) and the pint (1/8) of this gallon, and the 36.368 liter bushel).

c) The United States (the 453.6 g pound, the 907.185 kg short ton, the 28.35 g ounce, the 4046.86 square meter acre, the cubic foot, the 3.785 liter gallon, the quart (1/4) and the pint (1/8) of this gallon, and the 35.2391 liter bushel).

d) The decimal metric system.

From the various attempts made by the Government, it can be said that only in three areas was it able to impose metrification totally: in property surveying and registration (although in commercial activities the square vara and the city block continued to be used); in coffee production, for which the hectoliter and double decaliter were established as the basic units, and in Customs Tariffs.

Situation in 1974

Fortunately there are the National Archives which make it possible to discern the causes of the failures of the various attempts to establish a single system of units of measures. We want to avoid these causes in the current attempt launched on September 25, 1974.

From the background study made, three basic facts can be seen as the reasons for past failures: a) mprovisation in the attempt to establish the decimal metric system, b) excessive flexibility and leniency of the officials, and c) resistance by the public, its lack of cooperation, and the veiled but effective inclination of commerce to avoid compliance with the law.

Under the new law, which came into force on September 25, 1974:

1) Appropriate periods of time for the adoption of the International Measuring System in the various activities are allotted.

2) The importation of measuring equipment which does not EXCLUSIVELY indicate the units in the metric system is forbidden.

3) Sufficient publicity is organized to persuade industry, commerce and the general public of the desirability of using the metric system. Furthermore, equivalency tables are published in order to avoid confusion.

4) A National Standards and Units of Measurement Bureau has been created, with a body of inspectors having two or more years of professional experience, to oversee the application of the Law. This Bureau is in the nature of a Directorate and is under the Ministry of Economy, Industry, and Commerce.

5) A number of basic activities are regulated to establish the use of the metric system, as follows:

a) For any legal act carried out with reference to measurements of any type, the use of metric units shall be compulsory and exclusive. Neither the law courts nor any other Government agency shall accept documents presented to them if they are not in metric units. Equivalencies are not permitted.

b) Administrative actions by public agencies which are not in accordance with the provisions of the law shall be annullable. Officials originating them shall be directly responsible and, of course, suffer the corresponding penalties. The Official Gazette shall not publish any document that is not according to law.

c) For any agricultural, commercial, or industrial activity, only measuring units authorized by law may be used.

d) On packaging, containers, or labels, measuring units shall be marked exclusively in the metric system.

e) Newspapers, magazines, and any other publicity media may not publish advertisements with measures other than in the metric system. Advertising space has to be sold also solely in units as prescribed by the law.

In general, all activities are regulated in accordance with the International System of Measurements.

Periods for compliance were established in advance in consultation with each of the branches of activity. These periods, in general, are between 1 month and 3 years. In very difficult cases, and where the law implies investment in machinery and equipment, such terms may be extended up to 10 years. Of course, before the end of this term, there has to be partial adoption of the metric system.

The following activities are exempt from the application of the International System of Units for a period of 10 years, from the time the law went into force:

1) those concerning official international agreements, when the parties to such an agreement are sovereign or international organizations, if one of the parties uses a system different from the metric system;

2) the import of mechanical spare parts and tools, provided they do not have non-metric scales;

3) import of non-metric machinery when it is in the national interest provided the importer guarantees to the buyer spare parts service for at least five years.

We are aware of the general resistance to the adoption of the Metric System. The chief enemy is the mental laziness of people, who do not take an interest in a change which apparently offers no incentives.

A sustained and systematic effort is necessary. We, who are in charge of that activity in Costa Rica, are convinced of the multiple benefits of a single system of measurement units and feel very optimistic and pleased with the preliminary results.

Background of Standardization

On September 21, 1951, the Government of the Republic of Costa Rica stated:

1) In view of the planned industrial development, it becomes necessary, for the better guidance thereof, the good of industry, and the protection of the consumer, to issue certain regulations concerning nomenclature, qualities, and other requirements to which industrial products should conform, as well as to provide to industry the technical assistance necessary for sound development.

2) Due to the heterogeneous nature of industrial activity, this task cannot be carried out without technical assistance from specialists familiar with various branches of industry.

3) It is advisable, in order to obtain the most effective results, to have the direct advice and cooperation of industrialists themselves who, by virtue of their knowledge and connection with industry in general, can offer an effective contribution.

Therefore, a Standards and Industrial Technical Assistance Committee was created operating under the Ministry of Agriculture and Industries. This Committee consisted of 7 persons, 3 of whom were representatives of the Chamber of Industries. They met once a week, and had a Chemical Laboratory to obtain answers for various problems presented. This Committee established 30 standards of different kinds. This operation stopped in the year 1956, when ICAITI, a multinational organization in charge of setting standards for all of the Central American area, appeared. The Committee's functions were diluted by other activities and assignments given to it by the Government under different laws.

With the appearance of ICAITI, the Standards Committee, whenever it felt that a standard was necessary, requested it from that Institute. Of course, these requests were not always complied with. We consider this reasonable, since we understand the complications of establishing such standards and the economic difficulties which this Institute has to face. As a reqult of these developments, Costa Rica no longer is engaged in establishing standards.

Present Situation of Standards in Costa Rica

When the National Bureau for Standards and Measurement Units was created, the Standards Committee disapppeared. This Bureau has an Advisory Committee, which carries out more or less the same functions as the earlier Committee. The most important point is that the standardization field already has its own personnel, in charge of overseeing the application of the Metric System. Concerning the additional task with which we are only now beginning, there is little we can say. At present we are mainly interested in standards for food in general (both for human consumption and animal feed) and those that concern agriculture. At present we are concentrating our efforts on the labelling of food products and, of course, we have many uncertainties which we would like to discuss with more experienced people.

We have also once more taken the initiative in establishing standards. At present we are working on standards for animal feed. We also want to modify some of the nomenclature for food products, mainly that concerning labelling. This type of NBS/AID/OAS Workshop is extremely important for Costa Rica and we are very enthusiastic about the great benefits which we may derive from this meeting.

THE STANDARDIZATION ACTIVITIES PROVIDED IN ECUADOR BY INEN

Raul Estrada A.
Director
Instituto Ecuatoriano de Normalizacion
Quito, Ecuador

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies

National Bureau of Standards

November 4, 1974

The Instituto Ecuatoriano de Normalizacion (INEN) was established by Decree 357, August 28, 1970. The Organization actually started functioning in December of the same year and recruited its first technical personnel in February 1971. According to that Decree, it is the duty of INEN to establish technical standards of quality for all products that are traded within Ecuador, that is, raw materials, intermediate products, and finished goods; to set standards for methods of testing, inspection, analysis, measurements, classification and designation of materials and products; and to grant certificates of marks of quality in accordance with standards.

It is imperative that INEN understand the economic conditions of industry and of the nation in order to respond effectively in the general progress of the country and more specifically in its economic development.

In Ecuador, agriculture provides the largest percentage of the Gross National Product. This is a typical case of what is called "Exporter Primary Model" in which the buying capacity (importation) is limited by the continuous price deterioration of basic products exported into the international market. This model shows a low elasticity, in terms of price and income, unfavorable terms of trade, and unstable pricing which creates a commodity surplus and greater instability of the prices. Historically, more than 90% of Ecuador's exports are raw materials, especially tropical ones: cacao, coffee, rice, and bananas. Each one of these products in its time has occupied first place among the exports. For a short time Ecuador was one of the major exporters of bananas, with 18% of the total world market; more recently, petroleum has become the nation's most important export, which complicates further the coherent economic development of the country.

Diversification of exports is urgently needed, for improvement of the Ecuadorian economy to increase the elasticity of the economy and to diminish the negative economic effects caused by excessive fluctuations in the prices of raw materials. These problems are accompanied by the great social problems caused by unequal income distribution, population increase, and slow institutional development. The condition of the labor market restricts the investment in certain economic activities. The slow expansion of the domestic market limits investment in manufacturing, because there are available competitive forms of investment with less risk, as for example in commerce. This structure favors increased consumption of the high income groups with the resulting negative effects on the market. The new phenomenon of economic integration in the Andean Group offers many possibilities for improvement of the export position of Ecuador, more specifically for diversification of sales of manufactured products, and at the same time for increased exports of traditional products. The gradual change in export sales composition, that is, the growing importance of industrial exports, is in itself one of the most beneficial effects expected from the economic integration process. The allied industrial programming which is one of the most effective instruments of the economic integration of the Andean Group is one of the major elements for the industrial development of Ecuador, even more important than the general system of preferences.

The possibility of marketing new industrial products of Ecuador, first in the Andean market and later in the international market, is however, mainly controlled by the competitive position in quality and prices. Efficient use of technology, good management, and the efficient use of resources are important. Technical standardization is regarded as one of the most useful means to obtain the best results from available resources by rationalizing industry and diminishing superfluous varieties of goods; moreover, it is regarded as an efficient instrument of technology transfer. The priorities, therefore, of the recently established INEN lie in two main fields:

1. To supply the proper instruments to improve exports

2. To improve the domestic market, providing for fair dealing, especially for the benefit of the consumer.

In order to achieve the first above-mentioned goal, INEN proposes to raise the level of quality of the national production, and to conform to the relevant requirements of the corresponding international tandards (e.g. those of ISO, IEC, FAO, and COPANT).

We know that in many cases the quality of the product should be in accordance with the standards of the buying country. It seems to be necessary to reach general uniformity of technical consensus at international levels, so as to promote efficiency in production. In this respect it is important to consider the strange situation still prevailing, in which countries like Ecuador who are producers of certain raw materials have not had the opportunity for proper participation in international standardization, so that the consumer countries are the ones who impose their views in standardization. Most of the time this situation works to the disadvantage of the producing countries. We wish to correct this situation with our active participation in ISO. INEN is already a member of IEC and it will become a member of ISO this year.

INEN, as an agency of the Ministry of Industry, Commerce and Integration of Ecuador, is in a favorable position to be an effective element in a coherent export program and, in fact, is being consulted. The active intervention of INEN and other organizations in charge of the country's export policy helps the Government execute a national policy. INEN has the responsibility to certify quality and to administer the use of trade marks in conformity with standards. INEN is enforcing a system of certification based on the best international experience. For the design of this system, it was necessary to analyze the actual technological development of the national industry. In 1971, the first year of activities by INEN, this institution established a system of lot inspection and certification for export purposes, and this has been very successful in finding markets for some new products.

These experiences show the benefits which may be realized with a general system of certification which has been begun in Ecuador. Through its use it is expected that eventually the whole export production will be certified by INEN. The certification marking scheme used by INEN is based on the establishment of systems of statistical quality control at factory level supervised on a regular basis by the Institute. Standardized control methods, designed by INEN, inspection methods, statistical techniques and analytical techniques are used. In this context the testing laboratories of the universities and technical institutes cooperate as "Official Laboratories of Analysis" for the conduct of the multiple tests required. For routine tests or simple analysis of inspection or for guidance purposes, INEN is developing its own laboratory facilities.

The fact that INEN has the function of quality certification as well as that of standardization gives it a special capability which is particularly important in a developing country. The Institute has to see to it that the standards issued by it (or international standards) are reasonable and strictly adhered to. INEN is trying to resolve the difficulties encountered in the domestic market, namely sensitivity to quality, exceeded by greater sensitivity to price.

By standardization solutions can be found to critical problems of quality of public health and safety. The food industry, for example, has serious problems due to the different levels of companies. Some are almost at artisan level, while others employ considerable managerial and technological resources. The whole industry is faced with competition in prices. Rationalization of this industry is one of the fields of action for standardization that has top priority for INEN.

Another problem is that of the construction industry, in which difficulties in national standardization are accompanied by a continual rise in cost, with an adverse influence on the low income population. INEN has among its priorities the standardization of materials, design, methods of testing, modular construction, etc., through which it expects to improve the situation greatly. This activity is the first step towards more important actions aimed to improve construction methods and materials especially with regard to low income housing.

INEN is making rapid strides in scientific metrology. This Institute, almost since its inception, has attempted to remedy the chaotic use of weights and measures that exists in the country through the implementation of the International System of Units. With this objective in mind, the Law of Weights and Measures was designed and issued by the Ecuadorian Government this year. The implementation of this law is the responsibility of INEN. With this implementation in mind, the Institute has installed one of the most modern laboratories of metrology in Latin America; this Laboratory has custody of the National Prototype of Mass and the standard kilogram for use in industry.

A service of instrumental calibration for industry has already been put into operation in order to establish the necessary confidence in the accuracy of the instruments used in the country; this service will be connected with the use of standard reference materials. For all the above actions, the contribution of the U.S. National Bureau of Standards has been of great importance.

INEN is an important link for the transfer of technology and of technical information on standardization and quality control, metrology, and related fields. Microfilm facilities and a mechanical data retrieval system are in the process of development.

It is useful to make reference to the use of the human resources of Ecuador. INEN is making a contribution to better utilization of Ecuadorian scientific and technological talents at all levels; during the present year the Institute has proposed 40 thesis subjects to students who have completed engineering courses at the universities and polytechnics of the country. These thesis subjects are fully sponsored by the Institute by means of:

scientific and technical assistance;
scientific and technical information;
financing of equipment
economic aid.

At this moment, ten theses have already been prepared under this program and now INEN is expanding the program. INEN's support of these thesis subjects is of great significance and is a big incentive for the execution of scientific and technological investigations applied to the country's economic development.

INEN's contributions to the economic development of Ecuador can be summarized as follows:

1. formulation of technical standards in accordance with the National Plan of Economic Development and with priorities for industrial development;

2. active participation in the execution of the National Plan of Development;

3. active participation in the national system of export promotion through certification by lots, improvement of workmanship and professional training, and through assistance in the publication of the Artisan Guide which covers rules and standards for the use of materials, tools and machinery;

4. sponsorship of scientific and technological investigations through support of engineering thesis studies in the areas related to the standardization process;

5. training courses in technical standardization, quality control and industrial safety for workers, as well as advanced courses including those in management;

6. promotion of basic infra-structure change, through the implementation of the International System of Units;

7. impetus to change from a price market to a quality market through the publication of a Consumers' Guide, which gives information on the basic characteristics of quality of products for direct consumption;

8. improvement of the national production through quality certification systems;

9. active participation, as a member of COPANT, in international standardization;

10. publication of basic and specialized knowledge, in periodical form, of: technical standardization, quality control, scientific metrology, industrial safety, and technology transfer;

11. direct assistance to industry with regard to technical standardization;

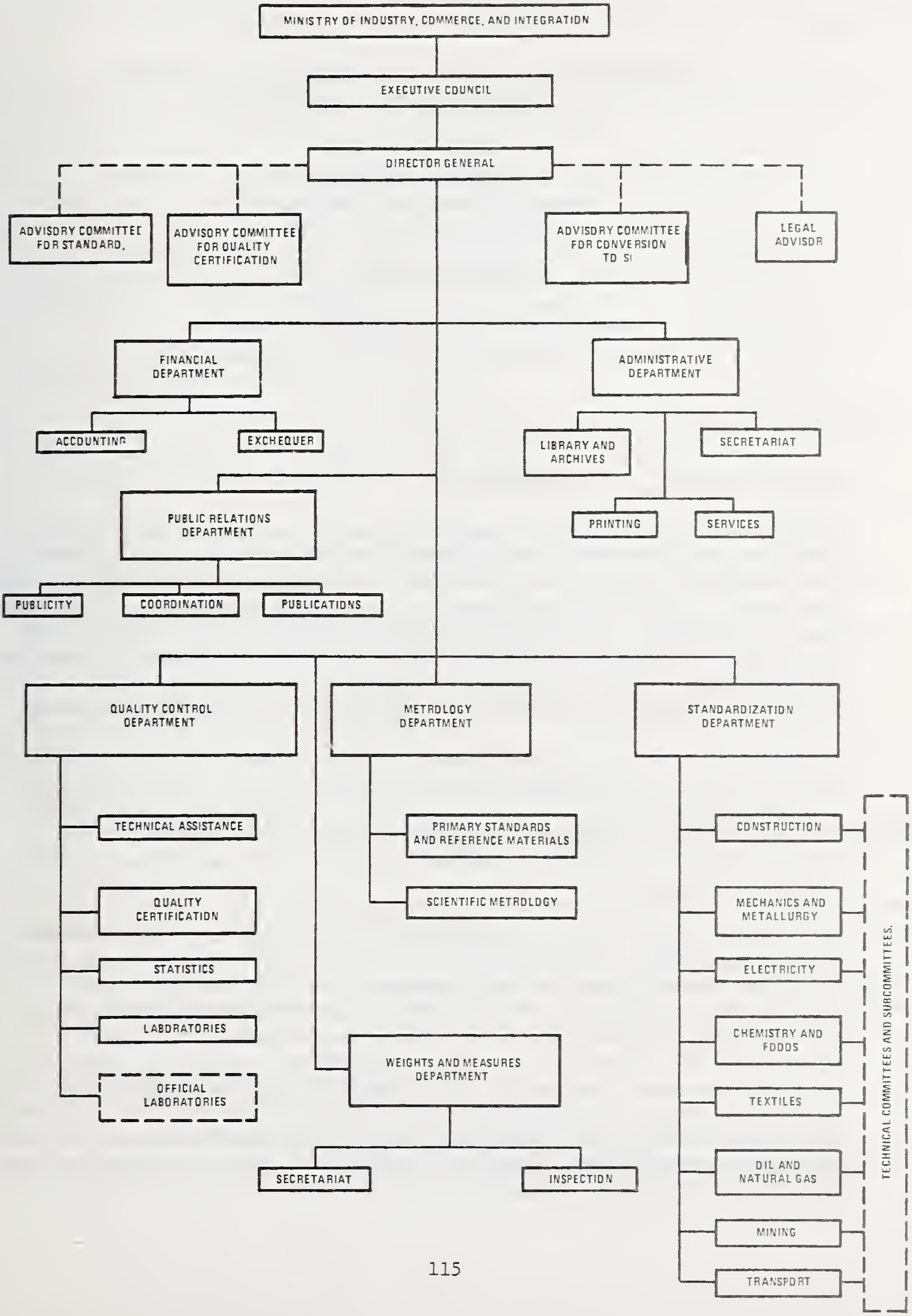
12. technical information services for industry to promote efficient technology transfer.

The Ecuadorian Government is conscious of the importance of INEN's activities, and has approved an increase of its annual budget from 3.5 million sucres to 13.7 million sucres from 1974 to 1975. The establishment of a complete new complex structure of INEN was possible this year as shown in Figure 1.

One of the main factors of INEN's success was the useful and important technical assistance provided by the U.S. National Bureau of Standards. In effect, in 1972, a complete survey of the standardization activities in Ecuador was carried out by an international team of experts with the leadership of Mr. Peiser of NBS. Most of the recommendations of the team were adopted by INEN. A short review of the survey was carried out in June 1974 and important new suggestions were made. It is possible to see now that INEN is capable of contributing in a substantial manner to the economical growth of the country as a whole and also in the technological development of industry.

Figure 1

INEN ORGANIZATION CHART



STANDARDIZATION AND METROLOGY SERVICES IN ETHIOPIA: PROBLEMS AND PROGRAMS

Zawdu Felleke
General Manager
Ethiopian Standards Institution
Addis Ababa, Ethiopia

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies
National Bureau of Standards

November 4, 1974

General Remarks on Standardization

The economy of Ethiopia is based on agriculture, supplemented by commerce and industry. Industrial development is a recent factor in the country's economy but is rapidly increasing in importance. While industrial production represents only a small percentage of the gross domestic product, it is growing rapidly and is one of the fastest developing sectors. Moreover, Ethiopia's foreign trade is important for meeting foreign exchange requirements and, consequently, influences positively the rate of growth of the Ethiopian economy.

During such a stage of development, there was and is a need to organize activities aimed at the rationalization of production, improvement of productivity and quality of products, reduction of wastage, and achievement of other benefits which may be attained through the introduction of standardization and quality control in the national economy.

Within the frame of the provisions of the Third Five Year National Development Plan, 1968/69-1972/73, the Ethiopian Standards Institution (ESI) was established, as an autonomous body of the Ethiopian Government, by Order No. 64 of 1970. Following the establishment of the ESI, the working period of 1970/71 was mainly devoted to organizing the activities of the Institution, including activities such as the establishment of all necessary rules and guidelines to ensure the proper functioning of the Institution, and the drafting of the ESI Proclamation. The preparation of certain standard proposals was also initiated and relevant Technical Committees (TC's) and Sub-Committees (SC's) were set up.

On April 24, 1972, the ESI Proclamation (Proclamation No. 300 of 1972) was enacted, providing the ESI, among other things, with the power to:

Prepare compulsory as well as voluntary Ethiopian Standards relating to practices, processes, materials, products and commodities in commerce and industry and enforce the same.

Review all standards issued heretofore and bring them into conformity with Ethiopian Standards.

Authorize the use of the Standards Mark to be affixed to materials, products and commodities which conform to Ethiopian Standards.

Certify import and export materials, products and commodities which conform to Ethiopian Standards.

Examine and test materials, products and commodities and conduct any investigation or research that may be necessary for their conformity to standardization and quality.

Enter, at all reasonable working hours, into factories to ascertain by inspection and sampling whether materials, products, commodities, practices and processes conform to Ethiopian Standards.

Require producers and traders to provide information necessary for carrying out the activities of the Institution.

Collect fees for services rendered by the Institution and administer any funds received by it.

Other enacted regulations concern the following:

Standards Mark and Fees Regulations which provide for the operation of the Standards Mark Certification Scheme,

Ethiopian Standards Regulations which deal with the approval and issuance of Ethiopian Standards, and

Revised Weights and Measures Regulations which provide for the efficient administration of the national weights and measures program in line with the standardization activities of the ESI.

General Remarks on Metrology

The concept of measurement and the application of measuring instruments in the economic and technical activities of the Ethiopian people is as old as the country's history. Originating from the environment, culture, economy and technical necessities, there has developed a myriad of traditional measurement units and sytems. Besides these traditional measures, during the 17th and 18th centuries, when foreign missionaries and traders entered Ethiopia, modern systems of measurement, metric and British, were introduced in the daily transactions of commodities bought or sold. However, as international ties became closer, bilateral relations in trade and technology grew stronger, and internal trade required more order and protection, it became essential to adopt an internationally accepted system of measurement for equity and uniformity.

Consequently, Ethiopia adopted the "Metric System" as the nation's legal system of measurement in all commercial and technical activities by Proclamation No. 208 of 1963. Later on, SI units were adopted through the approval of relevant Ethiopian Standards. Furthermore, to provide a more scientific and effective measurement system for the Country's continued development of commerce, technology and science in cooperation with other industrialized and developed nations, Ethiopia, in March of 1974, became officially a full member of the Organisation Internationale de Metrologie Legale (OIML).

Progress Achieved in Preparation and Implementation of Ethiopian Standards

Following the establishment of the ESI in September of 1970, the preparation of standard proposals was immediately initiated and relevant TC's and SC's were set up. The members of the different TC's and SC's are drawn from all concerned sectors of the economy, and included representatives of producers, consumers, Government departments. research bodies, university faculties, Chamber of Commerce, consultant groups, technical experts, etc.

The preliminary standard proposals prepared by the ESI Secretariat adopted the standard specifications, practices and methods of sampling, and testing provided for in the relevant International Recommendations and Standards. In cases where such documents were lacking, national standards of specific countries were employed for reference purposes, copies being obtained through the ESI Library. In either case, however, accumulated local data and experiences were used to analyze, verify, and supplement the inputs to standards making and to ensure that the standards evolved were applicable to Ethiopian conditions.

During the preparation of the different standard proposals, study visits were conducted to different factories, export and import groups, laboratories, institutes, Government agencies and the like, concerned with the materials or products regarding which standard proposals were in preparation. Expert opinion on the proposals was also sought from many specialists through personal interviews. Following the completion of initial reports on these undertakings, most of the standard proposals prepared were distributed to concerned organizations for preliminary review and possible comments in their specific areas of activity. The visits and the personal interviews were necessary in order to gain knowledge on the precise contents and scope required for the standard proposals to meet the physical and economic needs of the country.

The standard proposals thus prepared were first submitted to the relevant SC for detail review and scrutiny, after which they were forwarded to the concerned parent TC for ratification and adoption. These committee meetings provided the best assurance that the national standards genuinely represent all viewpoints; that they are adapted to national economic needs; and that they will be successfully adopted when published. Furthermore, the meetings afforded the opportunity of bringing together the best qualified and most experienced people and were instrumental in encouraging them to work together on concrete technical and economic problems, thus providing an invaluable contribution to the technological progress of the country. The standard proposals were distributed, after adoption by the parent TC, to a large number of relevant organizations and individuals for comments. The comments were encouraging and very much in agreement with the standard proposals.

Each standard proposal was then prepared in a form of Draft Ethiopian Standard and submitted to the Standards Board for final approval. The board members, in the light of the recommendations of the concerned TC and the explanations provided by the ESI Secretariat, reviewed each Draft Ethiopian Standard for its applicability to local conditions. As shown below, a total of 658 Ethiopian Standards related to practices, processes, materials, products and commodities have been so far finalized and approved. These standards specify such elements as terminology, method of production, safety requirements, specifications and tolerances of characteristics such as quality, dimensions and the like, sampling, test methods, marking and packing.

Economic or Industrial Field	Number of Ethiopian Standards Approved			
	1971/72	1972/73	1973/74	Total
Basic Standards	11	19	5	35
Safety Standards	-	9	2	11
Agriculture & Food Products	71	132	85	288
Medicines & Pharmaceuticals	-	-	23	23
Water Supply & Sanitation	-	-	32	32
Printing & Office Materials	10	4	6	20
Building & Civil Engineering	11	26	24	61
Mechanical Engineering	6	6	27	39
Chemical Engineering	1	34	46	81
Electrical Engineering	-	18	23	41
Textiles	-	12	15	27
Total	110	260	288	658

The implementation of national standards through the application of the Standards Mark Certification Scheme (involving quality control, testing and the affixing of a certification mark) is a means of guaranteeing that the goods bearing the mark have been inspected and tested, and that they can be purchased with an assurance of quality. In Ethiopia, this procedure was established by the Standards Mark and Fees Regulations of 1973, according to which the use of the Standards Mark shall assume either mandatory or optional status depending on the requirement of the relevant Ethiopian Standard. The producer or trader, upon entering the Standards Mark contract with the ESI, is permitted to use the mark.

In order to shorten the time between the implementation of declared Ethiopian Standards and the signing of the Standards Mark contracts, extensive preparatory activities were undertaken. These activities included:

Conducting a survey with a view to gathering necessary information on individual enterprises, identifying quality control problems, and preparing preliminary inspection reports.

Distributing Standards Mark facsimiles, application forms, and copies of the Negarit Gazeta, with an accompanying letter which invites the relevant producer or trader to submit a completed form.

Surveying facilities of existing testing laboratories, whose normal activities may be quite different from those undertaken by the ESI, to determine their capabilities to perform testing of products according to the relevant Ethiopian Standards.

Sampling and testing products to prove their conformity with requirements specified in relevant Ethiopian Standards.

Making arrangements with the relevant National Marketing Boards so that they take on the responsibility of implementing Ethiopian Standards issued in their respective fields.

Following the completion of the tasks mentioned above, the first group of 110 Ethiopian Standards concerning weights and measures, agriculture and food products, paper and stationery, building and civil engineering, mechanical engineering, metallurgy, and chemical engineering were put into effect by signing Standards Mark contracts with the concerned producers and traders. Consequently, the working period 1973/74 marked the start of the application of national standards in the Ethiopian economy.

Progress Achieved in Metrology

A program of legal metrology providing for equitable weights and measures that assure correct and clearly understood quantities of commodities bought or sold is one of the basic requirements for a healthy development of commerce and industry. Hence, the development of the legal metrology program has been given early attention. The basis for any weights and measures program is the enactment of a law. Such a law does exist in Ethiopia and the ESI has, besides its basic standardization functions, the mandated responsibility of developing and implementing the national weights and measures program.

A small number of inspection teams has, with modest equipment, been verifying annually the accuracy of metric measuring instruments found in the country. The legal metrology work has benefited from the technical support and guidance of the Institution; consequently, a large number of newly manufactured and imported measuring instruments was inspected and verified.

Problems in Standardization

Editing, printing and translating the highly technical standards into Amharic - the official language of Ethiopia - have been very demanding and time consuming tasks. The publication of standards necessitates very close and constant checking and authentication in translation. Certain difficulties were and are still being encountered in the application of Ethiopian Standards, due to the fact that standards are for the first time being enforced and implemented in the national economy. The establishment of internal quality control schemes and substantial public relations activities, aimed at popularizing standardization work, are found to be essential for the success of the standards implementation program.

The lack of adequate testing laboratories and facilities has been a major handicap to the enforcement and application of Ethiopian Standards through a national quality control program. The ESI urgently requires such testing facilities suitable for performance of relevant tests and for strengthening the national standardization practice by integrating quality control, and industrial research for quality control, with the national standardization procedure.

Problems in Metrology

The lack of adequately trained inspectors and other support personnel needed to conduct systematic and periodic verification and calibration of measuring instruments, coupled with the existence of a myriad of traditional measures and hundreds of variations of them, has limited the success of the national weights and measures program.

The major problem which impeded the proper development of the weights and measures activity is the lack of a National Metrology Laboratory where the national primary and secondary standards could be kept and properly maintained for calibrating and tracing the accuracy of field and working standards. Similarly, the shortage of reference and working standards available for verification purposes has slowed down the progress of the weights and measures program.

Programs in Standardization

The importance of rapidly introducing standardization and quality control in the national economy as well as strengthening the metrology services has been constantly emphasized in the Five Year National Development Plans of Ethiopia. In order to provide for the smooth production and transmission of goods and services between the various sectors of national activity, a strong infrastructure of standardization and metrology needs to be created. Hence, during the Fourth Five Year Development Plan period starting in 1975, preparation and issuance of a total of 1,100 Ethiopian Standards is envisaged. Similarly, over 500 certification marking operations are planned to be undertaken during the same period.

The principal objective of the ESI is to support the national interest by the stimulus which standardization and quality control impart to industrial development. We hope to apply Ethiopian Standards in a number of different industrial fields, and gradually establish a guide to nationally agreed industrial practice in order to render production units economic, enhance output of goods of reliable quality, and foster import substitution. In order to achieve this goal, the ESI is planning to establish a National Quality Control Testing Center operating under the Institution. Although the main objective of the Center will be to undertake laboratory tests required for the implementation of Ethiopian Standards, it will also be the place where research and developmental testing can be undertaken for projects directed towards continuous improvement, adoption and development of indigenous and imported technology. Hence, the Center would provide a capability for improving the quality of export oriented production as well as for helping a possible shift from the export of raw materials to that of semi-finished or finished products. It is envisaged that the Center will also undertake testing and research activities necessary to provide basic data and information to be used in the preparation of standard proposals. Thus, it will help functionally to integrate quality control and industrial research for quality control with the national standardization practice. Such an integrated approach will effectively correlate manufacturing capability of industries with national standards and with the implementation of standards after they are issued. Consequently, the involvement of industries in the national standardization process will increase substantially. This will enable the industries to respond meaningfully to standardization at all levels of operation. Hence, the national standardization practice will grow roots in the indigenous "soil".

Programs in Metrology

An essential ingredient of the national legal metrology program are the physical standards of weights and measures. National reference standards and working or secondary standards are necessary for enforcement of legal requirements. It is necessary, initially, to provide primary standards of mass, length, and volume. These would serve as the national standards. Commercial measurements and legal determinations should be traceable to the national standards. Primary reference standards are essential to provide the basis for an equitable level of accuracy in commerce. To provide traceability and the link between commercial measurements and the national standards, adequate field standards of weights and measures are employed; these include standard weights, capacity measures, and linear standards.

The standards program will be broadened in the future to include electrical standards, temperature standards, gage blocks, and other measuring instruments. However, the initial requirements usually relate to the measurement of mass, length, and volume. Calibration of field standards against national standards does not necessarily ensure that measurements are accurate since other aspects of measurement process may not be under adequate control. As the measurement practices in Ethiopia become more sophisticated, attention will have to be given to the entire measurement procedure in order to be sure that systematic errors are minimized.

The establishment of an environmentally controlled National Metrology Laboratory to house the national standards and laboratory instruments is planned. The Laboratory will have the following main responsibilities:

To provide and maintain the national physical standards which, to assure accuracy, will be compared at regular intervals with national physical standards of major industrial nations or international primary standards.

To develop and provide calibrated verification equipment for the Office of Weights and Measures, for use in legal enforcement activities.

To plan, institute and operate a nation-wide educational program for the consumer and farmer so that the public can know and identify the correct type of measurement and also exercise self-protection when selling or buying agricultural or industrial products.

In cooperation with other organizations, to do research and find solutions, if possible, to problems involved in developing accurate and standardized measuring devices for replacement of traditional ones.

To develop standards of performance, accuracy limits, and other requirements for testing commercial devices for an orderly commercial weights and measures program.

To provide annual calibration services for verification of instruments used by the Office of Weights and Measures.

To develop test procedures for weights and measures inspectors to apply to commercial as well as scientific measuring devices.

To assist in developing laws and regulations concerning weights and measures.

To provide calibration services to industries, universities and other research institutions.

To train scientists, inspectors, and technicians of different laboratories as necessary for metrology.

The national weights and measures program will therefore concern itself with metrication activities as well as conducting systematic periodic calibration and verification of measures and measuring instruments used in commerce and industry. The program will involve establishment and operation of District Control Laboratories for Metrology and Inspectorates.

Conclusion

An increasing rate of economic growth is the major national goal of any developing country. Achieving more rapid growth requires, among other things, investment, influx of technology, and creation of the infrastructure and other support facilities essential for the proper performance of the various sectors of the economy. The national aspirations of a country like Ethiopia are, however, hindered by economic problems which inhibit progress.

Standardization makes an important contribution to the solution of several economic problems which affect all countries, but which are particularly pressing and crucial for developing economies. Among the various factors affecting productivity, standardization ranks high. Standardization permeates the entire economic structure because it profoundly influences the productivity and efficiency of each and every enterprise. Without the foundation of standards, metrology, and quality control programs, mass production and the development of a mature industry and export capability are all virtually impossible. It is to achieve these objectives that the ESI is vigorously expanding its efforts to introduce standardization, metrology and quality control programs in the Ethiopian economy. Since developing countries like Ethiopia are faced with limited resources and technical personnel, developed countries will have to provide technical assistance to strengthen and accelerate the standardization and metrology programs of developing economies.

PRECISION MEASUREMENT IN INDONESIA

Mr. Sumantri
Deputy Chairman for Technology
Indonesian Institute of Sciences
Jakarta, Indonesia

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies

National Bureau of Standards

November 4, 1974

Accurate and uniform measurements are essential for the scientific community, and for industry and commerce. Examples of areas of national life where measurements are of vital importance include:

- accurate assessment of natural resources;
- regulation of trade;
- regulatory and service functions of Government (e.g., health, electricity);
- scientific research;
- medicine;
- chemical analysis and the characterizing of the properties of materials;
- testing of industrial and agricultural products;
- ensuring the correct performance of equipment (e.g., aircraft maintenance); and
- ensuring interchangeability of mass produced parts

The provision of adequate measurements and analytical and testing services, is therefore an important link in the infrastructure required for national development.

Indonesia has not as yet a body, or organization, which is responsible (accountable) for the custody of national physical standards in a way which ensures that they are consistent with the physical measurements of other countries, and for ensuring that measurement services are adequate to meet the needs of science, medicine, and industry, as the nation develops (except in the limited field of "weights and measures" to be used in trade - and such standards should in any case be calibrated in terms of the physical standards referred to above). In other words, there is no "national standards laboratory".

There are laboratories with capability in various classes of measurement; but the level of skill in measurement, and the accuracy of the equipment, across the entire spectrum of precision measurement, is very uneven; and in some classes of measurement there are no precision measurement facilities at all.

Although reasonable equipment does exist for some classes of measurement, the laboratories which have these facilities do not have any statutory responsibility to provide nation-wide calibration services so as to maintain their facilities at the level required to service the needs of the country (except for the Directorate of Metrology of the Department of Trade, which has responsibility in the limited field of weights and measures used in trade). Each organization therefore provides what it requires for its own purposes, without regard for the needs of other groups who might also have a need for precision measurement in that field. There is no co-ordination on the basis of national needs at all.

One important deficiency caused by this lack of a body responsible for national physical standards is that Indonesian measuring equipment is not calibrated in a way which ensures that its calibration is <u>traceable</u> to international standards.

It is true that when measuring equipment is purchased it will have been calibrated by the maker in terms of international standards, and at that time its calibration can be said to be "traceable" to international standards. But measuring equipment does not retain its calibration indefinitely. Even if it is well used, its calibration will drift with time; and if it is misused, its calibration will change rapidly - or it may lose its calibration altogether. In any event, when it is repaired it must be recalibrated.

Instruments must, therefore, be recalibrated at regular intervals - particularly in the Indonesian climate, which is very unfavorable for the retention of calibration for precision measurements. But up until now, there has been no one responsible for ensuring that the calibration is done. Furthermore, the very low allocation by Government for instrument maintenance means that laboratories cannot afford to send instruments overseas for recalibration even if they recognize the need for it.

From the facts described above, one may conclude that Indonesia's services in the field of precision measurement are inadequate to meet the future needs of an expanding economy, particularly an economy in which industrialization will play an increasingly important part.

Services must be provided to rectify this situation. Such services must lead to:

- a complete and consistent system of measurement;

- coordination with the measurement systems of other countries; and

- measurement services which are adequate to meet the needs of science, medicine, industry, commerce, and education, as the nation develops.

A program has recently been initiated by the Minister of State for Research to develop a national system for calibration, instrumentation, and metrology. Besides the achievement of goals as stipulated above, the program also attempts to bring about improvements in the state of serviceability of scientific and industrial instruments in Indonesia. The Indonesian Institute of Sciences has been entrusted by the Minister of State for Research with the task of serving as the center of system management of the program.

No measurement is ever absolutely accurate and some degree of experimental error is always present. Obviously, measurements should be made as accurately as possible, but as the accuracy of the measurement is pushed higher, so too is the difficulty and the cost of making the measurement. In developing countries like Indonesia, there is a limit to the resources which can be allocated to this, or, indeed, to any other field of science. In such circumstances, therefore, no matter how laudable it may be to strive for perfection, it is necessary to stop short of what can conceivably be attained in the interests of common sense and best utilization of resources.

In Indonesia it is not considered likely to be necessary, at least during the next decade, to set up an organization which attempts to realize primary standards independently. This would be a very expensive, complex, and difficult task, which we cannot afford to undertake. We consider it more appropriate to obtain, as a first step, high quality instruments which have been calibrated in another National Laboratory, or at the International Bureau of Weights and Measures.

It is considered sufficient to provide facilities which are matched to the country's needs, and to assure that the standards facilities are kept constantly under review and strengthened as and when necessary, so that the real needs of the country can be met as the industrial development of the country places greater and greater demands on accuracy of measurements. In this way, the resources which are allocated will be utilized to the full and employed so as to give the maximum benefit to the country's science and technology.

In Indonesia, responsibility for precision measurement will, at least for the next decade, be shared by a number of complementary laboratories with specific fields of measurement. In so doing duplication of expensive facilities which already exist could be avoided. It is very important, however, that such facilities as there are be kept in a "current" state of calibration (which they are not at the moment), that there be a clear responsibility for certain fields of measurement, and that funds be allocated for the discharge of that responsibility.

Multilateral and bilateral aid is being sought for building up our national system for calibration, instrumentation and metrology. As a first step, external assessors may be requested to visit the laboratories responsible for the different fields of measurement, to assess the situation in each field and recommend ways and means (such as recalibration of standards, staff training, and laboratory procedures) of strengthening those laboratories so that they may dispatch their duties properly in meeting the needs of the country for precision measurement.

JAMAICAN BUREAU OF STANDARDS

Ovan Julal
Jamaican Bureau of Standards
Kingston, Jamaica

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies

National Bureau of Standards

November 4, 1974

Introduction

The Jamaican Bureau of Standards was established six years ago but laboratories were set up only three years ago. The Bureau offers to Jamaica calibration and testing services in the fields of:

1. Mechanical Engineering
2. Electrical Engineering and Electronics
3. Metallurgy
4. Legal and Engineering Metrology
5. Building and Associated Materials
6. Non-Metallic Materials
7. Chemistry and Microbiology
8. Food Inspection and Testing

Work

One of our main tasks is to make Jamaican industry aware of the importance of producing goods of a desired quality using accepted methods and tools properly calibrated and maintained.

The Bureau's technical staff makes visits to manufacturing establishments to assess their quality control facilities, advise on improvements needed and take samples of manufactured products for testing in the laboratories. It is not uncommon on such visits to discover pressure gages, thermometers, micrometers, balances, ammeters and the like in actual need of servicing and calibration, while still being taken to be in proper working order. Personnel at such plants are sometimes aware of the need for servicing and calibration but do not have other equipment to substitute while the faulty ones are being serviced. The opinion sometimes is that with the existing equipment production is kept at the desired level of quantity, while the quality aspect is being overlooked.

In our efforts at the Jamaican Bureau of Standards to protect consumers, we have established a consumer relations section which receives complaints and channels them to the appropriate sections. Besides each staff member is urged to be on the lookout for shoddy goods on the market, or those not conforming to our compulsory labelling requirements. The consumer relations section also undertakes to give lectures, demonstrations and tours to interested groups.

There is the problem of many small manufacturers who do not have the resources necessary to establish proper quality control facilities. We assist by making our services available, sometimes at a token charge. A system is now being worked out whereby manufacturers - large and small - may send their quality control personnel to be trained in our laboratories at no cost to the manufacturer.

Specifications

Sixty-two specifications have been developed. Nine of these, of which three are compulsory, have already been declared as standards. Our Standards Mark, as a part of our certification mark scheme, is not now being used on any product but an early appearance is foreseen.

Equipment

The equipment of the laboratories was donated largely under United Kingdom Technical Assistance. The U.K. also provided four experts to assist in setting up the laboratories and to train Bureau staff. Additional equipment is required in order that we may expand our services to the country.

Staff

There is a total staff of 112, of whom approximately two-thirds are directly involved in laboratory work. The majority of the technical staff are university or technical college graduates. Only a few of the present staff benefitted from the training offered under the U.K. Technical Assistance mentioned before. A few have received training by way of short courses in the relevant fields.

The Participant's Experience in Standards and Metrology

The participant was recently appointed to head the Engineering Metrology Laboratory which he joined six months ago when that Laboratory was linked with the Weights and Measures Laboratory and Inspectorate to form the Department of Metrology. He reports to the head of the Department. He had no previous experience in Engineering Metrology.

He spent the previous three and one-half years working in the Electrical and Electronics Laboratory of the same institution where experience was gained in the calibration of current, voltage, and power meters in the maintenance of standard cells, standard resistances, precision potentiometers, etc, and in the safety and performance testing of electrical products such as batteries, switchgear, air conditioners, refrigerators, electric irons, plugs and sockets.

In the Engineering Metrology Laboratory, the work undertaken includes the calibration of slip gages, micrometers, height and depth gages, dial indicators, straight edges, length bars, steel balls and surface plates. Among the products entering the laboratory for dimensional checks are electrical conduit wires, thread forms, pipes, nails, wire staples and dies.

The equipment of the laboratory includes dimensional standards, millionth comparator, a toolmaker's microscope, a pitch-measuring machine, an optical rotary table, surface tables and hand tools.

An expansion of our services into the field of machine tool metrology is now being studied as a result of requests made by factory and workshop personnel. We are also investigating the need for a manual of simple measuring devices for use in technical schools.

ECONOMY AND STANDARDIZATION

Kim, Zae-Quan
Director General
National Industrial Standards
Research Institute
Seoul, Korea

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies
National Bureau of Standards

November 4, 1974

Economic Development

A system of standardization and measurement cannot exist and develop separate from the state of industry, especially from the degree of industrialization of our society.

Therefore, I shall begin with a brief discussion of the state of Korean industry today and its projected development.

Within a relatively short span of a decade, Korea has made major progress towards becoming a modern industrial nation. With a population of approximately 33,000,000, the country's total production increased from US $2.6 billion in 1963 to US $12.4 billion in 1973 and per-capita income rose from $98 to $376 in the same period. The economic planning during the two already completed 5-year economic development plans stressed industrialization and export as the twin national goals. The first (1962-1966) showed an annual average growth rate of 8.3% and the second plan (1967-1971) achieved an average growth rate of 11.4% per annum.

During the current third economic development plan (1972-1976) the main emphasis has been placed on a more balanced growth of agriculture and industry, with economic growth slowed to 8.7%, and on building the structural foundation for the heavy and chemical industries. In the fourth plan period of 1977-81, the economy is targeted to an average of 9.0%.

In this manner we hope to increase the per-capita income to approximately $1,000 and to attain $10 billion of export by 1981.

Such far-reaching goals would be impossible to achieve without a significant change-over of the nation's production apparatus to turning out export products, and an industrial restructuring that increases the ratio of heavy and chemical industry from 33% in 1971, to 40% in 1976 and 46% in 1981.

Need for standardization and quality control

Much of the industrial advances of the sixties in Korea was based on the labor factor. In the manufacturing sector it has led largely to the formation of labor-intensive operations, such as the assembly of cars and industrial equipment. The effort of the seventies is directed towards attaining a greater sophistication in industrial technology and capability, in parallel with an accelerated development of the machinery industry.

However, it might be noted that the building of a modern machinery industry is probably the single most difficult industrial undertaking in a developing economy. The industry serves a rather exacting market (the industrial market), and its development requires the simultaneous build-up of an extensive and economically-viable parts and components supply network. Yet this must be accomplished if the country is to participate successfully in the world market.

The development course that Korea has set for herself is as an exporting nation of manufactured goods. Realistically speaking, there is no other option for Korea since the land is not abundantly endowed with natural resources. In recent years, the array of export items has been shifting and will continue to shift from the simpler labor intensive manufactures to goods demanding greater technical know-how and skills, as well as modern manufacturing facilities. As many of you are aware, Korea launched her first 253,000 DWT supertanker earlier this year. Going back to the nation's development goals, the key to the whole proposition is and will be technology, from the building of R & D capabilities to the establishment of codes and specifications in manufacturing. In fact, it is the technological potential of the country, and not low labor rates, that provides the best rationale for the various industrial undertakings now being implemented or envisioned in the field of metals, shipbuilding, auto manufacture, petrochemicals and electronics. Citing at random some urgent tasks ahead are standardization of select auto components: inlet and exhaust valve, cylinder liner, piston and piston ring etc. Relevant planning and studies are currently underway. However, their implementation will require organization and programs on a national scale that will effectively involve the government and the industry. The organization must above all be competent and objective in the endeavor to establish national standards, the system of quality control, and testing procedures in manufacturing. The programs must be compatible with the needs and the realities of the nation's industrial circumstances. The major responsibilities for these organizations and programs are to be assumed by the Institute that I represent. In the following, I shall briefly introduce the institute and describe its history as well as additional major tasks that the institute must perform.

National Industrial Standards Research Institute

a. Brief history

Korea first established regulations governing modern weights and measures in 1902, although the national standards of the meter and the kilogram had been obtained in 1894. But it was in 1959 that Korea ratified the convention of the meter, and the metric system was put into force in 1961 to modernize weights and measures. The National Industrial Standards Research Institute, an organization similar to the U.S. National Bureau of Standards, was originally established as the Bureau of Mint in July 1883. In April, 1912, the body was renamed as the Central Testing Institute (CTI) responsible for industrial education, as well as testing and analysis of industrial products. The educational department of CTI was detached to become what is today the engineering college of the Seoul National University, and another department gave birth to the National Geological and Mining Research Institute. In September, 1945, the institute was reorganized as the Central Industrial Research Institute and in October, 1961, it was renamed the National Industrial Research Institute. In January, 1973, it became the National Industrial Standards Research Institute (NISRI).

b. Present functions

1) Modernization of the National Standards System
   i) The custody, maintenance and development of the national standards of measurements.

   ii) Testing and inspection of legal weighing and measuring devices.

   iii) Calibration of measuring and weighing equipment for industrial purposes.

   iv) International verification of national standards.

2) Quality control

   i) Testing and analysis of industrial products.

ii) Testing and analysis of export goods.

iii) Production and distribution of standard reference materials (SRM).

3) Research on standardization technology.

4) Technical services.

i) Technical extension service.

ii) Consulting service.

iii) Distribution of technical information.

iv) Seminars and symposia.

5) Training.

6) Energy economy and R & D.

i) Improvement of the Korean traditional heating system "on-dol".

ii) Improvement of efficiency of 19-hole briquet burners.

iii) Development of insulation materials.

iv) Improvement of efficiency of boilers.

c. Development plan

Standardization is of fundamental importance in international trade. It provides a reference in clear language for the negotiations between buyer and seller, especially if there is a scheme for inspection which guarantees conformity with standards. Interchangeability of component parts, achieved by standardization, is important for servicing and maintenance, particularly of exported equipment. The implications for Korea are clear. Exports which amounted to US $40 million in 1961 reached over US $ 4.5 billion in 1974 There was not only an increase in the quantity of exports but also a major change in the type of exports. In the early sixties, primary products constituted over 50% of total exports, while by 1974 these had been reduced to less than 20% with a corresponding increase in export of industrial goods. This trend is expected to continue. In this connection, I should like to introduce our two major projects in NISRI.

1) National Standards Institution

Since the duties of industrial standardization and quality control are scattered over several agencies, the work of industrial standardization has been performed inefficiently. Moreover the need has not been widely recognized. Realizing the importance of these problems, our government invited surveys by United States NBS/AID teams in 1967 and 1972. Based upon their recommendations and our present situation, we are proposing to establish a Standards Research Institute whose main function will be the development of a modern national standards system, research in metrology, standardization of products, and the dissemination of relevant technological information.

We hope to secure the requisite funds from the USAID.

In September 1974, we contracted with General Electric Tempo for a feasibility study of national standards programs, covering the organization, the equipment needs, the staffing needs, and the technical information system plan. Also the Korean government will allocate around 6.5 million dollars for land, buildings, and other basic facilities.

2) Testing and Inspection Centers

At present, there are not enough adequate facilities in Korea for the testing and inspection of industrial products. A proposal for the establishment of a metals testing & inspection center in Chang-Won was made in October 1973 at the German-Korea Economic Working Level Conference. In October this year an agreement was reached for a German feasibility-study team to come to Korea next year. This center is expected to undertake the following tasks:

(a) Quality improvement of metal products to the level of international standards. (b) Technical improvement of the metalurgical industry (c) Training of metalurgical engineers and technicians.

In addition to these we are also planning the establishment of Electronic and petro-chemical products testing and inspection centers which will be located in the various industrial centers.

It is hoped that the maturation of these plans will accelerate Korea's progress to an advanced state of industrialization and a better standard of living.

NOTES ON THE GENERAL DIRECTORATE OF STANDARDS OF MEXICO

Antonio Rico L.
Secretary of Industry and Commerce
Direccion General de Normas
Cuauhtemoc
Mexico, D.F., Mexico

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies
National Bureau of Standards

November 4, 1974

Objectives of the DGN (General Directorate of Standards)

DGN's responsibilities are to coordinate and develop standards for industrial products through standardization committees; to enforce mandatory standards (mainly those concerned with public safety, consumer and other than buyer-seller interests) through the Department of Industrial Inspection; and to verify weights and measures used in commerce and industry through the Department of Metrology. DGN is operated under the Assistant Secretary for Industry in the Ministry of Industry, Commerce and Fisheries. DGN has a Director General and two Deputies respectively for Metrology and Standardization.

The Basic Problem Faced by the Standardization Institutions in Mexico

There exists a lack of understanding and, as a direct consequence, lack of interest in standardization, in the affected sectors of society.

This problem is basically caused by the following factors:

a) The government has not adequately promoted the interests of both the industrial and consumer sectors.

b) Industry has not shown sufficient understanding necessary for carrying out standardization.

c) Lack of communication and coordination among the groups that should carry out standardization.

Solutions to these Problems

Presently, the root causes mentioned above are generally eliminated one by one. The actions are carried out in accordance with the characteristics of Mexican traditions and existing institutions.

Actions in Metrology

First it is necessary to analyze the concepts and contributions made by metrology from a wide view point. Basically it means answering these questions: What is metrology? What is its usefulness? What problems can be solved by metrology? Work is being done to answer these questions.

The present lack of coordination between the relevant institutions and organizations in Mexico, that is Governmental organizations, universities, research centers, etc. is a common condition found in most under-developed countries. It is imperative to eliminate this situation in Mexico. Mexico is therefore promoting the creation of organizations whose functions are to organize and coordinate the existing scattered elements.

The market and the available resources for the establishment of a metrology laboratory are being surveyed.

Staff training will be provided to obtain utmost efficiency. This aspect of DGN's work is receiving attention simultaneously with the other three points.

PROBLEMS AND EXPERIENCES ON MEASUREMENT AND STANDARDIZATION SERVICES IN PAKISTAN

K. Ammar Hussain
Director
Central Testing Laboratories
Pakistan Standards Institution
Karachi, Pakistan

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies

National Bureau of Standards

November 4, 1974

Pakistan emerged as an independent country in 1947 as a result of the partition of the Indian sub-continent into two sovereign states. The area comprising Pakistan inherited a purely agricultural economy with little or no industrial activity. It lacked the institutional facilities considered a necessary prerequisite for healthy industrialization and progress. The Government of Pakistan, realizing the importance and urgency of industrial development alongside agricultural growth, established the Central Testing and Standards Laboratories and the Pakistan Standards Institution in 1951.

Establishment of the Measurement Services

Initially the Central Testing Laboratories was chartered to assist the Government purchasing agencies in the determination of quality, grade and standard of stores procured, and in rendering technical assistance in a host of executive functions. However, with the passage of time and the industrialization of the country, the Central Testing Laboratories gradually came to shoulder the responsibilities of the premier national agency responsible for quality control, with regional centers throughout the country.

By now the Central Testing Laboratories has the following Divisions in operation, manned by adequately qualified, trained and experienced personnel:

- Chemical Division - Organic and Inorganic
- Physical & Engineering Divisions, including Electrical/Electronic/Manufacturing Engineering
- Cement & Building Materials Division
- Textile Division

Bacteriological Division
Planning Division

The problems and experiences of our Laboratories in the area of measurement, analysis and testing are briefly discussed below:

(1) Paucity of Funds

Paucity of funds, in foreign exchange as well as in local currency, has been the most serious impediment to satisfactory progress and development of the measurement and standardization services. Unlike the situation in Europe, America, and even Japan, the private sector of industry, trade and commerce in Pakistan extends no financial assistance in the setting up, modernization, or expansion of scientific institutions. Therefore, the entire expenditure has to be funded through the Government Exchequer which is already overburdened by the endeavor to provide the barest minimum of social facilities to the masses and the need to provide for industrial and agricultural development, etc.

It will be appreciated that scientific and technological development is so rapid these days that testing equipment becomes obsolete very fast, requiring replacement from time to time. We cannot afford the associated expenditures. Similarly, new techniques, raw materials and products are brought to market almost continually; these innovations require specialized equipment, machinery, and apparatus, as well as arrangements for analyses and tests. To keep pace with the times it is essential to ensure the availability of the latest methods of measurement and analysis, which require adequate funding.

(2) Planning of Laboratories

National development plans as they are drawn up from time to time, emphasize adequately with huge capital layout, the development in different areas of economic activities which aim to achieve balanced growth. Yet no importance is attached to expanding and upgrading measurement, analytical, and testing institutions. While therefore very significant and praiseworthy progress is visible in various economic spheres, proportionate institutional improvement in ability to determine the quality and grade of products for purposes of quality control and standardization is seriously lacking.

(3) Wages

The wage structure and other service conditions in our Laboratories are far from satisfactory and do not hold enough attraction for the workers to encourage prolonged employment. As a matter of fact, chemical analysts stay only until a better opportunity is found; this situation has virtually converted measurement institutions to training institutions.

(4) Lack of Calibration Services

Tremendous difficulty is experienced due to the absence of institutionalized facilities for the calibration of industrial and precision measuring instruments. The Central Testing Laboratories provide calibration facilities for industrial instruments on a limited scale. Some calibration facilities for precision instruments are also available. All these facilities are inadequate to match the sophisticated demands of science and technology. The present Government has already realized the acuteness of the problem and has established a weights and measures organization to implement legal metrology and approved in principal establishment of a National Physical Laboratory for Scientific metrology and a National Calibration Service for industrial metrology.

(5) Planning and Training Facilities

No scientific institution worth the name can think of continued progress and betterment without continual planning and development directed towards new fields and areas to match the demands of the times. The greatest impediment to development of new areas is the lack of training facilities for the workers and a proper program for development with expert advice and guidance. Unfortunately, there is neither a national nor an international agency to help in planning, development and execution in new areas of measurement and analysis by offering advice on machinery, equipment, and man-power required and by recommending facilities to train the available human resources. In this context it may be worthwhile to mention that the publications issued by the National Bureau of Standards have been found to be extremely useful as references for the development of new fields of measurement, but they do not serve the need mentioned above. Neither do the books written on laboratory planning and design offer solutions to the problems encountered in setting up new fields of measurement and analysis.

(6) Repair and Maintenance of Equipment

Repair and proper maintenance of sophisticated instruments and equipment has so far presented serious challenges in the absence of needed physical facilities, and with the uncooperative attitude of the suppliers of machines. Very frequently, a particular piece of equipment remains out of commission just for lack of one small component which the suppliers of the machine fail to send despite repeated requests. Similarly, replacement, due to breakdowns, of small spares, especially in older equipment, has proved to be a severe problem, as the suppliers of the equipment typically do not find the request for dispatch of one particular component (which is generally of slight value) attractive enough to arrange for prompt shipment.

(7) Lack of Final Authority in Measurement

There is no legal protection of the results furnished by the national measurement institute. This encourages representatives of vested interests to challenge results and even drag the officials involved with the subject into a court of law where attorneys, by gruelling questions, impute a different meaning to the report than that actually intended. Not being contented with this practice, the attorneys even try to, by mere jugglery of words, to snatch from the mouth of the official appearing in support of a given Test Report, a completely different interpretation of scientific work from that intended. Declaration of the Industrial Metrology Service as the final authority on technical measurements will create confidence among local and foreign contacts, besides boosting the morale of the officials employed in the organization by providing them with protection from unnecessary harassment.

(8) Classification for Purposes of Taxation

Requests are received by the Laboratories from customs authorities for classification, for assessment of State Duty according to customs and tariff regulations, of goods (whether products or matreials) imported from abroad. Very frequently, this presents a delicate problem as the analytical results obtained from any given sample place it on the borderline of two different types of goods, making exact classification very difficult. No doubt Brussels Handbooks, Lloyds Handbook, and some other guides are available on methods of accurate analysis in such cases, yet there are occasions when the scatter of results makes it almost impossible exactly to categorize the goods. According to prevailing taxation rules, a wide difference in the rates of duty may be applicable for a product if it is classified on one side or other of a borderline. As is usual, the importers are keen that the classification and grading is made to minimize duties, while the customs authorities are anxious for the opposite ruling.

(9) Counterfeit or Adulterated Chemicals, Reagents, Etc.

Substantial quantities of chemicals reagents, etc. are procured by the Laboratories from the local market for use in analysis. Experience has shown that very frequently, the chemicals, reagents, etc. are adulterated and occasionally counterfeited. This is one of the causes of inaccurate analytical results requiring rechecks and providing unnecessary opportunities for vested interests to challenge the results, to the embarrassment of the institution.

(10) Duplication of Facilities

While it is admitted that shortage of funds is responsible for the improper and inadequate layout of the existing measurement services, it has been observed that every governmental organization sets up its own testing facilities with utter disregard of existing arrangements. On the one hand, this duplication creates idle capacity, and, on the other, it leads to wastage of scarce foreign exchange for creating facilities already available in the country. By coordinating or pooling the resources of the agencies concerned, large sums can be saved and measurement services can be considerably strengthened.

(11) Standardization Services

The Pakistan Standards Institution was established in 1951 under the same institutional framework as the Central Testing Laboratories. However for administrative reasons, the Institution was made an autonomous organization in 1959. The Institution is primarily responsible for establishing national standards for various items of trade and industry. The affairs of the Institution are managed by a General Council which consists of members of various fields of industry, trade, science and technology, from both the private and public sectors. The General Council appoints an Executive Committee and a Finanace Committee to look after the day to day work of the Institution. The standardization work is carried out by six Divisional Councils and 105 Sectional Committees. The Institution is also responsible, under a law known as P.S.I. Certification Marks Ordinance 1961, for exercising quality control in indigenous industries in general and in export oriented industries in particular. The Pakistan Standards Institution has been a member of the I.S.O. since 1951, and of I.E.C. and A.S.T.M. since 1959. Pakistan being a member of the Regional Cooperation for Development scheme (with Iran and Turkey), the Pakistan Standards Institution is represented on its "Committee of Industry and Standardization" for establishment of Common R.C.D. Standards.

Our problems and experience in the field of Standardization are briefly discussed under the following seven headings:

(1) Neglect of Standardization in Planning

Standardization does not find its proper place in national and international development policies.

In the national theater, this factor is manifest in the unabated process of diversification and in the increasing complexity of plants and machinery obtained from different sources abroad. Planners and designers pay little heed to the requirements of standardization.

Usually, economy is sought in the latest and largest plants without much regard for the infrastructure and resources available in the country. This continually creates problems for national standardization.

The international bodies giving economic and technical assistance and loan-giving agencies, such as the World Bank and the International Monetary Fund, do not seem to attach much importance to the requirements of standardization when examining requests for assistance or loans. In view of the economic benefits of standardization, it is highly desirable that a specific portion of the assistance and loans should be reserved for standardization and quality control, and that this portion should be endowed with special concessions applicable if the loan is used to promote standardization.

(2) Development Loans

Invariably, loans offered by advanced countries for industrial development are tied to the procurement of the plant, machinery, equipment, etc., from predetermined sources. Even if no such condition is specifically imposed, feasibility reports, design, manufacture, erection and studies of operation and maintenance details, which are normally carried out by the aid-giving countries or foreign experts, tend to restrict the selection of plant and raw materials. As a result of the tied loan process, during the past several years, many types and makes of plants, machinery and equipment have been placed in operation. Due to these tied loans even in the same sector of industry, diverse types of plants are in operation. This presents a major problem for standardization. It is therefore imperative that for the sake of standardization no conditions as to the source of procurement of plants and raw materials should be attached to development loans.

(3) Lack of Testing Facilities

The Pakistan Standards Institution does not have its own testing facilities; this results in the work of standardization and certification marking remaining incomplete. However, this handicap has already been appreciated by the Government and the Institution is being reorganized with adequate testing facilities.

(4) Dissemination of Standardization

For promoting an understanding of standardization and its benefits, intense publicity is needed. Documentary films should be used to appeal directly to the masses. The Institution does not have the funds necessary to prepare such documentary films. Standardization conciousness has not grown to the desired extent; the activities of standardization and certification marking are viewed either with no interest or as an encroachment on free enterprise.

(5) Raw Materials

Manufacturers usually are reluctant to adopt national standards on the ground that they do not have an opportunity to import raw materials of proper specifications due to restricted licensing. For the same reason, they are not prepared to guarantee uniformity in the quality of their products.

(6) Absence of Technical Data

The entire standardization activity is based on the experience of others. National and local conditions relate little to the standards. This is due to lack of reliable technical data and lack of co-ordination between the research and standardization agencies.

(7) Lack of Interest and Talent Development

The entire work of standardization has to be done by the staff of the standards body. Very little assistance is available through the meetings of the Divisional Councils and Sectional Committees. The members attending these meetings have no particular aptitude for or experience in standardization. They show either no interest or too much vested interest.

In Pakistan no proper institutional facility is available in either the public or the private sector of industry, trade or commerce to develop potential talents for standardization work. Manufacturing units do not have any standardization activity, since they adopt the company standards of their principals located abroad. Furthermore, no adequate emphasis is laid on standardization and quality control in education at college and university levels.

ACTIVITIES OF THE PANAMANIAN COMMISSION FOR INDUSTRIAL AND TECHNICAL STANDARDS

Ofelia de Young
Panamanian Commission for Industrial and Technical Standards
Panama City, Panama

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies

National Bureau of Standards

November 4, 1974

In 1970, the Government of the Republic of Panama issued a decree-law (No. 282 of December) creating the Panamanian Commission of Industrial and Technical Standards (COPANIT), an organization under the Ministry of Industry and Commerce, in which representatives of sectors, such as industry, Government institutions, and the laboratories of the University of Panama, participate in the development of national standards. At present COPANIT employs 20 persons.

It was only in 1973 that the work of the Commission received support from an executive body, which was established in the Department of Standardization and Quality Control of the Ministry of Commerce and Industry. The task of this body was to develop plans and to carry out the programs of the Commission.

In the period between 1970 and 1973, COPANIT started its standardization work by setting up the basic committees for technical work in priority areas, which in accordance with Panama's needs were related to the fields of construction materials and construction codes. The first experience with standardization work was gained by subcommittees for cement, additives including dry materials, and concrete. From direct relations with the U.S.A., the relevant ASTM standards became the basis for the corresponding standards of Panama. In other areas of industry, the same pattern was followed. Taking into account the limited available Panamanian capabilities, we set up a five-year standardization program starting in 1973. This program cover was extended to about 80% of the products manufactured in the country, and it is now directed to the areas of construction materials, food products, and chemicals, for local consumption. Up to now, the program has covered about 10% of the total work proposed. We have approximately 60 official standards, and a similar number of additional standards are being discussed in subcommittees; approximately 100 further standards are being prepared for adoption as provisional standards. The working procedure we are trying out at present has the following aspects:

1. Utilization of resources available at the Government and private level for standardization plans, although coordination of activities between ministries is difficult, in view of each institution's priorities. For example, the Ministry for Agricultural Development is at present responsible, under our guidance and as a member of COPANIT, for preparing and discussing outlines for produce and standards and, more important, for promoting awareness of the importance of standardization by agricultural producers and consumers.

2. Utilization of the resources available at the University of Panama for testing and analysis for compliance with standards, as well as for research concerning standards for test methods.

3. Coordination at the regional level of standardization activities, including their enforcement.

For our task, which is just beginning, the receptivity of private industry has been so great that, much sooner than expected, we have had to carry out quality control work while at the same time programming for metrification and metrology. In quality control we are at present directing our activities to advisory services to those industries which request the Government to grant them tariff protection or import quotas.

In the field of metrification and metrology, a working committee has been set up with five technical subcommittees, responsible for structuring a metrification program. This program includes a basic plan for introduction of the basic tools of metrology. There is thus a need for some investment of funds to implement this plan. So far, it is fund limitations which restrict the purchase of equipment required to carry out the assigned tasks.

At the same time, there are matters of a more subjective nature, such as the lack of full understanding of what standardization means for countries such as ours. Companies working under international standards, due to their links with multinational corporations coexist with companies which are unaware of what is a specification, much less of what is a standard. Imported materials and consumer products from developed countries may have a level of quality which our industry, being in its infancy, and our Commission itself, are unable to realize.

The need for metrification arises in our country, from the confusing use of a dual system of measurements. Each organization uses units according to its technological level and its links with the international market. Greater problems are caused by the import of obsolete equipment and tools, which are sent to us from the developed countries. Lack, in Panama, of a unified metric system and knowledge on world progress makes such equipment locally saleable.

In Panama, it is important to introduce, at this time, a level of technology which will make our products more competitive. For this purpose, it is necessary to promote technological interchange by means of regional or international standardization, which may help us to attain a balance between the speed of growth of the industry and the speed of adoption and adjustment to standards. Hence, our initiatives are directed towards:

1. Adoption of provisional standards with the intent of introducing the basic concepts of specifications and testing. These standards are to be revised after clearly defined periods of time.

2. Upgrading of existing laboratories by periodic small investments.

3. Installation of a basic metrological laboratory to start our activities in the field of mass, length, and volume measurement and associated regulation of trade.

4. Continuous training programs in quality control at an internal level within the Government and directed also towards all levels of industry.

In these ways we need cooperation from the Latin American region, as well as from OAS and developed countries. With that cooperation, we will be able to go forward.

THE TESTS AND STANDARDS DIVISION AND THE SMALL AND MEDIUM SCALE INDUSTRIES

Jose Planas
Science Research Supervisor
National Institute of Science and Technology
Manila, Philippines

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies
National Bureau of Standards

November 4, 1974

After the liberation period of the last Pacific War, the Philippines saw the beginning of a rapid expansion and proliferation of industries. For example, we increased our production of sugar and copra which are still among our primary export products.

According to an official report of the Department of Economic Research of the Philippine Central Bank, dated December 4, 1973, the ten principal exports of the Philippines, logs and lumber, sugar, copper concentrates, copra, coconut oil, plywood, gold (non-monetary), desiccated coconut, bananas, and canned pineapples, alone created an aggregate income for our Government of U.S. $1 326.3 M. in 1973. During the same period the total earnings from cottage industry exports totalled U.S. $508 M. or an increase of 95.5% over the previous year. It can also be said in passing that, aside from the export of agricultural and industrial products, our tourist industry is fast becoming an important source of revenue.

We find today several large pharmaceutical establishments operating with foreign assistance, producing drugs and pharmaceutical products which we used to import ready packed in small containers for direct sale to the consumers. We find today many partly foreign financed industrial manufacturing subsidiaries. In the steel industry, we witnessed the growth of the Marcelo Iron and Steel Corporations and the Philippine Blooming Mills, not to mention the Iligan Integrated Steel Mills on the island of Mindanao. Iron and steel foundries also increased in number, casting and producing metal products and parts to exacting requirements.

Our leather and shoe manufacturers are putting out much better leather goods now than before. As a proof of this, there was a news item that circulated about two years ago in Manila to the effect that the leather shoes we were importing from Hong-Kong at that time were made out of Philippine materials and by Filipino labor. The cement industry has increased its number of mills in order to cope with the increasing demand for this commodity from our infrastructure and housing programs as well as for export to neighboring countries. The food industry is not to be outdone in the expansion process. We find today various food processing plants manufacturing such items as mayonnaise and salad preparations, fruit juices, milk and other dairy products like canned cheese, food seasonings, candies and other confectionary products, etc. We have also witnessed the development and expansion in other areas like textiles, paper products, construction materials, rubber and plastic products, cigarettes, industrial chemicals and fertilizers. By reason of local and foreign demand they enjoy a favorable economic atmosphere.

As science and technology advance as a result of new discoveries of knowledge, advances in the development of more sophisticated and precise devices or instruments used in the field of measurement follow closely. It is for this reason that instruments operating under the principles and techniques newly acquired are introduced as fast as they are developed, and as a result, we have at our disposal new methods of solving our technical problems.

As we have observed, the progress and development in instrumentation moves rapidly. Today, for example, one develops newer and more precise measurement equipment which can turn out to be outmoded after only a few years by a more versatile and improved instrument. The latter is no doubt much better in performance and more accurate. To an enterprise which is science oriented and which possesses sufficient financial resources or the backing of its mother company, this situation would not be a problem at all; but small and medium scale industries which lack the resources necessary to procure the newly introduced equipment on the market do have a problem. As a matter of fact, a majority of the small scale industries and many of the so-called medium scale enterprises are not even fully equipped for their quality control work. They rely mostly on the integrity of their suppliers of raw materials and on whatever tests they themselves are capable of doing.

There are hundreds of these manufacturing enterprises that need this type of technical assistance and support. At this time where there is resort to compartmentalization in production, different parts of a product being manufactured in several places and afterwards assembled, the problems in measurement are very real and obvious. It is in this area where the Government can give a helping hand.

I am pretty sure that in almost all countries Government testing and standards laboratories of some sort have been established to help industry. In the Philippines, for example, there is the Tests and Standards Division of the National Institute of Science and Technology (NIST) which conducts testing of products and materials and performs calibrations of weights and measures. The responsibility of drafting and implementing product standards, however, belongs to the Bureau of Standards of the Department of Trade, whose present Director, Mr. Vidalito Ranoa, is present with us today. With your indulgence, I would like to discuss with you something about the Testing and Standards Division (TSD) in particular.

It can be stated without fear of contradiction, that the NIST has served the Filipino people and its industries for many years. It was established by Act. No. 156 of the Philippine Commission on July 1, 1901, at an early stage of the American occupation, as the Bureau of Government Laboratories. The prevalence of diseases like cholera, yaws, typhoid fever and dysentery at the time led to the creation of these laboratories and those of the Bureau of Health. The Bureau's first Superintendent was Dr. Gasper Freer, whose appointment on June 20, 1901, had even antedated the approval of this Act.

The first work initiated by the Bureau was in the field of chemistry and in the investigation of tropical diseases. Other activities were undertaken later on as conditions changed; studies in biology, plant breeding, manufacture of vaccines and sera, fish conservation, mining methods, food processing, ceramics, leather, coconut and its by-products were done, as well as calibration of weights and measures and provision of technical services to industries, the general public and the different agencies of the Government through the analysis and testing of products and materials.

A few years ago, NIST signed a letter of agreement with the Bureau of Standards, whereby, among other things, NIST agreed to provide testing services in connection with the Bureau of Standards' activity in standardization. The staff of the NIST also participates in and contributes to the drafting of standard specifications being formulated by the Bureau of Standards and other standardizing agencies. Its services are also available to consumers' associations, like for example, the KILUSAN NG MGA MAMIMILI NG FILIPINAS and the Consumers Union of the Philippines. Since about two years ago, its senior staff have been rendering their services to the Metric System Board, whose Executive Secretary is our friend, Mr. Vidalito Ranoa, who has filled this role in addition to his duties as Director of the Bureau of Standards without additional compensation.

In accordance with the decision of the Metric System Board, created by Presidential Decree No. 187, dated May 20, 1973, NIST was designated as the official custodian of 5 base physical standards, i.e., those for length, mass, electricity, temperature, and luminous intensity.

The rapid industrial growth of the Philippine economy that we are experiencing today as a result of the stimulation being provided the New Society under the leadership of President Ferdinand E. Marcos has rendered the present testing facilities and the calibration capability of NIST totally insufficient to meet the demands of the industries and trade.

As far back as 1962, the need for an assistant to advise the Philippine Government in the modernization and expansion of the capabilities of the TSD was presented to the United Nations Technical Assistance Board. One expert, Mr. Alwyn P. Cox, then Principal Scientific Officer in the Defense Standards Laboratories of the Department of Supply, Commonwealth of Australia, was assigned to the job. A little later, Mr. Arnold Wexler of the U. S. National Bureau of Standards was contracted by UNESCO to prepare a project proposal for assistance to UNDP, which was entitled "Request for Assistance from the U.N. Special Fund for the Establishment of a Testing and Standards Center".

As proposed, the Center will function as a non-profit organizational unit within the framework of NIST, serving both industry and Government. It will have the responsibility for maintaining the national standards of physical measurements, calibrating and certifying secondary standards, providing independent authoritative testing and analytical services, and offering advice and consultation. The original proposal was submitted in 1965 with an estimated total cost of U.S. $2,732,000. Some time in the middle of 1968, a survey team composed of Dr. Ernest W. Nagelstein, Senior Consultant, UNDP, and Dr. James F. McDivitt, Director of UNESCO Regional Center for Science and Technology for South East Asia, made an on-site inspection of the conditions existing in the country. As a result, we submitted a revised version of our proposal in 1969 reducing the estimated costs to U.S. $2,092,356.

Should the UNDP fund this request, the TSL will then become a more potent factor, no doubt, in accelerating our economic development.

A DECADE OF STANDARDIZATION AND A YEAR OF METRICATION IN THE PHILIPPINES

Vidalito F. Ranoa
Director
Philippine Bureau of Standards
Manila, Philippines

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies

National Bureau of Standards

November 4, 1974

First of all, I would like to congratulate the NBS for conducting this Special Workshop on Standardization and Measurement. I also want to take this opportunity to express my profound thanks to Dr. Richard W. Roberts for his kindness in inviting me to this special occasion.

You may be interested to learn of our experience on standardization in the Philippines. Since we are so new in this field, you will certainly not so much profit by our experience as you can help solve standardization problems encountered in our country.

1. Introduction

Despite a decade of efforts directed along this line, standardization and metrication, strictly speaking, have not yet made their full impact in the Philippines today. Neither their advantages nor the benefits derived from their adoption have been realized. To hasten the achievement of our goals, we are at present in the process of reorganizing the governmental machinery to make it more effective and responsive under the demands of the New Society in my country.

2. Standardization

The Philippines Bureau of Standards was created in 1964 by Republic Act No. 4109 with the main objective of promoting and protecting the quality of commodities for both local and international consumption. Responsibilities and powers are defined and entrusted by that legislative measure.

Essentially, Republic Act 4109 enjoins compulsory standardization and inspection of commodities so as to ensure quality acceptability for all goods offered for sale, particularly those for export. For all standardized products, it is mandatory for the Bureau "to inspect in order to sample and determine the standards of said product, and to certify on the inspection and standard thereof".

This law, together with its implementing rules and regulations, requires that the Bureau shall:

1. Establish standards for all

    a) agricultural,

    b) forest,

    c) mineral,

    d) fish,

    e) industrial, and,

    f) other products of the Philippines for which no standard has as yet been fixed by law, executive order, rules and regulations.

2. sample, inspect and certify the quality of;

    a) all standardized commodities and prevent the sale of all commodities which do not comply with the requirements of the Philippines Standards Law.

    b) all products, standardized and not standardized, offered to Government or Government-owned or -controlled corporations which affect life, health or property of the people.

    c) all shipments for export prior to release by the Collector of Customs.

    d) all commodities being imported prior to release by the Bureau of Customs. (The Bureau until a few years ago had confiscated all articles originating in countries with which the Philippines has no trade agreements.)

3. Fix and collect fees for:

    a) inspection,

b) certification,

c) testing or analysis,

d) other services rendered.

4. Make rules and regulations to enable these duties to be performed efficiently.

5. Grant licenses to manufacturers to operate under the Philippine Trade Standard (PTS) Mark Scheme when the Bureau is satisfied that the manufacturer:

   a) can consistently produce goods of the required quality.

   b) has adequate testing facilities to measure the quality produced.

   c) maintains records of the routine quality tests performed.

   d) permits a Bureau inspector to visit the plant at any time to verify that the above-stated conditions are satisfied.

   e) provides the Bureau inspector with any sample product he requires which can be tested by an independent authority in order to verify that the routine records truly represent the quality sold in the market.

6. Grant commodity clearances to exporters registered with the Board of Investments (BOI).

The present organizational set-up of the Bureau of Standards consists of four (4) main divisions, namely: Technical, Standards Control, Field Services, and Administrative. The Technical Division is manned by technical personnel who are charged with the preparation of standards, while the Standards Control Division, together with seven (7) Field Service Units distributed in various parts of the country, is concerned with the control of quality of export and local products covered by the standards promulgated by the Bureau or the buyer-seller standard in the absence of Philippine Standards. The present size of the staff is hardly adequate to cope with the extensive and complex nature of the work involved. For a span of ten years the Bureau has promulgated 186 national standards covering agricultural and industrial products. The Bureau also operates a certification mark scheme known as the PTS Mark and has since 1968 issued 143 licenses to manufacturers to use the mark as a guarantee that their products comply with relevant national standards.

At the time when the Bureau came into existence, there existed and there now still continues to exist a number of other government agencies and organizations which were and are still concerned with standardization matters within specified fields. These are:

1. The Bureau of Fiber Inspection Service, which deals with the grading and inspection of Philippine commercial fibers for export, especially abaca, coir, ramie and maguey.

2. The Bureau of Forestry, now reorganized as Bureau of Forestry Development, which deals with grading rules for timber logs.

3. The Bureau of Public Highways, which is concerned with standard specifications for highways and bridges.

4. The Bureau of Public Works, now the Department of Public Works, which is the authority on materials and products for building and construction.

5. The Bureau of Supply Coordination, which is concerned with specifications for and inspection of goods processed for Government use.

6. The Food and Drug Administration, which is responsible for the standards on food products and drugs.

7. The Philippine Coconut Administration, which is concerned with the grading and inspection of copra and coconut by-products.

8. The Philippine Tobacco Administration, which is concerned with classification and grading of native leaf tobacco.

9. The Sugar Quota Administration, which is responsible for the grading of sugar and for packing of sugar.

10. The Bureau of Labor Standards, which is concerned with codes of practice for wiring and electrical safety.

11. The Bureau of Internal Revenue, which is the Philippine authority on control of weights and measures.

12. The National Institute of Science and Technology (NIST), which is equipped with testing and standards laboratories,

and charged with the task of maintaining national standards and conducting on a high scientific level specific tasks intended to serve the needs of a number of entities and private enterprises in matters of testing of goods and making chemical analyses of products.

13. The National Cottage Industry Development Authority, which deals with the standardization of cottage industry products.

14. The Bureau of Soils, which deals with the standards and testing of fertilizers.

15. The Bureau of Plant Industry, which is the agency for classifying plants in the Philippines.

16. The Bureau of Fisheries, which deals with the classification of fish and marine products.

17. The Bureau of Animal Industry, which deals with the grading of poultry feeds and animal products.

18. The Philippines Standards Association, which is a private agency composed of and managed by manufacturers and producers.

With such many and varied agencies in mind, it would not be difficult to imagine the considerable problem of coordinating, unifying and rationalizing their different standardization operations and responsibilities.

3. Metrication

Historically, the metric system was introduced in the Philippines in the year 1906 and the then Bureau of Science (now National Institute of Science and Technology) was authorized to maintain the "meter" and "gram" as standard units of measurement. A meter bar certified by the International Bureau of Weights and Measures with Serial No. 71 and calibrated at 999.9862 mm had been procured. The meter bar has not been calibrated since then.

In actual practice, the use of the English system and other local measures is still prevalent in the country. With the emergence of the New Society, Presidential Decree No. 187 was issued on May 10, 1973, recognizing only the metric system of weights and measures and enjoining complete adoption of the system in the Philippines effective January 1, 1975.

To realize this objective, the decree created the Metric System Board under the chairmanship of the Secretary of Trade, with the following duties:

1. Cause conversion of existing measures,

2. Draw up a program for nationwide use of the metric system,

3. Promulgate rules and regulations,

4. Acquire new devices conforming to standard weights and measures in the metric system,

5. Disseminate information on the new system, and

6. Provide official equivalents for the old measures.

The Metric System Board has already agreed on the terms relating to fundamental units, conversion factors (including those for old measures), specifications on commercial length, weight, and capacity measures. With respect to the definitions of fundamental units, the Board has decided that national prototypes be maintained by the National Institute of Science and Technology, but the maintenance of National Time remains the responsibility of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), formerly called the Weather Bureau.

Physical standards at various levels (prototype, reference, secondary and working) have to be procured and maintained in the country and these have to be traced back to the International Standards. The Work involves metrology of many types. The maintenance of physical standards at various accuracies and the related metrology is very important in view of the expanding industrialization of the Philippines, not to mention its remarkable economic growth and social stability. At the request of the Metric System Board, a UNIDO Metrication Expert on loan to our Bureau with the assistance of officers of the Tests and Standards laboratories, NIST, the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the Precision Measurement Association of the Philippines and representatives of trade activities, prepared an estimate of the cost involved in the procurement of various devices and the associated metrology. The estimated cost of various units and measuring instruments was about U.S.$1.5 million but, considering the global inflationary trends, the amount may actually exceed U.S.$2 million.

The Philippines Bureau of Standards has no laboratory of its own, a handicap since its inception. It avails itself of the testing facilities of the National Institute of Science and Technology and other Government agencies, including private laboratories, but these facilities have been found to be inadequate to serve for all products subject to standardization. The Bureau has now taken definite steps to set up its own laboratory.

As the science of measurement has become sophisticated, advanced and intricate, it is felt extremely important that we in the Philippines undertake studies in such highly developed countries as the United Kingdom, U.S.A., Switzerland, France, West Germany and Japan. The studies would effectively help us in the maintenance of highest accuracies and in the work with commercial weights and measures, as well as in bringing about complete metrication.

4. Conclusion

That, in brief, is a modest presentation of the condition of standardization in the Philippines, together with its attendant problems. It is hoped that all the participating countries in this Workshop can assist each other in improving their standardization activities, particularly in solving our common problems, under the enlightened leadership and guidance of the host country, the United States of America.

STANDARDIZATION AND METRICATION ACTIVITIES IN SRI LANKA

Ronald T. Wijewantha
Director
Bureau of Ceylon Standards
Sri Lanka

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies

National Bureau of Standards

November 4, 1974

Preamble

It is a privilege and a pleasure for me to participate in this management level Workshop and I wish to convey my sincere thanks to the National Bureau of Standards and the Agency for International Development for inviting me.

Introduction

In this introductory talk, I propose to discuss briefly our experiences in Sri Lanka. In doing so, I shall be leaving many questions unanswered with the hope that such questions will be raised at subsequent sessions and bring about useful and profitable discussions at that time.

Sri Lanka has intrinsically an agricultural economy. Its major exports include tea, rubber, coconut, and to a lesser extent, other agricultural products. The problems which confront us, like most other developing countries, are many and result from severe competition in export trade, eagerness to earn foreign exchange with a view to reducing the balance of payments deficit, and a lack of technical know-how of basic industrial raw materials and of the foreign exchange required to buy even minimal industrial machinery. We now have, added to these problems, the numerous direct and indirect effects of the current energy crisis. In this situation, we have assigned high priority to the rapid expansion of our export capabilities and (where possible) of import substitution, so as to improve our foreign trade balance.

It may not be inappropriate here to mention briefly our industrialization efforts. Industrial ventures can be broadly separated into two categories: the public industrial sector and the private sector. The public industrial sector mainly comprises industrial production of basic items such as steel, cement, plywood, paper, etc., required as inputs for secondary industries and industries geared to the production of other commodities such as leather, tires, graphite, ceramics, textiles, hardware, salt, chemicals, oils and fats. The importance of these public sector industries can be gauged not only by the fact that it supports large infrastructural investments which the private sector finds it difficult to make, but also by the fact that it helps to regulate the development of the economy on sound lines of growth as envisaged in the declared policies of the present Government. The private sector industries embrace production in all other areas such as those of machinery for the tea, rubber and coconut industries, paper, rubber and plastic products, and consumer items such as food, beverages and tobacco.

The value of total industrial production in Sri Lanka in 1972 was U.S. $361.4 million, and in 1973 the value of industrial production at current prices was U.S. $392.4 million.

Standardization Activities

The Bureau of Ceylon Standards was established by Act of Parliament in 1964, and was set up in 1965. The principal objective of the Bureau, as set down in the Act, are to promote standards in industry and commerce, to prepare National Standard Specifications and Codes of Practice, to operate a Standardization Marking Scheme, and, as the need arises, to provide test facilities. The organizational structure of the Bureau of Ceylon Standards consists of a Council of 11 members, one of whom is elected as Chairman. The Director of the Bureau by virtue of office is the permanent Vice-Chairman of the Council. The Council is responsible for laying down policy. The functions of the Director are to organize, direct, and carry out the work of the Bureau in accordance with the policy adopted by the Council. Since the Director is a member of the Council, there is the necessary link between policy making and execution.

The Bureau of Ceylon Standards is by and large an autonomous institution. It is funded by an annual grant from the Goverment's yearly budget. This mode of financing helps the Institution to operate confidently on a set program of work. Sri Lanka has now produced 300 of its own standards and, because of the agricultural bias of the country, a majority of these standards are related to agricultural and consumer items. We have, however, now moved into more sophisticated areas, and at present we are writing standards on about 300 subjects.

As implied earlier, in Sri Lanka industrialization is still in its infancy. The prevalent conditions are different from those in developed nations. Hence, we are faced with chronic teething problems in our efforts to adopt and adapt practices and guidelines used by developed nations. The above is applicable in particular to the principles, the concepts and the methodology of standardization. The method we follow is the same as that which is adopted by developed nations, but it is important to remember that standardization and its methodology in the present form have been evolved in an environment of sophisticated technologies. Shortcomings in implementing standards produced in a similar fashion in an underdeveloped country are, therefore, inevitable. The root cause for the shortcomings and the problems arising is the fact that these practices or concepts are incompatible with our practice and alien to us, yet have been adopted in toto. Although we are aware of the undesirable aspect of this situation, Sri Lanka still follows the accepted conventional methods of standardization. This, I am sure, is because there is presently no other suitable and acceptable alternative method of control and evaluation of industry and commerce. The numerous problems which are emerging are of great concern to us and I think that the time is opportune for re-examination of the underlying methodology.

In Sri Lanka, technical committees which formulate standards are designated as Drafting Committees. The members appointed to these committees are persons whom we regard as competent in their respective fields. Drafting Committees are also balanced as far as possible by ensuring that different groups, such as the scientific community, the industrial community, and the consumer community, are represented on them. In developed countries to secure such representation is not difficult because of the many available competent persons employed in each diverse sector. On the other hand, in my country it is difficult to constitute Drafting Committees which are well-balanced and competent in all respects, especially for industrial standards writing.

I would now like to draw your attention to one aspect of standards formulation. In standards preparation we consult national, regional and international standards, which serve as a useful guide in the preparation of our standards. However, these standards come to have a profound and not always desirable influence on our national standards, especially in cases where our Technical Committees lack competency. Consequently, standards are evolved which, more often than not, ignore the process capability of local industry and may be difficult or impossible to implement locally.

We have recently streamlined the methodology for standards writing, taking into consideration the Australian experience. This streamlining is intended to expedite committee work as well as to utilize better the specialist personnel who serve on Bureau Technical Committees. The new methodology, which has to a great extent eased the undue burdens imposed on members of the Technical Committees, makes it obligatory for the members to study their respective briefs thoroughly prior to attending meetings. It has discouraged unnecessarily prolonged activities of Drafting Committees. It has also made it clear to Drafting Committees that details of drafting and editing work should be left to the Secretariat. A notable feature is the requirement imposed on members to convey suggestions and amendments by letter to the Secretary of the Drafting Committee prior to discussion, rather than making them at the meeting itself. This seems a reasonable approach since standards are open to prompt amendment. It is scarcely necessary to strive for the completion of a standard in every detail before publication. I am sure you would agree that it is more desirable to proceed to publication with a standard rather than hold it up indefinitely until some difficult or abstruse detail is resolved.

While we have so far referred to standards writing, it is equally important to discuss standards implementation. Here, we must confess, we have run into very severe problems. The present problems of lack of technical know-how and the unavailability of foreign exchange to import appropriate machinery and raw materials have contributed to the difficulties with which we are faced. Consequently, except in the case of mandatory standards, the implementation of standards has suffered serious delays. We feel that a vital requirement for the implementation of standards in a developing country is the close cooperation of all interested organizations, whether they be governmental, semi-governmental, or oriented towards consumers, industry, commerce, testing, research, or education. We hope that through multilateral cooperation and a coordinated or integrated approach, effective implementation will become possible. To achieve this end, we have now effected dialogue with the organizations mentioned above.

Since voluntary implementation of standards has not been effective in Sri Lanka, we have been compelled, in areas where we cannot wait any longer, to adopt the less dignified process of compulsory implementation. The areas in question relate to consumer items and export items. The implementation of compulsory standards is possible in two ways. The first way is for the National Standards Institution to make use of provisions in its own legislation to declare a standard compulsory. In such circumstances, the National Standards Body becomes intimately involved with the production process and in enforcing the standard. We have adopted this procedure for two items of consumer interest. The second way is to make a standard mandatory through regulations provided for under other Government Acts or Statutes. In such cases, the enforcing authority is an institution other than the standards body. We have adopted this second approach, to start with, for selected export items. In these cases, the Controller of Exports and Imports has framed regulations stipulating that no export will be permitted unless all consignments of these commodities have been tested and found to conform to the relevant national standard. This method of mandatory imposition of pre-export inspection has satisfactorily been implemented in the case of minor agricultural products such as nutmeg, mace, pepper, cardamoms, cinnamon, cloves, and cocoa-beans. Work is in progress to extend the scheme to include marine products like frozen lobster tails and frozen shrimp. I would like to spend a little more time to describe this scheme, since what we are in fact attempting to do is not only to take policing action, but also to make a deliberate and calculated attempt to effect quality control throughout the different stages in the production lines. It is intended that pre-export inspection will finally be a quality assurance scheme as far as the buyer is concerned.

Once an exporter of minor agricultural products has graded his produce and prepared it for packing, he is initially required to have his consignment assessed and certified by a surveying organization recognized by the Bureau for this purpose. Simultaneously, the exporter notifies the Bureau that the services of the surveyor have been sought for the initial survey of the consignment and that the consignment will in its turn be ready for inspection by the Bureau officers. When the consignment has been assessed, the surveyor is required to send a copy of his report to the Bureau. On receipt of this survey report, Bureau inspection personnel will visit the stores of the exporter and draw a representative sample of the commodity of the consignment. The drawn sample will then be divided into two parts, one for examination and the other for referee purposes. After the requisite sample has been drawn by the Bureau personnel, all components of the sampled consignment will be sealed. At the Bureau, the part of the sample set aside for examination will be evaluated for compliance with the relevant requirements. If the sample is found to be in compliance, a certificate of quality will then be issued to the exporter who will have to attach it to his application for an export license. When the export license is granted by the Controller of Imports and Exports, shipment can be effected. At the Customs, a check will be made to be sure that the seals which were placed on the consignment are intact. If the consignment does not conform to the Ceylon/Sri Lanka Standard, the exporter will be notified by the Bureau. The exporter can then either appeal to the Director of the Bureau within 24 hours of receipt of notice of non-conformity of his consignment or agree to regrade his consignment and start all over again. In case of an appeal, further investigations will be carried out by the Bureau but the verdict that is then given will be final. Up to the present we are pleased to record that we have not had any instances of appeal against our first verdict. I believe this is due to the fact that in the initial stages of implementation of this scheme we educated our exporters and taught them grading and packing, following this up by gaining their confidence through numerous discussions and conferences.

The second major class of export commodity items coming under pre-export inspection and certification is frozen shrimp and lobster products. In the execution of a scheme for standardization of a consumable food item which deteriorates rapidly except under rigidly controlled conditions, safeguards against spoilage and decomposition are absolutely essential. Therefore, the first step in the scheme of pre-export inspection has been to register establishments processing lobster products and frozen shrimp. Such processing establishments are inspected, by a team of personnel drawn from the Department of Commerce, the Department of Fisheries and the Bureau of Ceylon Standards, for their ability to conform to the Sri Lanka Standard Code of Hygienic Practice for the processing of frozen shrimp and lobster products. This Standard Code of Hygienic Practice (SLS 208) lays down conditions in regard to hygienic standards that should be operative in the processing plant and for processing methodology, raw material requirements, freezing conditions, storage and transport.

The next step in the methodology of this scheme is to maintain a continuous check on processing in each of these registered organizations. This is taken care of by Inspecting Officers paying random routine visits to each processing unit, at approximately monthly intervals. Samples from the production line are drawn and examined for conformity to standard and a check is also made on the adherence to the relevant national standard.

The third and final requirement would be to check every processed consignment, and in certain cases, smaller processed batches (depending on the requirements of individual exporters), for conformity to the standards laid down by the Bureau (CS 10 and CS 188). The Bureau has recognized the laboratories of the Department of Fisheries as its approved testing laboratories for marine products. The Department of Fisheries will issue a test report to the Bureau on the basis of which a certificate of quality will be issued to the exporter who will then have to obtain clearance for shipment from the Controller of Imports and Exports. After the required clearance has been obtained, shipment of the consignment could be effected. Here, too, there is provision for appeal in case an exporter disagrees with the assessment relating to a particular batch or consignment.

A discussion of standardization activities in a country is not complete unless mention is made of the educational program. The Bureau presently conducts two sets of courses, one at the middle management level and the other at the technician level. These programs cover important areas such as sampling, control charts, correlation and regression, analysis of variance, design of experiments, and, of course, the principles and philosophy of standardization and quality control. Lectures are interspersed with factory visits to enable participants to obtain first hand information on local industry. The lecturers for these courses are drawn from the universities, other Government departments, the Ceylon Association for Quality Control, and the Productivity Association of Ceylon, as well as from the Bureau. We have also arranged to hold lecture classes in factories for workers in industry.

Measurement Systems

According to the Bureau of Ceylon Standards Act, Section 14 (a), a function of the Bureau is "to house the primary standards for Weights and Measures and to calibrate secondary standards for use by the Weights and Measures Division of the Department of Commerce". This function has in actual practice been in disuse, for two reasons. First, there is a lack of necessary facilities in the Bureau and second, a similar function is prescribed for another organization in the "Weights and Measures Ordinance of 1956 and its Amendment of 1971". Further, the actual field implementation of the measurement services is not a function of the Bureau of Ceylon Standards but a function of the Weights and Measures Division of the Department of Commerce.

In the circumstances, I wish to confine myself to only briefly enumerating my Organization's activities in the field of the proposed conversion of Sri Lanka to the metric (SI) system of units for weights and measures.

In 1966 two associations, the Ceylon Association for the Advancement of Science and the Ceylon Institute of Engineering, jointly made representations urging the Government to consider a change to the metric system. A study group was set up under the aegis of the Bureau of Ceylon Standards to prepare a report on the feasibility of such a change. This report, which recommended that Sri Lanka make the change, was placed before Government in 1969. The metric system which was recommended for adoption was the International System of Units (SI). In 1970, the Government made a decision accepting this recommendation that Sri Lanka should change progressively to the use of SI in all its measurement activities. Further it set up a National Metrication Board to carry out two specific tasks. The first was the preparation of an implementation program phased over a certain period, and the second was the preparation of an estimate of the probable costs. The National Metrication Board was headed by me as Chairman and used the facilities of my Organization, whose technical and supporting staff structure was temporarily strengthened for this purpose.

The National Metrication Board submitted its report to Government in a surprisingly short time. The main part of the report of the National Metrication Board consists of an Implementation Plan for converting Sri Lanka into a metric country. However, there is one point which should be borne in mind, and that is, it is not envisaged that at the end of implementation of the Plan, the country will use the metric system exclusively in all its activities. What is envisaged is that at the end of the implementation program, the main commercial and scientific work in the country will be wholly metric; while certain residual measurements may be in non-metric units provided no actual measurements are carried out at the time of any transaction which will be covered by the Weights and Measures Laws, e.g., in a land transaction. In general what this primarily means is that the country at large would think and act in metric terms in transacting the bulk of its business.

The plan envisages in the first instance a mandatory change. The Board unanimously accepted as the only reasonable and effective way to carry out the change with a minimum of discomfort and cost was to make the change mandatory. Voluntary change will not work because each particular interest would wait for a move from others. It was also felt that a voluntary change of this nature would certainly run into considerable difficulties because it is not possible to effect a change in a particular area without there being a coordinated change in those fields which affect it or are affected by it.

Based on these two premises, the plan provided a period of 10 years for the change. The actual planned for time, however, is seven to eight years, a two year margin being allowed for any adjustment that may have to be made. The plan is not programmed in detail because of the very nature of the change and the considerable number of parameters which are still unkown but which are very significant in a change of this nature. It should be recognized that the change is not purely one of usage in commercial, industrial and scientific activities of the country. It affects the social and cultural life as well, directly and indirectly, in many ways. One example which will affect the rural population will be the eventual removal of mile-stones and their replacement with kilometer-stones. This will change the usual manner in which directions are often given in the country, e.g., "meet me at the 6th mile post".

The commencement of the implementation of the plan is dependent on the amendment of the Weights and Measures Laws to recognize the Metric System of measurement for all measurement activities on the Island. The necessary physical standards, both national and derived, must then be obtained. At first, the standards procured will be mainly standards of length and mass and their derivatives.

In planning the change, high priority has been given to the export sector. The country depends on its export earnings, and these in turn are dependent entirely on the demands of the purchasing countries. There is a considerable movement, both in the tea and rubber trades, for buyers to ask for quantities they purchase to be stated in metric terms, even when they are packed in British units, and this has caused considerable inconvenience to these trades. Hence, change in this sector will take place almost simultaneously with the legal recognition of the metric system and the establishment of metric units of measurements.

The Report of the National Metrication Board has been accepted by the Government and certain steps have already been taken to prepare the way for implementation of the porposals in this Report, for the introduction of the metric system. The first is the amendment of the Weights and Measures Ordinance. It has been decided to save time by amending the Ordinance rather than prepare new weights and measures laws. The following rules have been adopted for amending the Weights and Measures Ordinance:

(i) that the primary system of measurement for Sri Lanka will be the International System of Units;

(ii) that the use of the present system of units with equivalent legal status will be permissible for the time being;

(iii) that in the schedule of units, which gives those units valid for all measurements, certain non-SI metric units will be included;

(iv) that the denominations of weights and measures which will be legal for trade use will be restricted. For metric units, as far as possible, a 5:2:1 ratio will be used with an exception in the case of the measurement of volume, where 250ml and 750ml measures will be permitted. The existing range of sizes for weights and measures in the British System will also be permitted.

The next step that has been taken is that of the preparation of fresh regulations for the Weights and Measures Ordinance. At present, since the metric system is not legal, no specifications have been made under the regulations for metric weights and measures or weighing and measuring instruments. The opportunity is being taken to revise the regulations completely to bring them, as far as possible, in line with the International Recommendations issued by the International Organization of Legal Metrology (OIML). This is particularly so in relation to the classification of weighing instruments. However, it was felt that a complete adoption of this particular recommendation was not suitable, since the lowest category in the OIML Recommendation is much lower in the specification for sensitivity and allows larger error than in the lowest category permitted at present in Sri Lanka. Furthermore, in order to match the manner in which metric weighing instruments are classified in the OIML Recommendation, a similar table has been worked out for one classification of weighing instruments which are marked only in British units. This will mean that there will be a uniform method of classification irrespective of whether instruments are graduated in metric or British units.

Steps have also been taken to obtain physical standards of measurement, both national and derivative. At present there is a national standard meter on loan from the French Measurement Service, and a kilogram weight calibrated at the National Physical Laboratory at Teddington in the U.K. The other national standards (including a standard kilogram calibrated at the BIPM) are on order. It will probably be 6-7 months before they arrive. Nevertheless, the fact is that there are two standards available, those of length and mass, which are of the quality of national reference standards, and they could serve as national standards at first. This has enabled the Amending Law to be proclaimed, as soon as it was passed by the National State Assembly as Law No. 24 of 1974. Finally, the Government has approved the setting up of a National Metrication Authority to implement the change.

Concluding Remarks

In conclusion, I would like to draw your attention to a few points arising from my discussion so far.

We are agreed that the cardinal principle in standards writing is the principle of consensus of opinion, and arising therefrom, the production of a standard which is practical, and acceptable to all sectors. But it seems to me that this concept holds true only when all interests represented on a Drafting Committee are competent. If not, we could very well end up with a standard which is deficient in strength and character. It would be interesting to find an answer to this.

The next point is that relating to standards writing itself. As I pointed out previously, certain practical problems arise from the adoption of the methodology of developed countries. I would reiterate that we in developing countries should review the methodology of standards writing and evolve a scheme which is practicable and acceptable. In this context, I would like to draw your attention to the suggestions of Shri S. K. Sen of the Indian Standards Institution. He has urged developing countries not to overlook realities. He postulates that standardization should begin with the setting up of quality control systems for selected industrial units relating to the subject under standardization. Analysis of quality control data from these units over a period of time will lead to a tentative national standard from which will evolve a suitable final standard. Shri Sen speaks of a spiral operation with progressive advancement of better and better tentative standards until a national standard comparable to international standards but suiting local conditions is produced. I would commend his suggestions for further thought.

At the same time, in the formulation of a national standard for export products, I would suggest that the following parameters be kept in mind, if such a standard is to be actively implemented:

(a) the quality of raw materials;

(b) the actual stage of industrial development with regard to such factors as manufacturing methods, equipment, and available raw materials;

(c) the expected quality of the final product;

(d) the quality demanded by the international market.

I must emphasize that national standards connected with exports could act as barriers to trade if they do not take cognizance particularly of point (d) above. Developing countries must realize the danger of different national standards diverging considerably from each other. Harmonization of standards at the regional and finally at the international level will serve not only the development of local industry and the home market but could also be instrumental in the expansion of intra-regional and international trade.

Finally, I would wish to draw your attention to certification marking and its efficacy for developing countries. Has certification marking been a practical success, or are the advantages of certification only marginal? Our own experience is that certification marking will not be effective unless producers of marked goods are given considerable incentives in one form or another.

My friends, I am thankful to you for your patient listening and hope that by sharing our experience we would, during the course of this Workshop, be able to find solutions at least to some of the problems facing us all. Thank you.

CARIBBEAN INDUSTRIAL RESEARCH INSTITUTE AND
TRINIDAD AND TOBAGO BUREAU OF STANDARDS:
AN OUTLINE OF THEIR FUNCTIONS AND INTER-RELATIONS

R. A. Fung
Electronics Engineer
Caribbean Industrial Research Institute
St. Augustine, Trinidad, West Indies

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies
National Bureau of Standards

November 4, 1974

The Caribbean Industrial Research Institute

The Caribbean Industrial Research Institute (CARIRI) was established in 1970 by the Government of Trinidad and Tobago. For the first five years CARIRI is being assisted by the UNDP with UNIDO as the executive agency. CARIRI is an autonomous institution, the Board of Management being comprised of members from the Government, the Industrial Development Corporation, the private sector, the University of the West Indies (UWI), and UNDP. UN assistance is being requested for a further three years.

CARIRI has been established as an industrial laboratory and a consulting institution to serve the industrial community and Government of Trinidad and Tobago. Its staff and equipment are available to all who want to hire its services. It is a non-profit organization but a fee towards meeting expenses is charged. All information about a client and his project is kept strictly confidential and the client may have exclusive ownership of the results of his project. Sophisticated scientific research for its own sake is not CARIRI's objective; rather, its purpose is to serve industry in a quick, practical and business-like manner without too much red tape and with few formalities. Under the Board of Management, there is a Director who is responsible for running the Institute. Assisting him in various aspects are the Chief Technical Adviser, who is on the UN staff of the Institute; the Business Manager, who looks after financial matters; and the Assistant to the Director, who handles some of the administrative duties of the Director. The main divisions of the Institute are outlined below:

The Engineering and Economics Division

This division handles projects in the following areas:

1. Feasibility studies,
2. Design and engineering - equipment specification and plant layout,
3. Process development - pilot plant scale,
4. Trouble shooting, and
5. Quality assurance.

Food and Chemistry Division

This division handles projects in food and chemical areas. Examples are the following:

1. Design of equipment (bottle cooler) for food processors,
2. Feasibility for locally manufacturing pyrogen-free water,
3. Selection of equipment for manufacture of jam, jellies, marmalades, cordials and pepper sauces,
4. Quality assessment of citrus products (limes),
5. Maximizing use of local ingredients in the manufacture of chocolates, and
6. Food product development.

Chemical analyses have been carried out on bagasse board, poultry feeds, floor polish, concrete, steel, boiler scale, solder, caustic soda, detergents, rum, brewery products, dairy products, shortening, and bay oil.

Work is also done in conjunction with the Ministry of Agriculture, the University, the Agricultural Development Bank, the Ministry of Planning and Development, the Industrial Development Corporation and the Development Finance Company.

Physics and Materials Technology

The Materials Section carries out mechanical and environmental tests on items such as fabrics, plastics, coatings, metals, ceramic products, construction materials, and synthetic and natural fibers. Some projects of a long-term nature are:

1. Testing and control of the production of particle board, and
2. Planning of activities related to Standards Organizations in the Caribbean Region. In this context visits were made to the Standards Institutes in Barbados and Jamaica.

Facilities for construction materials will be expanded and there will be concentration on environmental testing.

The Physics Section is involved mainly in three areas:

1. Instrument service and calibration,

2. Assistance to the Trinidad and Tobago Bureau of Standards (TBS), and
3. Feasibility studies on production of electrical and electronic products

Other areas in which the Physics Section is active are:

1. Acoustic measurements,
2. Advice to clients on equipment selection, and
3. Product development.

Technical Information Service

The Technical Information Service offers the following services:

1. A Question and Answer Service for providing specific items of scientific or technical information,
2. An Information Retrieval Service,
3. A Seek and Provide Service for obtaining information of the kind that is not well documented and usually has to be sought from individuals and institutions rather than from literature,
4. A Documentation Service, which supplies photocopies either in printed form or in micro-film, subject to copyright law, and
5. An Extension Service to ensure the proper evaluation and use of the information supplied.

This concludes a short description of CARIRI. I shall now tell a little about the Trinidad Bureau of Standards. CARIRI and the TBS are two separate autonomous bodies and I am here as a representative of CARIRI. The relation between CARIRI and the TBS is that the facilities at CARIRI will be used to carry out tests and measurements, as required by the TBS for the purposes of drafting standards and checking compliance with standards.

The Trinidad and Tobago Bureau of Standards (TBS)

The Act providing for the Trinidad and Tobago Bureau of Standards was agreed to in January 1973. This Act gives the Bureau general power to make standards for goods, services, processes, and practices, except for food, drugs, and cosmetics, standards for which would fall under the Food and Drugs Ordinance. The purpose of the Bureau is to promote and encourage the maintenance of standards for the improvement of goods produced or used in Trinidad and Tobago, for ensuring industrial efficiency, and for development and promotion of public and industrial welfare, health, and safety. The Bureau may also provide advisory services for manufacturers as to the type and methods of quality control applicable to their products and may undertake the training of manufacturing staff in quality control.

After the Act providing for the establishment of TBS was approved, a governing body for the Bureau, the Standards Council, was appointed in March 1973. A Director was appointed in July 1973. In the first half of 1974, the Council has been dealing with applications for posts in the Bureau. Now most of the staff have been hired and work has started. The services of a UN Consultant to advise the Bureau on standardization have been obtained through UNIDO.

Though neither have actual standards been formulated nor has any practical work on calibration in relation to standards been carried out, some limited investigations have been carried out on a few goods. As resources are limited, these investigations were restricted to articles of general use or importance. For example:

1. Household articles such as bleaches, toilet soaps, and household cleaners,
2. Car tires,
3. Building materials such as galvanized sheets, and steel reinforcing rods, and
4. Air pressure gauges for service stations.

Suggestions for priority items for standardization were made at a seminar on standards held a year ago (October 19, 1973). These were:

1. Labelling, in particular, of garments and fabrics,
2. Buildings - design, materials, and safety,
3. Furniture - design, dimensions, and materials,
4. Garments - sizing and craftsmanship,
5. Servicing of appliances and vehicles, and
6. Quality control in local firms.

The measurements required for some of the above investigations were carried out using the facilities at CARIRI. Personnel at CARIRI and TBS will be working closely with consumer groups and industry personnel in the establishment of standards.

Regional Cooperation

Two of my colleagues visited the Jamaica Bureau of Standards and the Barbados National Standards Institution and put forward the following suggestions in a report on their trip.

Implementation of:

1. Unified standards and test methods for the region.
2. Offering of a regional service in fields where one of the

laboratories is equipped with highly specialized and/or sophisticated equipment. Examples in this context are:

a. Metrology and calibration of secondary standards, Jamaica Bureau of Standards,
b. Petroleum products testing at CARIRI,
c. Accelerated durability testing of materials in environmental simulation equipment at CARIRI,
d. Textile testing at Barbados National Standards Institution (when the laboratory is equipped as planned), and,
e. Ceramic raw materials testing and evaluation at Jamaica.

Thus it is hoped that in metrology and calibration, CARIRI will be equipped with secondary standards and use the primary standards in Jamaica for cross checking. There may be some inconvenience in this, since Jamaica is over 1,000 miles away from Trinidad.

SOURCES OF REFERENCE

1. CARIRI, 1971 (Published by CARIRI)

2. CARIRI, 1973 (Published by CARIRI)

3. Trinidad & Tobago Act No. 38 of 1972

4. Trinidad & Tobago Bureau of Standards Newsletter No. 2

5. "The Present State of Standards in Trinidad & Tobago" by Michael Lines (TBS Report)

6. Trinidad & Tobago Bureau of Standards Newsletter No. 1

7. Trinidad & Tobago Bureau of Standards Newsletter No. 3

8. Visit to Material Testing and Standards Institutions in Barbados and Jamaica, by R. McDavid and U.S. Halvorsen

METROLOGY IN VENEZUELA

Zully Perdomo
Ministerio de Fomento
Direccion de Comercio
Servicio Nacional de Metrologia Legal
Caracas, Venezuela

NBS/AID/OAS Workshop
on Standardization and Measurement
Services in Industrializing Economies
National Bureau of Standards

November 4, 1974

Introduction of Metrology in Venezuela

In 1952 a strong movement toward industrialization and economic development occurred in Venezuela. At that time it was decided to introduce the concept of metrology into the Venezuelan economy. As a first step, a study was made of the adequacy of municipal weights and measures services, the availability of equipment and technical personnel, and the requirements of the industrial and commercial sectors. Possible modifications of existing legislation were considered, and a plan for metrological services was proposed.

While the study was being carried out, the very eminent metrologist, Mr. Maurice Jacob, Chief of the Belgian Metrology Service and President of the Provisional Committee of Legal Metrology, visited Venezuela. He provided us with advice and recommendations for the creation of a modern National Metrology Service, capable of serving the varied demands of industrialization suited to a dynamic country in the process of development.

By 1955 a plan for the creation of a National Metrology Service in Venezuela had been prepared. Due to political, social, and economic circumstances, implementation of this plan had to be postponed, but three years later the plan was approved and the Department of Metrology was created.

The programmed activities were initiated with the creation of a special commission for the development of a new law on weights and measures, which would take into consideration recent trends on the subject, and for the creation of a legal instrument of wide and easy applicability.

Such a new law should make mandatory the units of measurement approved by the relevant international organizations, and it should introduce definitively and exclusively the decimal metric system and involve the concepts of metrology.

In July 1959 this Department of Metrology, having been found inadequate, was transformed into a Metrology Division, which set up the first metrology laboratories in Venezuela. This Division, since its beginnings, has trained personnel, evaluated requirements, and taken up the difficult task of selecting measuring equipment, apparatus, and instruments for its laboratories. Also it prepared regulations for various levels, worked to create a national metrology consciousness, and engaged in other activities.

Given the importance of establishing close contacts with international organizations operating in the appropriate technical fields in order to establish positive and efficient collaboration, the Division of Metrology made an effort to convince the Venezuelan Government to become a member of the International Organization of Legal Metrology (OIML) and to adhere to the Metre Convention. Those objectives were attained during 1960 with the issuance of Decree 301 (OIML) and Decree 382 (Metre Convention). These governmental decisions were of great importance and facilitated the implementation of the plan to organize a nationwide metrology service. This paved the way for a new law entitled "Law of Measurements and Their Application" which comprises:

1. adoption of SI units of measurement and their compulsory usage and teaching,
2. calibration of apparatus and measuring instruments for commercial and industrial uses,
3. creation of a National Service of Legal Metrology (SNML) to serve the needs of science and industry in Venezula,
4. establishment of penalties for non-compliance to be imposed by the SNML and by courts according to the seriousness of the offense.

The SNML contained, in addition to a Central Office and a facility for the provision of technical advice, Laboratories for Physical Research, Electrical Research, and Industrial Metrology and Quality Control; Divisions of Legal Metrology, and of Scientific and Industrial Metrology; and a Department for Technical Control for mobile measurement units. The SNML has metrological equipment (not all of it has so far been installed) with a book value of approximately 3 million bolivars. Nevertheless, it is far from being properly equipped.

SNML has advanced capabilities for the measurement of length, mass, electric current and current density, frequency, electrical potential, electromotive force, electrical resistance and conductance. SNML has an average capability for the measurement of time, area, volume, specific gravity, angular frequency, and pressure. It also has weaknesses. Below average capabilities exist for the measurement of many quantities such as plane and solid angles, thermodynamic temperature, chemical concentrations, force, power, viscosity, electrical charge, electric field strength, and capacitance. There are many quantities such as speed, acceleration, energy density, molar energies, magnetic and luminous flux, acoustic energy flux and intensity, etc., for which there is at present no measurement capability.

These deficiencies should be remedied after careful study of the needs of the SNML. We know that it is not enough to acquire equipment. It must be installed and operated effectively by trained personnel.

International Assistance

For the SNML international assistance constitutes the basis on which operations are performed. Continuous development of new measurement material and methods produced at large metrological laboratories can neither be known nor studied at SNML without international assistance. The sources for these advisory services can be classified according to the field.

In scientific metrology, advice can be obtained from the Bureau International de Poids et Mesures (BIPM), Sevres, France, or from such large national laboratories like the Physikalisch-Technische Bundesanstalt (PTB) of Germany, the National Physical Laboratory (NPL) of England, the Institut de Metrologie (DI) at Mandalau (near Caracas), and the National Bureau of Standards (NBS) of the U.S.A. This assistance should be expanded and better programmed in the future. The National Bureau of Standards must play a fundamental role in our future technical assistance programs.

In industrial metrology, advisory services should be provided not only by the large national laboratories already mentioned, but also by the Conservatoire National des Arts et Metiers of Paris, the Electrotechnical Laboratory of Tokyo, and the Istituto Elettrotecnico Nazionale-Galileo Ferraris of Italy.

A goup of engineers with broad knowledge of metrology will be in charge of the coordination of these assistance services so as to orient and program the requirements of the Service and to link them with those of our national industry.

In legal metrology, there already exists an international organization created for providing adivsory services as well as for worldwide coordination and for promotion of uniform legislation based on international recommendations. This institution is the International Organization of Legal Metrology (OIML), whose office is located in Paris. Basic work needs to be oriented towards the approval of recommendations studied by the International Committee of Legal Metrology and discussed with the metrology institutes in the member countries.

Interdependence of Metrology, Standardization, and Quality Control

It is difficult to implement standardization in any country if there are no appropriate means for industrial standards to be maintained. In general, many clauses in standards are expressed in numbers which rely, directly or indirectly, on the result of measurements; thus standardization requires metrology. In writing a standard, it is easy to require a fixed value if the manufacturer uses adequate measurement instruments in complying with this requirement.

Three basic engineering techniques are applied in industrial standardization: quality control, process control, and instrumentation for quality quantization.

For the first approach, standardization is a very important ingredient for the optimization of quality at minimum cost. In order to carry out a project, it is necessary to have access to measurement equipment. So metrology plays a role here.

In process control, the second approach, metrology has a much more direct part since during the process, good measurements constitute the basis of the control itself.

In the third approach by instrumentation, metrology is involved in the inspection and testing that determines the final quality of the product.

In Venezuela, metrology should be substantially improved to promote the advancement of industrial techniques, standardization, and quality control.

SUMMARIES OF NBS PRESENTATIONS

At the request of several participants, we include here abstracts or brief summaries of some of the NBS presentations. Unfortunately, these were not requested in advance, and in many cases the presentations were informal with no prepared text. All those who made presentations to the Workshop are listed in the Schedule, Appendix III.

NBS-AID Workshop
Tuesday, November 5, 1974
Weights and Measures Enforcement in the United States
R. N. Smith, Technical Coordinator
Office of Weights and Measures

The United States is unique among the nations of the world in the fact that weights and measures enforcement is primarily a state and local function. The Federal Government has enacted legislation adopting uniform national standards and has provided the mechanism for equipping each state with complete sets of primary weights and measures standards whose values are traceable to the national standards. A high degree of uniformity exists with respect to state laws and regulations due largely to the efforts of the National Conference on Weights and Measures. The National Bureau of Standards, through its Office of Weights and Measures, provides the necessary technical resources to bring about complete uniformity of enforcement and to cope with rapidly changing technology in the marketplace.

SUMMARY OF ELECTRICITY DIVISION'S PRESENTATION
at the NBS/AID/OAS Workshop in
November 1974

General Overview of the Division - Mr. Norman Belecki

The Electricity Division of the National Bureau of Standards is a part of the Institute for Basic Standards. The primary concern of that Institute is the support of the National Measurement System. By National Measurement System, we mean that system of people, instrumentation, standards, procedures, and apparatus by which all measurements are made in the United States.

In keeping with that concern, the mission of the Electricity Division is to support within the United States a complete and consistant system of electrical measurement by providing those electrical measurements, standards and related data required by industry, commerce, government, and the scientific community for the pursuit of their various goals. When viewed in the content of electrical metrology, this translates into the following six goals:

1. The improvement of the technology by which the electrical units are realized, maintained, and disseminated (requiring a research and development effort).

2. The maintenance of electrical units and operation of dissemination services.

3. The development of instruments and measurement methods for the solution of special measurement problems requiring the extension of the state-of-the-art.

4. The continuing evaluation of the needs of the National Electrical Measurement System and involvement in experimental and other activities to insure international compatibility in electrical measurements.

5. The attainment and publication of essential data and physical constants in those cases for which the experimental mechanism for the determination of such data is closely related to basic electrical metrology.

6. The dissemination of metrology information through a continuing high level of participation in the operations of standards organizations and various consulting activities.

Electrical Reference Standards Section

The Electrical Reference Standards Section is responsible for the dissemination of the basic electrical units of capacitance, inductance, resistance, and voltage. This is accomplished in two ways; by the calibration of electrical standards and related instruments belonging to industrial corporations, other government organizations, universities, and other groups, and through our Measurement Transfer Services in which highly developed transportable standards and instruments are used to investigate experimentally measurement capability as it exists in various parts of the system. These services are supported by a modest but continuing research and development activity with the general goal of improving operations, increasing accuracies, and expanding the scope of such services, where necessary.

It must be stressed that expansions of service and other improvements, such as those of accuracy, are in response to demonstrated needs of the measurement community. This must be so, since limited resources are available to us in the division. Recently, due to a leveling off of accuracy requirements, more emphasis has been placed on practical measurements such as those encountered in an industrial environment. An example of this is an experiment recently undertaken to investigate the capability of measuring certain "odd" valued resistors existant in the resistive ladder production line of a west coast electronics firm. A special resistor, whose value was close to those normally produced there, was measured here, by the corporate standards laboratory, and on the production line. This experiment serves as a prototype demonstrative of improved quality control methodology and the principles behind it are applicable to a wide variety of cases. It is expected that further efforts in the same view will be forthcoming.

The largest single effort in the development area in this section is aimed at automating the apparatus used for calibrations of standards. The major motiviation for this effort is not cost-effectiveness in the calibrations themselves, but rather a response to the increasing use of and hence, problems with automatic test equipment in the industry we service. By becoming intimately involved in computer-controlled measurement and testing, the personnel of the section can bring their peculiar expertise to bear upon metrology problems, while gaining experience in the control and communication technologies and the effects of their application in measurement situations. It has been seen, moreover, that certain types of measurements are only feasible under computer control because of their complexity or the time required for their completion. At the end of the project, methodology for the use of automation to improve measurements will be documented and distributed.

Finally, the section is involved in the production of a series of technical notes in response to industrial demands for information on basic metrology. The first in the series will be on voltage metrology and will use a description of practices in our standard cell laboratory as illustrative of a viable methodology for the maintenance and surveillance of a local unit of voltage in an industrial environment.

<u>Electrical Instruments Section</u> - Mrs. Bernadine L. Dunfee

The section's areas of responsibility were described by means of a flow chart. It was emphasized that the section is responsible for the measurement of ac voltage, current, power and energy and for the ac/dc transfer process that relates these quantities to their dc counterparts and hence to the legal dc standards. Also, the section extends the dc voltage scale up to 2000 volts by means of resistive ratio networks, the dc current scale to 1000 amperes through current shunts and the ac current scale up to 12000 amperes through magnetically coupled ratio networks such as current transformer and current comparators. A reprogramming effort is in progress on the high-speed measurement of these electrical quantities, utilizing electronics and computer techniques. It was emphasized that essentially all research and development are directed toward the design of physical standards and methods which are used to provide a calibration and measurement service to the scientific and technical communities. Some examples were cited which included:

(1) Calibration of transfer instruments for voltage and current to 100 kHz at a maximum accuracy of 20 and 30 ppm.

(2) Calibration of voltage divider networks to a maximum accuracy of 20 ppm and current shunts to 50 ppm. Services offered by the Measurement Assurance Program were also described.

(3) Calibration of current transformers at 60 Hz up to 12000 amperes with a capability of 50 ppm, and the on-going development of a method for measurements up to 50000 amperes which would be carried out on the premises of the customer - identified as in-situ measurements.

(4) Calibration of transport watthour meter standards for the power industry. This was discussed in somewhat more detail by making use of a slide which showed how these calibrations result in a measurement chain within the meter laboratory that ultimately leads to the calibration of house-type watthour meters located on the premises of energy consumers.

High Voltage Measurements Section - Dr. Oskars Petersons

With the help of slides, an overview of the section's activities presented. Examples of measurements and equipment were selected from all three of our research areas — high voltage ac, dc and impulse measurements. I explained our approach to high voltage calibrations whereby some of them have to be performed in situ on our clients' premises because we do not have a full scale laboratory, and some of the clients' equipment is too large to be transported or cannot be taken out of service. During the laboratory tours I showed them our high voltage ac facility. Judging from questions, there were at least two persons in the group who are or have been associated with high voltage research. "Are you performing partial discharge measurements?" "Is any of your research related to high voltage underground transmission?" I had one request (Miss Perdomo from Venezuela) for technical papers describing our instruments and measurement methods.

MEASUREMENT ASSURANCE

by

J. M. Cameron
Office of Measurement Services

The totality of measurements made in agriculture, commerce, industry, transportation, medicine, science, etc., constitutes the National Measurement System of a country. In deciding on what measurement services to provide the economy, one should know the health of the system--are the measurements accurate enough for their intended use? Is the quality of industrial production, correctness of medical diagnosis, adequacy of safety and environmental control, etc., reduced by measurement error? The answer to these questions involves the properties of measurements which include the operator, environment, instrument, type of item being measured, etc. By the study of the interacting elements one could decide whether operator training, improved conditions, instrument repair, or other changes would improve the measurements.

By viewing measurement as a production process one can apply the usual quality control techniques to monitor the process. If performance checks (e.g. part A fits part B) do not exist, some form of redundancy has to be introduced into the system to sample the output. In this effort, one should use the Deming concept of quality control in that one is interested in not just conformity to specifications, but effectiveness quality, foreign sales, etc.

By emphasis on the quality of practical measurement one can measure the success of programs developed to improve areas where deficiencies exist. Improved measurement has great promise for improving quality and reducing scrap and as such constitutes a national resource.

STANDARD REFERENCE MATERIALS AND
MEANINGFUL MEASUREMENT

by

H. Thomas Yolken
U. S. National Bureau of Standards

The development and success of any industrialized society depends largely upon mass producing goods and services. Mass production, however, requires strict quality control to prevent wasting both material and labor and ultimately to produce an efficient economic system in that society. In turn, quality control implies ever-increasing accuracy in the measurement process, interchangability of parts and stringent performance criteria and control of composition and physical properties for a wide variety of materials — from raw materials to finished product.

The key to efficient and useful quality control is meaningful measurement. For measurements to be meaningful, they must be accurate and precise.

To clarify these two terms, I would like to use the example of a marksman firing a rifle at a target.

Imagine a marksman, first untrained, firing six shots at a target. His shots scatter badly — we say he is not in quality control. Then he learns to hold the gun against a support and now he is able to produce the middle result. He is now precise. When he learns to adjust the sights properly he hits the bull's eye (or the true value) and now he is both precise and accurate. When a measurement system can do the same, we say that meaningful measurements are being made and the system is in quality control.

One of the principal ways in which the NBS assists in the achievement of meaningful measurement — and thereby quality control — is through the production, certification, and issuance of standard reference materials. NBS defines a Standard Reference Material or SRM as a well-characterized material, produced in quantity, that calibrates a measurement system. SRM's are easily transported to the site of the user, where the user may perform on-site calibration of his instrument or measuring process. This eliminates the need for the user to ship his instrument to a central standardizing laboratory for calibration. Thus, time and money are saved and the possibility of damage to the instrument or having it become uncalibrated in transit is eliminated. That the values obtained by on-site calibration in widely separated points may be referred to a common, widely accepted value is one of the major advantages of SRM's. Furthermore, because of the Bureau's reputation for high technical competence and impartiality, these SRM's are widely accepted, both within the United States and internationally, as primary standards for the intercalibration of measuring processes.

SRM's fulfill four primary uses. They provide:

1. better quality control of industrial and technological production processes by on-site calibration.

2. smoother, controversy-free exchange of materials and goods, both nationally and internationally.

3. a clear definition and basis of performance characteristics tied to national and international systems of measurement.

4. permit evaluation of measurement techniques and instruments.

Historically, the first NBS-SRM's were issued in 1905, shortly after the U. S. Congress established NBS. These were four cast irons used to control the quality of cast iron production in the United States. The need and use of one of these original cast iron SRM's has continued to this day, and has required twelve renewals for new batches produced in the intervening 68 years. From that modest beginning, the program has expanded to include more than 800 different SRM's. Of the 30,000 units (valued at 1.4 million dollars) sold last year, 25 percent were exported outside the U. S. In the U. S. several major industries depend extensively on NBS-SRM's for the quality control of their production and processes valued in the many tens of billions of dollars. These industries include for example, metals, ores, rubbers, glass, ceramics and nuclear power.

I would like to describe how NBS produces and certifies SRM's by starting with how accuracy is determined. One of the most important <u>facts</u> built into most NBS-SRM's is <u>known</u> accuracy. The accuracy of an NBS-SRM is generally established by one or more of the following three ways:

1. Reference Method
2. Two independent methods
3. Round Robin or Interlaboratory Testing

The three routes to certification of an NBS-SRM are arranged in order of preference.

In the first case, a reference method is a method of known or proven accuracy, and its use assures the accuracy of the determination if personal bias is eliminated. This is why the measurements must be made, if possible, by two or more analysts.

The second route to certification, used when a reference method is not available, consists of using two or more independent methods. Each of these independent methods must have estimated systematic biases that are small relative to the accuracy goal set for certification.

The first two routes are subject to critical scientific review through statistical analysis of the data obtained. This, however, is not the case for the third route which is subject to a somewhat less rigorous analysis of the data through statistical analysis. The <u>only</u> valid proof of this route to certification is that in a system under good quality control, it works.

I have selected some examples that illustrate these routes of certification.

In the first case lead was determined in a series of glasses containing trace elements at levels from 0.02 ppm to 500 ppm by isotope dilution mass spectrometry, a recognized reference method of known and proven accuracy. Similar standard deviations were obtained by the two analysts working 2,000 miles apart. This is an important sign that the system is under control. The certified value is 426 ppm lead, with a conservative uncertainty of ±1 ppm that also allows for unknown sources of systematic error.

In the second example, the use of route two, or in this case, three independent methods of analysis, are used to determine Cd, a toxic metal, in our beef liver SRM.

The third route to certification, a round robin or interlaboratory test is used by NBS for various reasons. An example is a round robin that involved 6 different, highly competent laboratories in the determination of the carbon content of a steel SRM. Although 4 different methods on 6 different sample weights were used, the results were highly satisfactory. It should be noted, however, that a previously issued NBS-SRM similar to the SRM under study was required for internal quality control in each of the labs. As discussed earlier, the round robin approach should be used <u>only</u> for measurement systems or fields of science and technology that have obtained good quality control. The danger in using the round robin approach is either that a field is not ready for it, or that the proper constraints may not be applied. This danger is illustrated by the wide range of values reported by different labs for various elements in an orchard leaves SRM.

I would now like to describe, by presenting an example, the process at NBS where the properties of the SRM's are measured for certification. Several years ago, NBS produced four trace elements in glass SRM's for trace element analysis in inorganic matrices. Since then, NBS has continued to provide additional certified data for these SRM's. The rods of glass were produced for NBS by the Corning Glass Works in New York State in continuous lengths over 200 meters long from a molten bath of glass to which 61 elements in 4 different concentrations (500, 50, 1, and 0.1 ppm) had been added. These rods were then cut into thin slices at NBS and the concentrations of these elements were measured very carefully by NBS scientists using over 15 different instrumental techniques.

Well over 11,000 man-hours of scientific effort has gone into the certification of these glasses and yet we still have additional work to do.

Although the process of producing and certifying SRM's at NBS makes a fascinating story, I am sure your primary interest lies in knowing what SRM's are available for various industries. For example, essentially all the synthetic rubber produced in the U.S. and Western Europe is quality controlled through the use of the NBS rubber SRM's.

In the area of raw materials over 30 SRM's are available to help control the measurement processes by which these important materials are assayed.

For basic industries such as ferrous and non-ferrous metals, glass, rubber, transportation, and chemicals, over 400 SRM's are available from NBS.

SRM's are used to calibrate instruments needed to assure the quality of iron and steel, copper, aluminum, and a wide variety of metal products — solder, high-temperature alloys, etc. They are used to insure the uniformity of products such as rubber tires and even hot water bottles. Another important use is to make sure that the customer of these products is getting what he has contracted for in the way of specifications.

Beyond SRM's for industry are those needed for basic metrology, in areas of health, for air and water pollution, and in agriculture.

In the U. S. most color specifications are based on this system of color coding. NBS issues color charts whereby people can communicate in a scientific way their ideas or requirements for various colors. Turning to another field, in the U. S. alone last year, 1,000,000,000 analyses were performed in over 12,000 clinical laboratories. Simply to handle this flood of work has necessitated the development and use of automated analyzers. But, the production of such a large number of analyses is made meaningful, and by that we mean accurate values useful to the physician, only if these complicated measurement systems can be calibrated in a meaningful way. NBS now has 18 SRM's with many more now in production for this purpose.

Air pollution is now a grave and fortunately well recognized problem for any industrialized economy. Before control can be effectively established it is necessary to install within a nation a system capable of determining the degree of pollution with some accuracy. NBS has issued SRM's for SO_2 in the air and for automobile exhaust. SRM's for additional auto pollutants and particulates are now in progress.

Great strides throughout the entire world are now being made to make agriculture more and more productive. Scientific crop fertilization, the development of disease resistant plants and fruits all depend upon meaningful measurement. NBS has prepared agricultural SRM's for both chemical analysis of fertilizers and crops. These allow the agricultural scientist to calibrate his analytical instruments and methods more accurately so that he can determine the contents of fertilizers. In addition, they allow him to predict how much and what type fertilizer should be used in a specific area.

I hope I have been able to show you in this short time some of the possibilities inherent in NBS-SRM's. Certainly one of the keys to expanded trade between nations is the improvement of the quality of goods produced, the rational and scientifically-based settling of differences concerning the quality and compositon of materials and goods exchanged and similar matters. Many of these problems and questions are either averted or answered through the use of Standard Reference Materials during the quality control or measurement process.

AN OVERVIEW OF THE INSTITUTE FOR COMPUTER SCIENCES AND TECHNOLOGY

by

M. Zane Thornton

The Institute for Computer Sciences and Technology provides standards guidelines and procedures for improving computer utilization by federal agencies. It further provides the technical foundation for federal computer policies including export controls in international computer trade. Automation and information technology are also promoted where increased productivity or imporved service quality can be anticipated. Since the Program is otherwise problem-oriented, other current objectives include improving computer security in federal agencies, improving the quality of computer software, promoting performance measurement techniques for improved computer selection, and to improving user access to computer networks.

The ICST program contains the following elements:

1) Computer Security, 2) Standards Management, 3) Performance Measurement and Software, 4) Computer Networking, 5) Computer Services, 6) Cooperative Technology Innovation and Diffusion, 7) Automation Technology, 8) Scientific and Technical Advisory Services, and 9) Mathematical Services.

ADP STANDARDS MANAGEMENT

by

Harry S. White, Jr.

The principal objective of the ADP standards program is to improve computer utilization within the Federal Government by providing effective standards for agencies to use in the procurement of their ADP equipment and services and for installation managers to use in their day-to-day development and operation of computer systems and facilities. The standards program under the leadership of NBS is a mandatory program and has a major impact on the computer industry, state and local governments, and federal users of ADP. This requires that NBS MAINTAIN CLOSE COOPERATION WITH INDUSTRY THROUGH THE VOLUNTARY standards activities of the American National Standards Institute and the Electronic Industries Association, and with state and local governments and other federal Agencies through interagency and public advisory committees. Currently, there are 13 active Federal Information Processing Standards Task Groups involving some 227 participants from government and industry.

In that the computer industry is a relative young industry, there are as yet very few standards. Subjects for standardization are selected based upon proven technologies, economic benefits to users, and marketplace practices of the industry. Through our active participation with ANSI some 40 voluntary industry standards have been developed and approved. Of these, 20 have been adopted as mandatory federal standards. NBS has separately developed 7 standards for federal use.

In addition to these efforts, NBS, through a joint agreement with the National Communications System, is undertaking the development of telecommunications standards for the interfacing of ADP with federal and common carrier provided communications networks.

The current standards efforts address four major areas: (1) standards that provide for the effective interchange and sharing of data, programs, and equipment, (2) standards to increase the performance and assure quality control of ADP products and services, (3) standards that facilitate the transfer and use of computer technology through effective man-machine interfaces, and (4) standards to provide for the safety and security of personnel, equipment, and data.

Measuring compliance with approved standards is a major concern of the Institute. The success of the standards program cannot be determined solely by the number of standards that are approved and published, but is dependent on the extent to which the standards satisfy the needs and are adopted for use by responsible officials in federal departments and agencies. We are attempting to identify and implement feedback mechanisms that allow us to assess the economic and technological impact of standards. This requires the support of both government agencies and industry. Our intent in such assessments is for NBS to become partners with industry and other government agencies in the development and use of standards, not to federally assume the role of standards enforcers. Our study on the impact of ACCII as a federal standard which has been completed, is a first attempt to make such an assessment. We are investigating other means such as sampling techniques and selected economic studies for obtaining information on the implementation of standards. We are also developing and initiating testing techniques and services for determining the extent that marketplace products meet approved standards. In the software area, COBOL compiler testing is now operational and FORTRAN compiler testing is under development. In this regard, COBOL validations have been completed. As yet, only one compiler tested has been determined to be in full compliance with the standard. FORTRAN compiler test programs have been developed by NBS and are currently being tested by industry prior to the establishment of a formalized FORTRAN testing service.

Proposed federal standards are coordinated with some 67 federal departments and agencies before they are forwarded to the Secretary of Commerce for approval on behalf of the President. After approval, they are published by NBS as Federal Information Processing Standards Publications known as FIPS PUBS. There are now 33 publications in the series consisting of 25 standards, 5 guidelines, and 3 information documents. The more significant standards development efforts to be undertaken within the next two years are standards for:

- OCR fonts
- Magnetic tape labels
- FORTRAN programming language
- A revised COBOL standard
- Standards for high speed signalling rates
- Extended character sets and codes
- Tape cassettes
- User terminals
- BASIC programming language
- APT programming language
- Code independent communications control procedures
- FORTRAN compiler test service
- Guidelines for benchmarking
- Guidelines for Hardware Performance Measurement
- Guidelines for ADP physical security

- o Graphic displays
- o Guidelines for data inventories
- o Guidelines for computer program documentation
- o Computer output on microfilm
- o Data definition languages
- o Operating system control language

In May 1973, by Executive Order, the President transferred to the Department of Commerce those standards functions performed by the Office of Management and Budget. Specifically, this transfer authorized the Secretary of Commerce to approve standards on behalf of the President, and transferred to NBS program responsibilities for data standards. In November of 1973, NBS prepared and obtained Secretary of Commerce approval of a new federal regulation for a program for standardizing data elements and representations. Some of the standards that have been approved or are under development include:

- o A Standard Representation of Calendar Date
- o Codes for Country Names
- o Codes for States of the United States
- o Codes for Counties of the States
- o Codes for Congressional Districts
- o Representation of Time
- o Guidelines for Data Standardization
- o Point Representations

and

- o SI and Customary Units Representations

Of particular importance to the effective implementation of standards is the essential aspect of providing basic references and calibration for ADP products designed in accordance with standards. These standard reference materials and calibration services are needed by the computer industry for quality control during the production phase and by government users during the procurement or acquisition phase.

We are now providing these services for magnetic tapes, cassettes, and magnetic disks. Examples of these are shown on the display on the wall of this conference room.

This has been a brief overview of our ADP standards program. We still have a long way to go in order to provide the complete set of standards that are needed.

If you have specific questions, I will be most happy to address these. Thank you.

COMPUTER INFORMATION SERVICES

by

Margaret R. Fox

Computer Informaton services are provided from a specialized information center which was established formally with the organization in 1966 of what is now the Institute for Computer Sciences and Technology. The plan was to centralize and extend both the corpus of and the services based on the scientific, technical and management information that had been developed over the previous 20 years of NBS involvement with the research and application of computers. During the early years, information which was obtained from other individuals and organizations working in the field either through voluntary exchange or at the request of the staff was reviewed in the Division Office and routed selectively to the technical staff. This collection, plus a complementary one developed by the jointly sponsored National Science Foundation - NBS Research Information Center and Advisory Service on Information Processing, became the nucleus of what is currently the most comprehensive repository of computer information resources generally available.

The objective was to provide a central point of contact, primarily for our own staff and the staffs of agencies of the federal, state and local governments, and secondarily for the remainder of the computer community including industry, academia and other nongovernmental activities, for services ranging from document referral and reference assistance to advisory and consulting services.

Basically, its mission was to serve as technical support to ICST's Offices and Divisions in carrying out the three-fold mission as outlined in Public Law 89-306, passed by the U. S. Congress in October 1965, of providing assistance to other agencies, (2) conducting necessary research and development, and (3) undertaking such activities as are required for making appropriate recommendations for the establishment of federal ADP standards, in order "to provide for the economic and efficient purchase, lease, maintenance, operation, and utilization of automatic data processing equipment by federal departments and agencies."

Actually, with the passage of time, the requirement for support services has expanded to include legal, social-economic and other policy considerations, e.g., individual privacy, computer security, revisions in copyright protection and data base management. In addition, since we developed a computer-based system to assist in managing the information we collect and analyze, currently through periodic production of sets of indexes to the acquisitions that are added daily to the repository, including KWIC (KeyWord In Context), and KWOT (KeyWord Out of Title) indexes, personal and corporate author indexes, and a bibliographic citation listing, we provide both the package of programs of the information management system and assistance in implementing them for data bases of other organizations with similar problems but different subject areas.

Last but not least, we work collaboratively with professional staff who are engaged in studies and laboratory efforts on specific scientific areas, such as networking, performance measurements and automation technology, in developing specialized data bases that are effectively subsets of the total collection. Thus we attempt to provide scientific and technical support through information that will permit optimum progress to be made in finding solutions to problems confronting both the producers and users of computer hardware, software, systems and services.

THE MATERIALS REFERENCE LABORATORIES

by

J. R. Dise

There are two materials reference laboratories at the National Bureau of Standards, namely (1) The Cement and Concrete Reference Laboratory sponsored by the American Society for Testing and Materials, and (2) The Materials Reference Laboratory sponsored by the American Association of State Highway and Transportation Officials.

The need for these organizations was brought to light many years ago by the inability of investigators to get satisfactory concordance of test results in cooperative investigations concerning standard methods of test for construction materials.

The first stimulus for action occurred in the cement field when in 1926, following an extensive series of tests, it was reported to ASTM Committee C-1 on Cement that the variations among the results of the participating laboratories were so great that any definite recommendations as to the relative merits of test specimens or methods appeared unlikely until some means of training would secure greater uniformity in the operator's work." When later cooperative tests only served to emphasize the problem, Committee C-1 appointed a Special Committee on Reference Laboratory to bring about the establishment of a group devoted to the promotion of uniformity in the testing of cement.

As a result of that Committee's efforts, a Research Associate Program known as the Cement Reference Laboratory was established at the National Bureau of Standards in April 1929, with Committee C-1 as its sponsor. That organization was the forerunner of the Cement and Concrete Reference Laboratory as jointly sponsored by Committees C-1 and C-9.

As time went by, highway engineers who were either watching or participating in the development of the CCRL programs concluded that similar activities in other materials fields would be of great assistance to them. As a result of this interest, after several years of planning by the Committee on Materials of the American Association of State Highway Officials (now AASHTO), and representatives of the Bureau of Public Roads (now FHWA), the second reference laboratory, now known as the AASHTO Materials Reference Laboratory, was established at NBS on October 1, 1965. The principal assignment of this new organization was to promote uniformity in the testing of materials other than cement and concrete in the central testing laboratories operated by our various state highway departments and the Federal Highway Administration.

Reference Laboratory Functions

All four of the activities that were to become the major functions of the CCRL, and subsequently of the AMRL, were enumerated by the creators of the CRL. Briefly, they are as follows:

1. Inspection of selected materials testing laboratories
2. Distribution of comparative test samples
3. Study of testing problems
4. Participation in the work of technical committees

Inspections

Inspection of laboratories is customarily regarded as the most important activity.

The general policies under which the work is performed are readily summarized. Inspections are limited to laboratories employing standard methods of test. Utilization of the CCRL's service is voluntary, and inspections are made only as requested by interested laboratories. Inspection itineraries are arranged so that regular participants may be visited at intervals of from two to three years. The work is advisory in nature and no efforts are made to certify, rate, or evaluate laboratories in any manner or to serve as a referee in disputes concerning the quality of materials or test equipment.

The current scope of the coverage afforded participating laboratories is as follows:

<u>Cement and Concrete Reference Laboratory</u>
- Portland and Masonry Cement
- Portland Cement Concrete
- Concrete Aggregates (ASTM)
- Reinforcing Steel

<u>AASHTO Materials Reference Laboratory</u>
- Bituminous Materials and Mixtures
- Concrete Aggregates (AASHTO)
- Soils
- Metals: Hardness Tests

An inspection of a laboratory consists of an examination of the apparatus used in testing a material for conformance to specification requirements, and observation of the related methods of test. The investigations are quite detailed, and as a consequence each inspector in the field carries a large collection of verification apparatus, hand tools, and reference literature. It is of interest to note that some of the services provided with this equipment would be difficult, if not impossible, for laboratories to obtain in another way.

While an inspection is in progress, the inspector brings each departure from specification requirements that is noted to the attention of laboratory personnel so that on-the-spot corrections may be made wherever possible. Pertinent observations about the physical condition of apparatus and other matters of probable interest to the laboratory are also made. At the completion of the work, a comprehensive oral report is presented to the laboratory supervisor or his representative, and all questions that arise are thoroughly discussed.

Within a short time after the inspection, a written confirmatory report is sent to the official who requested the visit and to such other persons as the laboratory may designate. The report is treated in a confidential manner, but this does not preclude subsequent distribution of copies to all interested parties if the inspected laboratory is agreeable to such action. This provision for the dissemination of inspection information is valued because it makes it possible for an interested third party to assess the capability of a given laboratory to do testing work in a satisfactory manner.

The Cement and Concrete Reference Laboratory has completed eighteen inspection tours (circuits) of the United States since it came into being in 1929. The Eighteenth Tour, which was concluded on August 15, 1972, is of particular interest because with a total of 454 separate laboratories being inspected it is the largest of all the CCRL programs from the standpoint of participation. A comparison of this tour with three other tours, the First when the cement work got underway, the Tenth when the concrete work got underway, and the Fifteenth which was the largest previous undertaking is shown in Table I. Continuing growth in participation and interest is reflected in the data here presented.

As of October 19, 1973, the AASHTO Materials Reference Laboratory had completed six inspection tours since its establishment in October 1965. The number of laboratories participating in each round was as shown in Table II.

The totals for the AMRL tours are modest because attention has thus far been focused on central state and federal materials testing facilities. The increase in service rendered in the Sixth Tour reflects an extension of the bituminous inspection program in January 1972 to include some branch highway laboratories and a few commercial laboratories wishing to avail themselves of the consulting services of the AMRL. Additional growth is expected in future tours.

It is always of interest to know if the desired results are being obtained. Evidence of good progress along these lines is found in the tabulation of percentage of conformance data for cement and concrete testing apparatus shown in Table III. Similar information is available with respect to the AMRL's work in soils and bituminous laboratories.

Comparative Testing

Distribution of comparative test samples is a second important function of the Materials Reference Laboratories. The present scope of that work is shown in Table IV.

All five of these programs are carried forward in a similar manner. At six-month intervals, quantities of two slightly different lots of a given material are procured and divided into individual test samples. Each participating laboratory receives a pair of the individual samples. Specified tests are performed and the results reported to the AMRL or the CCRL for review and summation.

Approximately six weeks after the samples are distributed, a preliminary report showing tentative average values and standard deviations for each determination, based on a few early returns, is sent to all participants. This quick response makes it possible for the technicians who did the work to know at an early date—very often within a few days of the time results were mailed—if acceptable test values were obtained.

Within two months a detailed final report is provided. This report contains average values and standard deviations based on all available data, plus scatter diagrams, repeatability and reproducibility values, and other statistical information.

The scatter diagrams, are obtained by plotting one of the two values each reports for any one property on the horizontal (x) axis and the other on the vertical (y) axis. An oval scatter of the resulting points with the long axis of the oval at 45 degrees, is evidence of a strong correlation of the test results obtained in any one laboratory, and also of laboratory bias. In the absence of bias there is a nearly equal number of points in each of the four quadrants around the center of the oval.

Laboratories finding themselves at some point significantly removed from the center of the oval are usually stimulated to look for the reason and to take action which will move their points closer to the center on the next round of tests.

Additional incentive for corrective action is provided by giving each laboratory a performance rating on each determination on the basis of the averages and the standard deviations obtained.

The Study of Testing Problems

The third major responsibility to which attention was invited was the study of problems evolving from, or related to, the inspection and comparative testing work. It seems sufficient for the purposes of this discussion to report that this part of the program is usually carried out as a coordinated laboratory-field operation with the principal aims being the development of information upon which revisions in methods of test or changes in MRL programs might be based.

One important responsibility in this area is the annual preparation of a listing of recently identified testing problems for consideration by the AASHTO Sub-Committee on Materials. Numerous needed changes in standards have been made as a result of this activity.

Participation in the Work of Technical Committees

Participation in the work of technical committees was listed as a fourth significant activity. At present, staff personnel are strongly participating in the work of Committees C-1, C-9, C-12, D-4, D-18, E-1, E-28, and E-36 of the American Society for Testing and Materials, the standing ASTM Committee on Technical Committee Operations, Committee 116 on Nomenclature of the American Concrete Institute, and the Sub-Committee on Materials of the American Association of State Highway and Transportation Officials.

For more than 40 years, the CCRL has performed a major portion of the secretarial work of ASTM Committee C-1 on Cement, and has served as its liaison representative to numerous other ASTM Committees. Relationships such as these make it possible for the Reference Laboratories to provide direct liaison between the authors and the users of over 200 methods of test for construction materials.

Laboratory Accreditation

The work of the Reference Laboratories is frequently mentioned in connection with the accreditation of materials testing laboratories. The concept of how this might be done is simple.

The AMRL and the CCRL are now engaged in the assessment of a large number of testing organizations through the inspection and reference sample programs. Accreditation of selected groups, for example commercial concrete testing laboratories, could be achieved by turning pertinent portions of the accumulated assessment information over to an accreditation authority for review and action. In all other repects, the two activities would continue to provide advisory services for the participating laboratories as previously described.

The feasibility of the idea has been explored in numerous ways. Many individual companies in the cement industry and a substantial number of state or federal agencies have developed methods for evaluating the capability of laboratories of interest to them to do satisfactory work based either in whole or in part on a review of inspection reports. The most notable of these is a procedure the Federal Highway Administration has devised for monitoring laboratories that test materials used in the construction of highways. Numerous engineers and architects, both public and private, who have observed the benefits of review procedures to the cement and highway industries now advocate review of reports in their own areas of interest, and there is one instance where a small accreditation program is being carried out on this basis.

Closure

The benefits derived from the work of the Materials Reference Laboratories might be described as:

1. Improving the reliability of test measurements.
2. Providing data to qualify standard measurement techniques.
3. Promoting greater reliability in the quality of materials reaching the public.
4. Providing a basis for national laboratory accreditation systems as needed.
5. Providing a direct line of communication between the authors and users of methods of test.

CLASSIFICATION AND NUMBER
OF INSPECTED LABORATORIES (CCRL)

CLASSIFICATION	TOUR-1	TOUR-10	TOUR-15	TOUR-18
Cement Producer	99	140	195	186
Commercial	45	39	120	161
Highway	25	48	61	61
University	21	9	--	--
Municipal	11	4	4	7
Federal	3	13	13	12
Concrete Products	--	--	27	24
Miscellaneous	4	8	6	3
TOTAL LABORATORIES	208	261	426	454
Cement Labs	208	261	307	273
Concrete Labs	--	131	251	293

TABLE I

CLASSIFICATION AND NUMBER
OF INSPECTED LABORATORIES (AMRL)

CLASSIFICATION	TOUR NUMBER					
	1	2	3	4	5	6
State	52	52	52	52	53	57
Federal	3	4	6	6	8	6
Miscellaneous	-	-	-	-	-	8
TOTAL LABS	55	56	58	58	61	71

TABLE II

CONFORMANCE OF APPARATUS WITH SPECIFICATION REQUIREMENTS

	Cement		Concrete	
Tour No.	No. of Pieces Checked	Avg. Conf. %	No. of Pieces Checked	Avg. Conf. %
1	14164	63	--	--
15	24320	85	8951	81
16	22831	87	9880	86
17	19620	91	9967	86
18	20325	94	11596	88

TABLE III

REFERENCE SAMPLE PROGRAMS

Materials		Approx. No. Labs.	Last 1973 Sample Number
CCRL:	Portland Cement	195	30
	Concrete	70	10
AMRL:	Bituminous	115	34
	Aggregates	75	22
	Soils	75	32

TABLE IV

APPENDIX I

At a Seminar in La Paz, Bolivia, June 24 - 25, 1974, on Standardization and Metrology in Latin America, it was the virtually unanimous feeling of the participants that in Latin America regional cooperation in standardization was or could be effectively implemented by the Comision Panamericana de Normas Tecnicas (COPANT). At the same time, similar cooperation was needed in metrology and for that purpose a new mechanism was needed.

In the intervening time, the Organization of American States has taken an active interest in this theme. In order to explore further the possibility of establishing a Latin American System of Metrology, OAS generously supported half the participants to the Workshop here described. At the end of the Workshop period, the OAS representative, Mr. Ferreira, convened a Latin American caucus which, with some reservations (arising from some doubts whether the meeting was representative and competent to discuss so important a question in which most nations had a vital interest), distributed the following draft Working Paper which has since been modified without in any way departing from the basic aim of regional cooperation in metrology. At the time of publication of these proceedings, the ideas are again moving towards an early anticipated implementation.

The Draft Working Paper follows.

DRAFT WORKING PAPER

In consideration, that a recommendation was formulated in the Resolution of Mar del Plata (CIECC 137/22A6/113/73, December 1972) related to the implementation of a special project on an Interamerican System of Metrology and Calibration, the Latin American participants of the NBS/AID/OAS Workshop, 12 - 16 November, 1974, propose to the OAS the following tentative scheme.

1. Definition of Objectives

The Interamerican System for Metrology and Calibration (SIMYC) has the following objectives:

(i) Contribution to the effective execution of industrialization programs of the Region by assuming the provision of adequate metrological services in education, research, industry, commerce and other areas including those related to international certification of quality.

(ii) Optimization in the use of the available metrological resources of the member countries by coordination resulting from a uniform set of principles and rules of operation.

2. Principles

(i) Voluntary participation.

(ii) Compromise for the acceptance of actions, which will be recommended for SIMYC, recognizing limitations applicable to realistic possibilities for execution.

Note: Establishment of new laboratories will not be part of this project.

3. Governing Council

SIMYC will be governed by a Council which will consist of one participant of each member country.

The Council will meet once a year in each member country in rotation.

The Council will establish by-laws in accord with which Working Committeees from its members will be established. These may meet additionally once a year.

The Council will study the initiatives, which will be presented for each member country, approve the annual working plan, and evaluate its progress.

The General Secretariat of the Office of Scientific Affairs of the OAS will establish follow-up actions for the execution of the plans assigned to each member country.

The Council will formulate concrete recommendations for activities.

4. Financing

Special contributions (see Resolution of Mar del Plata).

5. Recommended Activities

The NBS/AID/OAS Workshop makes the following non-exclusive recommendations for field of activities:

(i) Up-to-date and systematic information on metrological capabilities of the existing laboratories in the member countries.

(ii) Up-to-date and systematic information on relevant ongoing projects and plans for the future.

(iii) Promotion of the use of SI and also of uniform metrological terminology.

(iv) Establishment of a system of laboratory auditing for all metrology laboratories of the member countries.

(v) Diffusion of technical publications relating to the methods of measurements of the base and derived units, the calibration of instruments, and the use of SRM's.

(vi) Development of the laboratories, in order to give the best metrological services in SIMYC, featuring complementation of equipment and expertise.

(vii) Organization of training courses at different levels for personnel in accordance with the requirements of member countries featuring interchanges of experts.

Note: The recommended actions are aimed at:

(i)—acceleration of the tranfer of metrological technology adequate for each phase of development.

(ii)—reduction in duplication of effort.

(iii)—reduction of idle time for facilities.

(iv)—improvement of the training of technical personnel.

6. Role of NBS in SIMYC

There are two alternatives:

(i) The U.S.A., represented by NBS, to be a member of SIMYC with equal status to other member countries.

(ii) The U.S.A., through NBS, to act as a technical adviser of SIMYC without intervention in the administrative process.

7. The Role of SIMYC in International Cooperation in Metrology

SIMYC should participate in the consolidation of international cooperation in metrology by liaison with CIPM, OILM, and other international or national organizations.

APPENDIX II

LIST OF PARTICIPANTS

NBS/AID/OAS Workshop on Standardization and Measurement Services in Industrializing Economies

November 3 - 16, 1974

Mrs. Ofelia de Young
Comision Panamena de Normas Industriales y Tecnicas
Apartado 7639
Panama 5, Panama

Ing. Orlando Donoso T.
General Director of Standards and Technology
Direccion General de Normas y Tecnologia
Ministerio de Industria y Commercio
P.O. Box 4430
La Paz, Bolivia

Ing. Raul Estrada A.
Director
Instituto Ecuatoriano de Normalizacion
Casilla 3999
Quito, Ecuador

Dr. Zawdu Felleke
General Manager
Ethiopian Standards Institution
P.O. Box 2310
Addis Ababa, Ethiopia

Mr. Romulo Ferreira
Head, Standardization Program
Organization of American States
1735 I Street, N.W.
Washington, D.C. 20006

Mr. Roy Fung
Electronics Engineer
Caribbean Industrial Research Institute
University Post Office
St. Augustine, Trinidad
West Indies

Mr. Khawaja Ammar Hussain
Director
Central Testing Laboratories
Pakistan Standards Institution
Government of Pakistan
Block 77
Karachi, Pakistan

Mr. Ovan Julal
Jamaican Bureau of Standards
P. O. Box 113
Kingston 10, Jamaica

Dr. Zae-Quan Kim
Director General
National Industrial Standards Research Institute
199, DongSung-Dong,
ChongRo-Ku
Seoul, Korea

Lic. Rodrigo Lopez A.
Calle 28
Entre Paseo
Colon y Primera Av.
San Jose, Costa Rica

Miss Zully Perdomo
Ministerio de Fomenta
Direccion de Comercio
Servicio Nacional de Metrologia Legal
Caracas, Venezuela

Mr. Jose Planas
Science Research Supervisor
National Institute of Science and Technology
Pedro Gil
Manila, Philippines

Mr. Vidalito F. Ranoa
Director
Philippine Bureau of Standards
P. O. Box 3719
Manila, Philippines

Mr. Antonio Rico L.
Secretaria de Industria y Comercio
Direccion General de Normas
Cuauhtemoc 80 1er piso
Mexico 7, D.F., Mexico

Ing. Patricio Sierra
Instituto Nacional de Normalizacion
Casilla 995
Santiago, Chile

Prof. Rafael Steinberg
Instituto Nacional de Tecnologia Industrial
Libertad 1235
Buenos Aires, Argentina

Mr. Sumantri
Deputy Chairman for Technology
Indonesian Institute of Sciences
Jl. Teuku Chik Ditiro 43
Jakarta, Indonesia

Mr. Felix Von Ranke
Executive Secretary
Associacao Brasileira de Normas Tecnicas
Av. Alte Barroso, 54 - 15°
Rio de Janeiro, Brazil

Dr. Ronald T. Wijewantha
Director
Bureau of Ceylon Standards
53, Dharmapala Mawatha
Colombo 3
Sri Lanka

APPENDIX III

SCHEDULE

NBS/AID/OAS Workshop on Standardization and
Measurement Services in Industrializing Economies
November 2 - 15, 1974

Saturday Nov. 2	12:30	Reception and Lunch, Cosmos Club Dr. E. L. Brady and Mr. H. S. Peiser, Hosts
	P.M.	Tour of Museum of History and Technology Smithsonian Institute
Sunday Nov. 3	All day	Tour of Washington
	5:00 PM	Working Dinner
		Presentation on AID/OST Activities by Mr. John Fry
Monday Nov. 4	9:00 - 10:00 AM	Greeting by Dr. R. W. Roberts, Director,
		NBS Overview by Dr. E. L. Brady, Associate Director for Information Programs
	10:00 - 10:30 AM	Workshop Introduction by Mr. H. S. Peiser, Chief, Office of International Relations
	10:30 - 12:00 M	Plenary Session: Speeches by Participants
	12:00 - 1:30 PM	Lunch, "The NBS/AID Survey Program on Standards and Measurement Services in Support of Development Goals" by Mr. H. S. Peiser, Chief Office of International Relations
	1:30 - 5:00 PM	"International Aspects of Standardization" by Mr. W. E. Andrus, Chief, Engineering and Product Standards Division

6:30 PM	Working Dinner, Speech: "Compatibility in Measurement Systems" by Dr. R. D. Huntoon, Consultant, Former Deputy Director, National Bureau of Standards
Tuesday	
Nov. 5 9:00 - 12:00 M	"Metrology Programs in Latin America" by Mr. A. Fontes and Mr. R. Ferreira, Organization of American States
12:30 - 1:30 PM	Lunch, "The Optical Physics Research at NBS by Dr. Karl Kessler, Chief, Optical Physics Division
1:30 - 3:00 PM	"Weights and Measures Activities at NBS" by Mr. R. N. Smith, NBS Office of Weights and Measures
3:15 - 5:00 PM	"Electricity Division Activities" by Mr. Norman Belecki, Mrs. Bernadine Dunfee, and Dr. Oskar Petersons, NBS Electricity Division
6:30 PM	Working Dinner, Special Invited Speech: "Regional Planning" by Dr. Albert Waterston, Professor of Economics, American University
Wednesday	
Nov. 6 9:00 - 10:00 AM	Plenary Session (Continued)
10:00 AM	"Product Evaluation Technology" by Dr. M. R. Meyerson, Chief, Product Evaluation Technology Division
11:00 - 12:00 M	"Measurement Assurance" by Mr. J. M. Cameron, Chief, Office of Measurement Services

	12:00 - 1:00 PM	Lunch, "Promotion of Invention and Innovation" by Mr. J. Rabinow, Chief, Office of Invention and Innovation
	1:00 - 2:00 PM	"Standard Reference Materials" by Dr. H. T. Yolken, Deputy Chief, Office of Standard Reference Materials
	2:00 - 3:15 PM	"Activities of the Institute for Computer Sciences and Technology" by Mr. E. J. Istvan, Associate Director for Teleprocessing, Mr. Zane Thornton, Mr. Harry S. White, and Miss Margaret R. Fox
	3:30 - 5:00 PM	"NBS Fire Programs" by Mr. I. A. Benjamin Chief, Fire Technology Division
	6:30 PM	Working Dinner, Speech: "The FDA Import Food Strategy" by Mr. B. M. Gutterman, Assistant Director, Office of Technology, Bureau of Foods, U.S. Food and Drug Administration
Thursday Nov. 7	9:00 - 10:00 AM	Plenary Session (Continued)
	10:15 - 12:00 M	"Activities of the Center for Building Technology" by Mr. C. Raley, Coordinator of International Affairs, Center for Building Technology, (CBT)
	12:00 - 1:00 PM	Lunch, "National Technical Information Service" by Ms. Vietta Dowd, Special Assistant to the Promotion Division Director, National Technical Information Service (NTIS)
	2:00 - 4:00 PM	Visit Division of Weights and Measures, Bureau of Building, Housing and Zoning, District of Columbia Department of Economic Development, 1110 U St., S.E., Washington, D.C. (Host: Mr. Ken Hayden, Chief)

	6:30 PM	Working Dinner, Speech: "Science and Foreign Affairs" by Mr. Herman Pollack, Consultant, Former Director, Bureau of Scientific and Technological Affairs, Department of State
Friday Nov. 8	9:00 - 10:00	Plenary Session (continued)
	10:00 - 12:00	"Activities of the U. S. Geological Survey" by Dr. Ralph Miller and Mr. Alvin Holzle, U. S. Geological Survey
	12:00 - 1:00 PM	Lunch
		Group Photograph
	1:00 - 2:30 PM	"Information Programs at NBS" by Dr. E. L. Brady, Associate Director for Information programs
	2:30 - 3:00 PM	"Materials Reference Laboratories" by Mr. J. R. Dise, Head, Materials Reference Laboratories Section
	3:15 - 5:00 PM	Concluding Executive Session
	5:30 PM	Director's Sherry Party, Host: Dr. R. W. Roberts, Director, NBS
	6:15 PM	NBS Dinner
Saturday Nov. 9		Tour of Washington
Sunday Nov. 10	AM	Free
	PM	Travel to Philadelphia, Pa.

Monday Nov. 11	8:30 - 10:00 A.M.	Visit American Society for Testing and Materials, Philadelphia, Pa. Hosts: Mr. Frank E. Clarke, President, ASTM, Mr. William P. Cavanaugh, Managing Director, ASTM, and Mr. Al Sadler, Assistant to Deputy Managing Director, National and International Standards Coordination
	10:30 - 11:30 A.M.	Visit to General Electric Laboratory 3198 Chestnut Street Philadelphia, Pa. Host: Mr. Jack Welsh
	1:30 - 4:00 P.M.	Visit Leeds and Northrup, North Wales, Pa. Host: Mr. Robert Verity
	Evening	Travel to Boston, Mass.
Tuesday Nov. 12	9:00 - 12:00 M	Visit to Massachusetts Institute of Technology, Cambridge, Mass. Host: Dr. J. P. Ruina
	2:00 - 5:00 P.M.	Visit to Arthur D. Little, Inc., Cambridge, Mass. Hosts: Mr. Derek Till, Vice President Production Development John Magee, President Louis Ashley, Product Development Vincent Giuliano, Organization Communications Technology John Stevenson, Vice President, International Development and Marketing Group Joseph Voci, President, ADL Management Education Institute
	Evening	Travel to Madison, Wisconsin
Wednesday Nov. 13	9:00 - 3:00 P.M.	Visit Midwest Universities Consortium for International Activities (MUCIA) and Forest Products Laboratory, University of Wisconsin, Madison, Wisc. Host: Dr. William Hunter

	3:30 - 5:30 PM	Tour of University of Wisconsin campus
	Evening	Travel to Chicago, Illinois
Thursday Nov. 14	9:00 - 11:30 AM	Visit Underwriters' Laboratories Northbrook, Ill. Arranged by: Mr. Robert van Brunt
	2:00 - 5:00 PM	Visit Illinois Institute of Technology and IIT Research Institute Host: Dr. S. Uccetta
	4:30 - 8:00 PM	Tour of Chicago, Dinner
	Evening	Travel to Denver, Colorado
Friday Nov. 15	9:00 - 11:30 AM	Visit Denver Research Institute, Denver, Colorado Host: Dr. Donald Evans
	1:15	NBS Boulder, Colorado Welcoming Remarks, Mr. B. W. Birmingham, Deputy Director Overview - Mr. Kent T. Higgins Announcements - Dr. Yardley Beers Electromagnetics Division Overview - Mr. David H. Russell Automated Network Analyzer - Mr. Alvin C. Wilson Near Field Antenna Scanner - Mr. Allen C. Newell Cryogenics Overview - Mr. Alan F. Schmidt Cryoelectronics - Dr. Donald G. McDonald Cryogenic Flow Metrology - Mr. James A. Brennan Atomic Time and Frequency Standards - Dr. J. A. Barnes Laser Frequency Synthesis - Dr. Kenneth M. Evenson
Saturday Nov. 16	8:00 - 11:30 AM	Workshop, Latin American Caucus (See Appendix I)

NBS-114A (REV. 7-73)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. NBSIR 75-769	2. Gov't Accession No.	3. Recipient's Accession No.

4. TITLE AND SUBTITLE
REPORT ON AN NBS/AID/OAS WORKSHOP ON STANDARDIZATION AND MEASUREMENT SERVICES IN INDUSTRIALIZING ECONOMIES

5. Publication Date September, 1975

6. Performing Organization Code

7. AUTHOR(S) Editors: H. Steffen Peiser, Robert Marvin, Michael McNeil, Joanne Mejeur

8. Performing Organ. Report No. PASA TA (CE) 5-71

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Complete Address *(Street, City, State, ZIP)*

Agency for International Development
Department of State
Washington, D. C. 20523

13. Type of Report & Period Covered Final Report

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

On November 3-16, 1974, a Workshop was held at the National Bureau of Standards, Gaithersburg, under the sponsorship of AID and the Organization of American States, the object of which was to give standards officials of industrializing nations insight into the standards and measurement systems in the United States and the role of the National Bureau of Standards, so that these officials might consider what parts of the U.S. system might usefully be adapted to conditions in their home countries. The report contains copies of speeches and presentations by the U.S. hosts and the participants from the other nations. In addition, information is given on the general agenda of discussions, presentations, and tours of laboratories at NBS and other U.S. organizations.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

AID; OAS; Assistance; Economics; Foreign Relations; Industrializing Nations; LDC's; Measurement Services; Standardization

18. AVAILABILITY [X] Unlimited

[ ] For Official Distribution. Do Not Release to NTIS

[ ] Order From Sup. of Doc., U.S. Government Printing Office Washington, D.C. 20402, SD Cat. No. C13

[X] Order From National Technical Information Service (NTIS) Springfield, Virginia 22151

19. SECURITY CLASS (THIS REPORT) UNCLASSIFIED

20. SECURITY CLASS (THIS PAGE) UNCLASSIFIED

21. NO. OF PAGES 227

22. Price $ 7.50

USCOMM-DC 29042-P74

☆U.S.GOVERNMENT PRINTING OFFICE:1975-210-959/14