NCCL CHAIRMAN'S VALEDICTION

First of all, I owe NCSL an apology. Early in the summer I changed jobs to one which has been very demanding of my time. As most NCSL Board and Committee members know, much NCSL business is accomplished at home, on weekends and evenings. However, the new job has made demands on the weekends and evenings also, to the extent that my attention to NCSL business has suffered. Because this situation seems likely to continue, I could not consider another term as NCSL Chairman.

Recently, Vice-Chairman Dick Ernst informed me that his new job will keep him from direct participation in metrology activities for the indefinite future and that his company will appoint a new delegate to NCSL. Hence, the Nominating Committee had to find a candidate to fill Dick's unexpired term. Meanwhile, NCSL owes special thanks to Dave Mitchell, who for the past several months has provided back-up support to Dick.

Since the Nominating Committee selected Vice-Chairman Jerry Hayes as their candidate for Chairman, the Committee was faced with the problem of finding a candidate to fill his unexpired term—all the above in addition to nominating replacements for the two Vice-Chairmen whose terms expire on September 30 of this year. Therefore, the Nominating Committee has had a larger than normal job. By the time you read this, undoubtedly you will have received your mail ballot and will have cast your vote. I believe you will join me in thanking the committee for a job well done.

A few weeks ago I had an interesting discussion with a top management member of an organization that is very much involved in our country's defense-aerospace programs. One of his major concerns ("...about my biggest problem") he said, is the fact that he can not use published performance specifications as a reliable guide in equipment procurement.

As a result of our discussion I decided to do two things: first, to inquire what additional role the National Bureau of Standards might be willing to play in regard to equipment performance specifications and second, to seek the reactions of Newsletter readers regarding the present extent and severity of the problem and regarding the desirability of possible alternative solutions.

I can report that, based upon tentative discussions, NBS is willing to lend a hand but has as yet not proposed a specific role. As possibilities, NBS could a) concentrate on design features that are likely to provide a specific type or quality of instrument performance, b) act as a clearing house for
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instrument evaluations now being performed by a large number of government contractors (with some critical analysis of the evaluations, perhaps) or c) conduct original evaluations of the selected types of instruments believed to be of most concern to the government. This information could be made available within the government and to government contractors. At the present time NBS is seeking to determine what approach would be the most useful.

Now I need wider input from NCSL members. Is this a continuing, serious problem today? If so, ideally how could the problem be solved? Practically, what can NCSL do toward a solution? What type of NBS effort would be most helpful? I would like comments from Newsletter readers on this question. Won't you please share with me your views before you lay the Newsletter aside today?

Before another Newsletter appears, NCSL will have a new Chairman. Therefore I take this opportunity to express my appreciation to everyone who has made my term as Chairman so enjoyable: to the Board members with whom I have had many stimulating discussions and who have taken commendable initiative; to the Committee members who, often behind the scenes, do the real work of the organization; to those readers who, in response to Newsletter items have made very thoughtful suggestions; and finally to all members of NCSL, whose continued support is evidence that the Board and Committee members have not burned the midnight oil in vain.

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NCSL NOMINATING COMMITTEE REPORT

Nominating Committee Chairman O. LINEBRINK reports that his committee has returned the following slate of officers for balloting. Terms of office are as noted.

Chairman - J.L. HAYES, US Navy Metrology Engineering Center, (1 yr)
                      Pomona, California
Vice-Chairman - J.F. HADLEY, Bendix Corp. Kansas City, Mo. (2 yr)
Vice-Chairman - W.L. VANDAL, McDonnell Aircraft Corp. St. Louis, Mo (2 yr)
Vice-Chairman - H.S. INGRAHAM, Jr., RCA/DCSD, Camden, N.J. (1 yr)
Vice-Chairman - F.J. DYCE, Martin Marietta Corp., Orlando, Fla. (1 yr)
Treasurer - D.I. HERVIG, US Army Sentinel Program, Huntsville (2 yr)
                   Alabama

For Board of Directors for 1 year - five members to be elected:

F. J. DYCE, Chairman of the NCSL Specifications Committee transmitted a final summary of data received in answer to a survey on "General Purpose Electronic Test Equipment Calibration Costs", and compiled under direction of W. M. McDILL. Some conclusions reached were that a) a large variation in calibration and repair times exists that is not necessarily determined by size of instrument inventory, and b) very few laboratories collect material costs related to individual instruments. A sampling of data reported includes:

- Technician average calibration time/instrument = 2.4 hr
- Technician average repair time/instrument = 2.3 hr
- Technician average repair and calibration time/instrument = 3.5 hr

Note that the data shown above are averaged from figures submitted by laboratories having a workload inventory of instruments ranging from less than 1000 units to more than 15000 units.

A.M. BAUGHMAN, Chairman of the NCSL Calibration Procedures Distribution Committee, reports as follows:

The Calibration Procedures Library is basically in full operation although several areas are still being worked on by the committee and the Interagency Data Exchange Program (IDEP) offices.

There are two categories of participants in the Library Exchange Program. Full distribution status (C-participant) is for a subscriber who submits a minimum of six procedures each calendar year and who will receive the complete library on microfilm, as well as the index, roster, and other material. A partial distribution (D-participant) is a subscriber who submits a minimum of two procedures each year and receives all calibration materials but not the microfilm file. He must request procedures from his IDEP office.

To date the Library has 115 participants who are broken down by IDEP offices as follows:

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<tr>
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<th>C Participant</th>
<th>D Participant</th>
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<tr>
<td>Air Force</td>
<td>35</td>
<td>9</td>
</tr>
<tr>
<td>Navy</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>Army/NASA</td>
<td>21</td>
<td>14</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>80</strong></td>
<td><strong>35</strong></td>
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The Library initially contains 41 reels of microfilm. Some problems have existed in the reproduction of the last 20 reels. Each "C" participant has received the first 21 reels and will receive the other 20 reels within the next two weeks.

The Library index has been distributed to each "C" and "D" Participant as well as a supply of Summary Sheets. The Instruction Manual and Roster of Participants are being printed and will be ready for distribution the latter part of August.

After the participants have several weeks of operation, a committee meeting will be called to discuss and to work out any possible problems. October 21-22 are the scheduled dates for the committee meeting which
will be held somewhere in the Los Angeles area.

Any questions pertaining to the Calibration Procedures Library will be answered by telephoning A.M. Baughman (805) 866-3733 or 866-7167.

JERRY HAYES reports that through the efforts of JACK SHACKELFORD's Information Committee, each Member Delegate can expect to receive during November a copy of the newly established NCSL Information Manual. Because of costs, only NCSL Member Delegates will receive the manual. It is a specially designed three-ring binder for collection and retention of official NCSL documents and other related NCSL material of interest. The manual will appear originally with five separator tabs labelled Publications, NCSL Organization, Recommended Practices, Calibration Procedures and Miscellany (further subdivision possibilities were limitless, so brevity was chosen). It is intended that each recipient insert appropriate NCSL material now on hand to establish a ready reference. In addition, Jack has been hard at work with other Committee Chairmen to get as much fresh material to include in the manual as he can, on its maiden release. Hoped for (but not guaranteed) items include the "Directory of Standards Laboratories" from Paul Long's Directory Committee; "Procedure for Preparation of Recommended Practices" and "Guidelines for Committee Chairmen" from Andy Woodington's Organization Committee; and "Requirements for Participation in the IDEP-NCSL Calibration Procedures Library" from Al Baughman's Calibration Procedure Distribution Committee.

As other new material is released by the committees, it will be mailed for insert in the manual (Ken Hedlund's Recommended Practices Committee is making renewed efforts to get some Proposed Recommended Practices in your hands within the next few months).

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On June 11, 1969 NCSL lost one of its Member Delegates through the death of Bernard W. Krupp, of the National Aeronautics and Space Administration, Electronics Research Center in Cambridge, Mass. We extend sympathy to his family and to his friends and fellow workers at NASA.

NCSL Chairman Lance has called a meeting of the NCSL Board of Directors and the NCSL Committee Chairmen for 7:30 PM on Tuesday, October 28, at the Shamrock-Hilton Hotel in Houston, Texas. The timing coincides with the 24th Annual ISA Conference & Exhibit also being held in Houston. The agenda for the meeting will be prepared by the incoming Chairman who will take office on October 1, 1969.
URSI GENERAL ASSEMBLY

The XVIth General Assembly of the International Scientific Radio Union was held in Ottawa, Canada on August 18-28, 1969. Slightly more than 600 technical and scientific delegates from all over the world crossed the border into Canada to register for the proceedings, to be joined by approximately 200 Canadian delegates and observers. Wives of delegates were made welcome and entertained by the wives of Canadian personnel, many from the National Research Council in Ottawa.

After opening ceremonies, presided over by the President, Prof. S. Silver of the University of California, the various commissions separated into the many buildings of Carleton University for serious work.

In the following report, delegates speaking are designated in parentheses by country of origin, and by number related to the candid shots made of many attendees, which accompany this report on opposite pages.

Three major categories of papers appeared on the program of Commission I:

a. LF and VLF propagation, phase comparisons, and phase comparisons of long-range measurements (Loran, etc.).

b. Frequency standards, quantum devices, generators, lasers, dc voltage standards (Josephson effect).

c. RF and microwave measurements and standards.

LF-VLF propagation and phase measurements

Geomagnetic coordinates of propagation are as equally important as geographic coordinates. Tests, for instance, from Ft. Collins (WWVL) to Teddington (NPL) on 20 kHz via the Polar route have suffered from severe solar disturbances--phase advances of 30 µs noted, followed by slow recovery over the period of a week.

Reder (U.S.-1) reported that cesium standards are now employed in a majority of the LF-VLF test stations. Researchers are primarily interested in long-time comparisons, seeking to relate locally-generated time scales with time-scales generated in other countries. A local well-established phase reference is of primary importance in correcting for the ionospheric disturbances during long-period observations.

Abom (Sweden-2) reported on studies of the Omega navigational system. By taking a linear combination of signals received on two phase coherent frequencies the diurnal shifts and other effects of solar disturbances can be eliminated on 30.6 and 10.2 kHz. Such techniques have also been applied to studies of signals from WWVL (20 kHz) and WWV (60 kHz). Comparison studies for periods of as long as 9 days have indicated results approximating one or two parts in $10^{12}$ mean value. Residual phase fluctuations approached 1 µs. These results were obtained for any time of the year. Optimum smoothing by the linear combination of two received frequencies will take out the gross effects of phase fluctuations and day-to-day variations can be reduced to the order of 0.1 µs.

Becker gave results of time comparisons between USNO and PTB via VLF, as confirmed by LORAN-C. Relative uncertainty for 1 year is approximately $1 \times 10^{-13}$ (3 µs).

Blair (U.S.-3) reported the present status of the program on time dissemination using WWVL (19.9, 20, 20.5 kHz). Results indicate that 100-kHz separation of transmitter frequencies is less than desirable; 500 kHz separation gave
positive cycle identification at several receiving sites.

It was noted that dual separation of transmission frequencies is far more economical of bandwidths than the LORAN-C system, although more complex instrumentation is required and careful analysis of the results is necessary. Availability of traveling clocks has permitted verification of test results at various sites. Latest trends in frequency separation have been toward wider separation, i.e., 1 kHz, in order to reduce the severe requirements on phase controls at transmitter and phase discrimination at the receivers. Steele (U.K.) noted that GBR was operating on 15.95 and 16.00 kHz and could disseminate time if desired although receivers would be pushed to unreasonable phase measurement demands (0.1 μs). Egidi (Italy) also reported that Italy contemplated dual-frequency experiments at 22.5 and 25.0 kHz.

Experiments conducted in the USA, which appeared to indicate that the frequency of radiation changed during the course of propagation because of some relativity effect, were refuted by Markowitz (U.S.-4). A series of controlled experiments conducted at Marquette University in the fall of 1968, disproved any effect of earth mass upon the frequency of LORAN-C transmissions.

Quantum research and development

Use of lasers has been made in light-velocity measurements and to incorporate into geodimeters in order to improve sensitivity. Interferometers have been constructed, working in the range of 3 to 30 meters. Bender (U.S.-5) reported on work done on long-distance measurement work, including that of two observatories which have successfully reflected beams off reflectors on the moon. Pulsed-laser range measurements to artificial satellites, conducted in several countries, were made to accuracy limitations of 25 cm, including the effects of the earth's atmosphere. It was noted that the uncertainties concerning the figure for the velocity of light introduce errors as large as 4000 cm, indicating one more specific reason for the intensive work conducted on establishing a more accurate figure.

Hall (U.S.-6) discussed the precise measurement of acceleration and the velocity of light by means of experiments conducted within an old abandoned gold mine near Boulder, Colorado. Orzag (France-7) touched upon geodetic applications of moon ranging and described some error derivations.

An incentive for experiments with quantum devices to establish wave length standards, now being conducted in a number of laboratories, is centered on the need for an improved value of "c". One such experiment concerns itself with a stabilized submillimeter radiation at 118 μ (NASA/Bell Lab), well beyond the giga-hertz region. The region embraces large numbers of wavelengths contained within the bounds of the Fabry-Perot resonator but accuracies of the order of several parts in 10⁶ were reported by Frenkel (U.S.-5).

Grivet (France-9) and Audoin reported progress in work on hydrogen masers. Audoin (France-10) mentioned stabilities of 5 parts in 10⁻¹⁴ for periods of 10 seconds; long term stabilities continue to be affected by cavity stability, long-term changes in the wall shift, etc., giving 6 parts in 10⁻¹⁴ stability for a three-week period, 5 parts in 10⁻¹³ for 3 months. Reproducibility of the frequency is quite high, of the order of 2 parts in 10⁻¹³; estimated accuracy is 5 parts in 10⁻¹⁴. It appears in this time that the cesium standard and the hydrogen maser have attained approximately the same order of accuracy. There is still much room for improvement in each type. Barnes (U.S.-11) reporting for Glaze, on cesium-beam work at NBS, noted that uncertainties in future cesium standards soon should be reduced to 1 or 2 parts in 10⁻¹⁳.

Becker (W. Germany-12) discussed results from a cesium standard recently placed
in operation at PTB. Comparison with a hydrogen maser for a period of 3
hours gave a relative frequency shift, due to residual phase difference,
of about $2.5 \times 10^{-13}$. Uncertainty of the C-field results in a relative fre-
quency uncertainty of $1 \times 10^{-14}$; inhomogeneity of the C-field gives a relative
frequency uncertainty of $1 \times 10^{-15}$. The largest relative frequency uncertain-
ty is due to the second-order Doppler effect and equals $3 \times 10^{-13}$. Present
claimed accuracy is $4 \times 10^{-13}$ ($1\sigma$); standard deviation of $\Delta f/f$ is $2.5 \times
10^{-12}/\sqrt{t}$ in seconds, when the 150-Hz line width is used.

Langenberg (U.S.-13) mentioned work involving use of radio frequencies to
obtain quanta for the Josephson junction from which the output voltage is
obtained. Steele (U.K.-14) noted that experiments in the US and UK have
shown a close relation in results—limits of error being $2 \times 10^{-6}$ approximately
and agreement being established to $2 \times 10^{-7}$. It was noted that these
results were dependent upon the value assigned the national volt in each
country. The possibility for near-future replacement of the standard cell by
a quantum device was noted. In the long term period of events it was antici-
pated that quantum devices would command and control the existing standards
of frequency, wave length, voltage, current, and perhaps even the kilogram.

Measurements and standards

The joint meeting with Commissions V and VIII drew attention of Commission
I to certain problems involved in noise measurements. Uncertainties in cali-
brations prompted Shakeshaft (U.K.) to ask for assistance in better defini-
tions and better calibration values for receiving antennas. He noted that
radio astronomy measurement of flux densities required a) knowledge of atmos-
pheric attenuation, b) a radio telescope with gain adequate to provide a good
signal-to-noise ratio and a resolution sufficient to separate the source
from others nearby of comparable gain, c) accurate knowledge of the telescope
gain, and d) a standard noise source to determine the sensitivity of the
receiver. Virtually all flux density measurements are relative to the flux
density of the brightest sources, which are then determined absolutely by the
use of comparatively small antennas whose gain can be found with much higher
accuracy. Atmospheric attenuation is attributable largely to non-resonant
absorption by oxygen (to 10 GHz). It is not greater than 1% over most of the
range. Shakeshaft noted that the stars Cassiopeia A and Cygnus A have well
defined spectra and are used as references between 10 MHz and 15.5 GHz. The
flux density of Cas A is decreasing with time, however, thereby posing a prob-
lem which needs solution through the work of observing laboratories.

Arthur (U.S.-15) reported on NBS-developed noise-power standards developed
for coaxial or hollow-waveguide systems. Precision coaxial-thermal-noise
generators (approximately 77 K and 373 K) are available for use at 3,30 and
60 MHz, having uncertainties of measurement of 0.10 K and 0.15K respectively.
In the frequency range 8.2 to 18.0 GHz, noise temperature comparisons in the
range 75 K to 50,000K are made with an uncertainty of less than 1%.

Horner (U.K.-16) discussed techniques for the measurement of atmospheric
and man-made noise. He noted that most measurements of these noises are
based upon the use of a signal generator or noise diode which is relied upon
as a standard reference for absolute amplitudes. Accuracy limitations are
usually confined to 10% in power, with a similar limitation for knowledge of
antenna characteristics. Horner suggested areas of future investigation
should include a) development of a common basis for measuring and describing
the two types of noise for better comparisons, b) compilation of data on the
waveforms of typical types of man-made noises (noise signatures), and c) study
of the relationship between results of measurements close to individual sources.
Prof. M. Zhabotinski, Chairman-elect (Comm I) outline plans for 1972 and to Chmn. Dr. L. Essen discussing formal resolutions with Delegates Weinschel, Altschuler, Steele, Chapin.
of man-made noise and the integrated noise from all sources at a distant site.

Tanaka (Japan-17) reported on efforts made for absolute calibrations of solar flux densities and spectrum, as well as several star sources. Stress was laid upon the variability of known sources and the need for continual monitoring.

Reporting on field-strength standards and calibrations (audio to 1 GHz), Egidi mentioned the technique of using a highly-conductive sphere to provide a calibration source calibrated at 30 MHz, in addition to the established use of standard vertical monopoles over metallic ground planes. He also touched upon the use of highly resistant semiconductor leads as special transmission lines, to provide near field measurements in strong magnetic fields without distortion of the observed field. Present limits of uncertainty of 3% up to 5 MHz and 5% or better from 5 to 30 MHz have been reported by NBS for establishment of standard fields. Induced field measurements can be established with an uncertainty of 10%.

Progress in measurement of microwave attenuation was reported by Steele. He noted that piston-attenuator control has been improved in some cases by incorporating direct interferometric indication of piston displacement. Development is under way for direct operation at 1 GHz to supplant measurements at i.f. frequencies. Another unit employs air bearings and air-gauging heads related to an invar ring standard. Accuracy of the modulated subcarrier measuring system has directed attention to the shortcomings of the existing rotary-vane attenuators, and has dictated the need for new designs.

For the field of rf and microwave power, Clark (Canada-18) reported on development of three coaxial calorimeters for use in the range of 4-8 GHz, with accuracies of about 0.5% for powers ranging from 10 to 100 watts. Harris (U.K.-19) discussed power calibration by use of precision connectors and of precise quarter-wave sections of line, giving measurement uncertainty of approximately 0.1%. Power ratios may be compared to limits of 0.0.4%. Engen (U.S.-20) reported on the successful conclusion of international intercomparison of power standards originated under the sponsorship of BIPM and BPI in 1965. General agreement of 0.25% was obtained during a 9-month period of tests.

Impedance measurement systems were discussed by Clark and Somlo. One system developed at NRC, comprises a terminating device, whose impedance is to be measured, which is moved with respect to a fixed voltage probe in the transmission line by the insertion of various lengths of precision transmission line. The voltage output from the probe and the stepped-frequency input are fed into a computer which calculates the phase and magnitude of the reflection coefficients in 14-mm precision line is 0.001 at 1 GHz and 0.002 at 8 GHz.

Somlo (Australia-21) described another reflectometer system which, by locating the unknown sufficiently far from the measuring port by introducing a long length of waveguide, arranges for the rate of change of reflections due to the load to be separated from the other uncertainties of the system.

Both approaches mentioned are part of the present day philosophy which calls for coverage by a wide range of frequencies and many measurements but with no reduction in accuracy. Steele, during his review-of-progress reports, noted that the trend toward use of computers was pronounced. He stressed the ability of the computer to store data relative to system errors, to incorporate standards values into the computer memory, and to correct for the system errors when the test measurements were being made. Beatty (U.S.), in a short report on computer/operator/instrument interfaces, gave a concise block-diagram presentation of the inadequacies of most so-called automatic measurement systems and stressed the interface requirements of the truly automatic system.
Sakurai (Japan-22) presented a brief report on the measurement work conducted by ETL and measurement systems in operation.

Fellers (U.S.) presented a report concerned with progress of measurements in the frequency range above 30 GHz. Among items mentioned were:
   a) a power-measuring thin film resistor load placed in the focus of a parabolic short circuit across an oversized wave guide operating in the 100-GHz region,
   b) a dual channel insertion-loss test set,
   c) a high precision wide band wavemeter (100-150 GHz) with a loaded Q of $10^4$, using dual cavities to avoid ambiguities.

Selby (U.S.-23) presented data on bolometric measurements of voltage and current through the microwave frequencies and stressed the facility with which the bolovac is used by unskilled technicians.

Radio measurement applications

Nahman (U.S.-24) presented a unique application, by NBS workers, of pulse techniques by which frequency domain data could be quickly obtained from time domain data. The experimental setup comprised a liquid filled semi-rigid coaxial line whose lossy characteristics contributed to the determination of the Debye relaxation time for dilute solutions of (polar) 2-heptanone in (non-polar) normal heptane. The step responses of the liquid filled line were measured and compared with the Debye model in order to deduce the relaxation time T.

Techniques of radio surveying were described by Blacknut (Canada-25) and Jaksic (Canada-26) of NRC. Extensive use is made of computers to provide more flexibility than that provided by purely optical/mechanical methods. The latter are limited by the accuracy of known base lines used for calibration purposes. RF techniques make use of accurately controlled transmissions to detect time taken by reflected waves to be returned to the transmitter. The method is a derivation from techniques employed in measuring the speed of light by resonating a closed cylinder in the microwave region.

Braginskii (U.S.S.R.-27) drew attention of Commission I to a method of using quantum techniques to measure small physical disturbances. The measuring instrument was a Fabry-Perot resonator, one mirror of which was attached to the mass of the oscillator under observation. The source of coherent optical radiation (power $N_0$ and frequency $\nu_0$) excites oscillations of the fundamental mode in the resonator. The motion of the mirror attached to the observed mass leads to a modulation of the light current leaving the resonator, which is registered by a photo detector. The smallest acceleration measured by the system is $10^{-11}$ cm/sec$^2$, with an observation period approaching one year.

Prast (U.S.-28) addressed the Commission-I members on the problems inherent in air-collision-avoidance systems and noted the need for atomic time-measuring devices of very compact size and low cost, to be used in controlling presently-designed systems and to promote the smallest (within safety considerations) spacing between aircraft, regardless of travel direction. It was also pointed out that a uniform international time scale would be an absolute necessity to permit controlled international flights.

Halford (U.K.-29) spoke on the necessity to standardize internationally upon the choice of test frequencies, since present experimentation and tests usually is based upon arbitrary choices of frequencies. He presented a series of preferred frequencies, repeated in decimal cycles, but capable of expansion or contraction within any decade, in accordance with the detailed schedule laid out.
Some time was given to relaxation:

**AT THE BARBECUE**

URSI President-elect Prof. Dr. W. Dieminger (left) enjoys a bit of conversation with the ladies and Delegates White and Fleischer listen in.

The ladies, Mrs. Fleischer, White, and Dieminger, are an intent audience, while U.S. Delegate Mumford relaxes over his coffee.

**DURING COFFEE BREAKS**

**AND AT THE GOVERNOR-GENERAL'S GARDEN PARTY**
Essen gave an interesting dissertation on the effect of acceleration upon the theory of relativity. He questioned some aspects of the application of corrections to travelling clocks, because of a general lack of comprehension of, or appreciation for, the fundamental assumptions upon which the relativity theory is based.

Makow (Canada) of NRC gave details of a new computable capacitor, based upon the Thompson-Lampard capacitor. The new capacitor, named LINCAP, is essentially a four-cylinder T-I capacitor bent into a nearly complete ring. It gives evidence of extreme stability under temperature and humidity environmental changes.

In addition to the reports of the Delegates, Commission I also took time out to compose several Resolutions for consideration by the General Assembly.

It was agreed that:

- the attention of Commission I be directed to the study of the following topics as they apply to biological effects:
  1. Methods of measurement of rf field quantities such as power density, electric and magnetic field strength.
  2. Conditions of measurement and associated definitions.
  3. Supporting instrumentation.
  4. Additional rf standards which may be required to ensure the accuracy of (1) and (3).

- investigations of the properties and ultimate possibilities of atomic frequency standards should continue.

- URSI should take steps to become a "co-operating sponsor" of CPEM without financial obligation.

- Commission I of URSI, through its national chairmen and with the cognizance of the respective national laboratories, encourage the international comparisons to establish the limits of agreement in determinations of electric and magnetic field strength and antenna gain.

- a symposium be held at some time prior to the next General Assembly to consider the following topics:
  1. Measurement of laser energy, power, and pulse shape including picosecond mode-locked lasers.
  3. Frequency-stabilized lasers and the absolute determination of frequency and wavelength.

- that the carrier waves of standard frequency emissions should have their nominal values, without frequency offset; that the time difference between the emitted seconds signals and Universal Time (UT) should be maintained within about 0.5 second by means of step adjustments of precisely 1 second; that the mode of operation in the first part should be put into operation as soon as possible and the mode of operation in part 2 should be effective on January 1, 1971.

- the investigations into the different possible methods of achieving synchronization be actively pursued.
METRIC SYSTEM NEWS

Metric System Obsolete?

With this lead title, PROFESSIONAL ENGINEER magazine, July, 1969, published a letter from reader J.E. Hubbell which stated:

"It might have made sense to change to the metric system 150 years ago—when it was abreast of the technology of the day. But the metric system is now obsolete.

"First, we should be moving from the decimal system rather than toward it. We should go to a binary derived system—such as the hexadecimal. IBM uses the latter in computers. The decimal system, so highly touted by metric advocates, is a relic of the stone age—it does not meet the needs of modern technology.

"Second, we should adopt the amu as the unit for mass—not an arbitrary quantity such as the kilogram. Third we should move to the Boltzman temperature scale rather than to the Kelvin scale. There is no need to load future generations with a complicated conversion factor in going from temperature to energy per particle.

"Fourth, we ought to relate mass and dynamic quantities by the Einstein law rather than Newton's law. We should have one unit for mass and energy. We ought not to measure mass in kilograms and energy in Joules."

Metric Study Financing

The U.S. Senate has passed a bill to authorize appropriation of $2,500,000 for a three-year study of the metric system. The money would be given to the Department of Commerce to continue work started by the National Bureau of Standards in 1968. It is anticipated that the House will not give the bill a hard time, thereby permitting the Department and the Bureau, to appraise the desirability and practicability of increasing the use of metric weights and measures in the U.S.; to examine the feasibility of retaining and promoting international use of engineering and product standards based on our customary measurement units; and to evaluate the costs and benefits of the various alternative courses of action available to the U.S.

Britain Moves Along

The U.S. magazine STEEL, June 9, 1969 reported on progress in Britain toward its "metricating" goal. (Metricating: the change of the whole conceptual framework in which the nation lives and works.) Complete changeover is scheduled for 1973; it is anticipated that the timing will be maintained close to schedule. Curiously enough, the whole metrication program is voluntary on the part of industry with the government supporting the move to the fullest extent.

It was noted that proper planning was most essential or chaos would result. All people were expected to be able to cope with the change, if given time. The existence of a dual standard of measurements, for an interim period, was not regarded as too helpful inasmuch as it appeared to encourage people to avoid their homework in learning the new system.

One company involved in the report, Joseph Lucas, Ltd., felt that at least one spinoff would be beneficial. In direct quotes, "-----because of the mental gymnastics we have performed during the changeover and from the filling
of our technical meetings. No other subject or event has ever caused an equal reaction. The company felt that other benefits which would accrue would be, "-----in international trade through common standards, savings in education time, and savings in time required for all technical and commercial calculations." Lucas is involved in the building industry.

USASI Speaks Its Piece

In the July issue of THE MAGAZINE OF STANDARDS the USA Standards Institute describes the purpose of its Metric Advisory Committee as related to the study authorized by Congress to determine the advantages and disadvantages of increasing the use of the metric system of measurement in the U.S. The key question in that study is "What would be the effect on American industry if the United States should expand the use of metric units of measure?" Three different approaches to answering that question are discussed. The basic units of the International System (SI) are given and the establishment of industrial and commercial standards of measurement are discussed. Also mentioned are the changes in existing practices, such as the use of comma or decimal point and standardization by preferred numbers derived from geometrical progression.

A WORTHWHILE PROJECT

Quite by accident we discovered, just recently, one of those services which plug away, year by year, with too little recognition from this busy world. Science For The Blind started in 1955 as Science Recorded--a monthly periodical on magnetic tape. Prof. T. A. Benham, lecturer in Physics at Haverford College, felt the need for blind persons to have access to current scientific literature not available elsewhere. A few volunteers assisted him, and the output soon reached 70 tapes per month.

Presently, circulation is over 2,000 per month and increasing. It is estimated that 1,000 persons have access to eight periodicals and a permanent library of more than 600 tapes.

In 1964 an Instruments and Aids Project was initiated to develop and adapt instruments for auditory and Braille readout. Such aids are of inestimable value to blind persons in being able to take their place in scientific and technical jobs and hobbies.

Perhaps our readers might care to help Prof. Benham's work. The address is:

Science For The Blind
221 Rock Hill Road
Bala-Cynwyd, Pa. 19004

By the way, Prof. Benham can appreciate the handicap of the blind person--he, too, is blind.
A New RF Ammeter

A small, portable radio frequency current ammeter has been developed at NBS which, when calibrated with the NBS Standard Electrodynamometer, will serve as an interlaboratory standard of high accuracy. W.W. SCOTT devised the transfer standard which has the required accuracy, ruggedness, and portability. It is composed of a silver elliptic cylindrical reflector having a cylindrical thin-film heater along one focus and a sensitive heat sensing thermopile along the other focus. Input current causes the heat to radiate infrared energy which is reflected and focused onto the thermopile. The resulting electrical output is proportional to reflected radiation.

The current measuring range is three times greater than that of other ammeters. It also has an output signal 10 times greater and an unequal broadband frequency range. Its design is compatible with a 50-ohm coaxial line. It compensates for both ambient and self-heating temperature changes.

Tests conducted on the prototype ammeter indicate that direct current ranging from 0.5 to 5.0 amperes passing through the heater produces a thermopile dc output ranging from 1 mV to 100 mV which corresponds to heater temperatures of about 33°C to 500°C. Heater destruction does not occur until the current reaches approximately 9 amperes.

Cross-section of a new radio-frequency ammeter developed at NBS reveals its main components. The diagram shows the scheme of radiation reflection by means of which thermal coupling is accomplished.

Microwave Measurements Simplified

For many years it was impossible to make precision measurements in coaxial systems because of impedance discontinuities and problems with the almost universally used Type-N connector. Although several different types of precision coaxial connectors have been recently introduced, much of the existing equipment is still fitted with Type-N connectors. The accuracy limitations associated with this connector have now, in large measure, been eliminated as
a consequence of a new measurement concept developed at NBS. It is a simplified technique in which power, maximum efficiency, and mismatch factor are fundamental parameters rather than the quantities of power, attenuation, and impedance which are used in normal operating procedures.

The concept of the new system, developed by GLEN F. ENGEN of the NBS Boulder Laboratories, calls for elimination of precision waveguide and connectors presently employed. It is illustrated in the following example.

Most power meters in the ultra-high and microwave frequencies are "terminating type meters" and are connected to the generator in place of the normal load. In the ideal world where all terminations are "matched", the load and the power meter are of identical impedance, so that the power to the load is identical to that indicated by the power meter. In the real world, however, where these conditions are never completely satisfied, to obtain the correct value for the load power, it is necessary to multiply the power meter indication by a "mismatch correction". Usually in cases of this sort the mismatch correction requires the measurement of three complex reflection coefficients which is often not possible in field-type situations. Thus, the mismatch correction often becomes an error because of the practical problems associated with its determination.

In using the new concept it is necessary to first consider the parameters used in characterizing the system. Among the different parameters used to describe a generator, one particular parameter is characteristic of the generator alone and, further, is independent of uniformity considerations. This is the available power which, by definition, is the physically determined maximum power which can be delivered to a passive load by the given generator. If one assumes a lossless region in the vicinity of the generator output port, this available power is invariant to the choice of terminal surface within this region.

In general, the conditions for maximum power transfer are not satisfied by the given load, and the actual or net power delivered by the generator to the load is the available power multiplied by a mismatch factor. This mismatch factor can range from zero to unity.

While the available power is a function of the generator only, the mismatch factor is a function of both generator and load parameters. Since the load power cannot depend upon an arbitrary division of the system into generator and load, the mismatch factor must have the same type of invariance to the choice of terminal surface as does the available power.

If, in the above example, the load is replaced by a power meter, the meter will indicate a power that is equal to the available power corrected by a mismatch factor peculiar to the generator-power meter combination.

Now, by taking the ratio of the mismatch factors (the mismatch of the load divided by the mismatch of the meter) and multiplying the ratio by the power delivered to the meter, the power delivered to the load can be readily determined.

Thus, the new-concept "solution" to the power-meter mismatch problem calls only for the independent measurement of both load and meter mismatch factors instead of computing them from a series of complex impedance measurements. Techniques to directly measure these mismatch factors have been developed.

It should be noted that in using this new procedure all measurements are independent of the choice of terminal surface within the region of the measurement. Although the measurement of mismatch factors is not to be considered as trivial, their determination and subsequent use represents a substantial simplification of current practice in microwave measurements.
HF Calibration of Two-Terminal Capacitors

A high-frequency capacitance calibration service for two-terminal, air-dielectric capacitors equipped with 14-mm precision coaxial connectors has been announced by the NBS Radio Standards Engineering Division. By equipping two-terminal capacitors with precision coaxial connectors, significant reductions in measurement uncertainties have been achieved. Older types of capacitors equipped with binding posts, banana plugs, or other types of unshielded connectors could, at best, be measured with uncertainties of the order of ±1 picofarad, even at frequencies in the audio range. The use of precision connectors on capacitance standards has made it possible to reduce these measurement uncertainties to the order of ±0.001 picofarad, and has also led to some dramatic improvements in measurement accuracy at the higher frequencies.

The new calibration service is available for capacitance standards having nominal values of 50, 100, 200, 500, and 1000 picofarads. To qualify for this calibration service, a capacitor should be within ±1 picofarad of its nominal value when measured at 1 kHz, and should not have a residual inductance in excess of 10 nohenries. The new service is offered at 0.1, 1.0, and 10 MHz. The service does not include the determination of conductance or dissipation factor.

The high-frequency calibration entails the measurement of the differences in capacitance between the unknown capacitor and each of the NBS standards by means of an admittance ratio bridge, used in this application as a comparator. In the Report of Calibration, the capacitance value is accompanied by a two-part uncertainty statement. The first part, called the "Total Comparison Uncertainty", is a statistically derived estimate of the limits of precision achieved in comparing the unknown to the NBS working standard. Typically, this uncertainty will be from ±0.005 percent to ±0.02 percent, depending upon the capacitance value of the capacitor being calibrated and whether the calibration was performed at 0.1, 1.0, or 10 MHz. The second part of the uncertainty statement is the "Uncertainty in Absolute Value of NBS Standard" and this may vary from ±0.01 percent to ±0.4 percent, again depending upon
capacitance value and calibration frequency. This is an uncertainty in the value of the NBS standard and therefore represents the minimum uncertainty in absolute value of any particular capacitor being calibrated. Of the two uncertainties, the "Total Comparison Uncertainty" is the more useful where measurement agreement is required. The uncertainty in the absolute capacitance is reported for use where this information is required. Limiting the service to specific capacitance values at specific frequencies makes it feasible to maintain reference standards whose values are not greatly different from the items to be calibrated. This reduces the calibration procedure to the determination of the small difference between an unknown capacitor and the NBS standard. The determination of these small differences is greatly aided by the use of a coherent detector, which permits the bridge to be balanced much more precisely than with more conventional detectors. A further advantage of the coherent detector is that it permits the operator to differentiate between bridge unbalances due to the real and the imaginary components. This allows the bridge to be balanced quickly and makes it unnecessary to manipulate the bridge conductance standard in order to achieve a capacitance balance.

REFERENCES FOR STANDARDS MANAGEMENT

A British Operation

Recent receipt of a copy of MARCONI INSTRUMENTATION, Vol. 11, No. 5 disclosed an article of interest concerning instrument calibration practices of a British industrial firm. The article describes the documentation and procedures which support the activity, the calibration services to the public for which it is qualified by the British Calibration Service, and gives general treatment to errors in calibration systems. Of deep interest to U.S. readers, is the emphasis placed, in the beginning of the article, upon TRACEABILITY and HIERARCHY OF MEASUREMENTS, two topics of deep and continuing interest to members of NCSL.

EDP Facilities Management

A concept of control, introduced by numerous standards activities in large industrial concerns, namely, control of facilities by computer, has at last been discovered by the computer software elements. ELECTRONIC NEWS, July 28, 1969 reports under the headline "Facilities Management Inviting", that the move by IBM, to establish a new service called custom contract services, has alerted companies in the software business to the huge possibilities for new business in the field of facility management. Perhaps presently-established standards activities, well-versed in this field, may be able to offer competitive services to outside firms, thereby cutting down overhead for both activities.

General

"The Emergence of the Technician Engineer in Electrical and Electronic Engineering", E.A. Bromfield, IEEE SPECTRUM, Jun 69. British experience in identifying, training, and rewarding technicians aspiring to, and attaining, the rank of engineer.

NEWS OF PROFESSIONAL ACTIVITIES

Precision Measurements Association

For a period of eight hours, on June 17, 1969, the Boston Section, PMA held the attention of a group of more than 100 attendees at Holiday Inn in Newton, Mass. The occasion was a successful panel meeting of seven experts talking first on the subject of "Instrument Specifications--Their Usefulness, Integrity, and Completeness", and later on "Instrumentation Needs of the Future". Moderator for the day was C.E. WHITE (General Radio) who introduced panel members and their topics as follows:

LEON DEAN (Dean Laboratory) - Truthfulness and Usefulness of Specifications
ALTON KAROLI (Eppley Laboratories) - Integrity (and Standardization) of Specifications
EDWARD SWENSON (ESI, Inc.) - Completeness and Language of Specifications
JOHN C. WILLIAMS (Chief, PMEL, Otis AFB) - Simplicity in Future Instrumentation
HENRY P. HALL (General Radio) - Precise Instruments in Imprecise Environments
LEOBE JULIE (Julie Res Lab) - Programmed Instrumentation of the Future
WESLEY H. SHIRK, Jr. (Leeds and Northrup) - Computer-Interfaced Instrumentation of the Future

The program was divided into two major sessions: the formal presentations of the panelists, followed by a hearty give-and-take session after dinner between the panelists and the audience, and occasionally among the panelists. General comments, as the meeting ended, hinted at a desire for more, but Pres. JOHN J. GREELY declared his impression that the panelists would be happy to end the meeting on the plane of the strong feeling of rapport between audience and panel which was then in existence.
Incidentally, recent balloting for 1970 Boston Section officers gave these results:

President--J.C. LAMBERT  
Vice-President--W.A. SIMMONS  
Secretary--H.R. CHABOT  

Treasurer--J.W. WHYNOT  
Director--C.L. VANDERSTAAY

Officers of the national association elected for 1970 are:

President--D.E. SHARP  
Vice-President--D. BUCK  
Director--R.J. COUTURE  
Director--J.M. SUTCLIFFE

Secretary--D. MAY  
Treasurer--A.K. EDGERTON

Past-President L.M. AUXIER announced locations for future annual conferences were accepted by the Board of Directors as:

(May 12-14) 1970--Washington, D.C.  
1971--San Francisco  
1972--Denver  
1973--Boston  
1975--Chicago.

The formation of two new PMA Sections has been authorized:

Southern California Inland Section (basically Pomona)  
Upper Missouri Valley Section.

Institute of Electrical and Electronic Engineers

Boston Chapter of the Instrumentation and Measurement Group elected officers for the year 1969-1970. They are:

Chairman--J.L. WEST, Weston Instruments  
Vice-Chairman--T.B. BLANKE, Hewlett-Packard  
Sec/Treas--J.K. SKILLING, General Radio

The activities program already is under control, starting in September with a lecture on "Cryotronics" by R. KAMPER of NBS; in October there will be a talk on "Electrical Problems in Instrumenting the Human Being", which will find the IEEE Engineering in Medicine and Biology Group Chapter cosponsoring; in November, R. ANDERSON of General Radio will talk on "Digital Voltmeter Calibration", with A. KALISKY of Avco Systems Division closing out the year in December with the first part of a two-part talk on "Computer Instrument Systems".

While looking over the program scheduled for September 11, by the Boston Chapter of the Reliability Group, the following meeting description caught our eyes:

"The impact of reliability on procurement practices will be discussed from the origination of reliability inputs to the invitation to bid, to the legal implications should the delivered equipment fail to meet its reliability requirements."

Among questions raised by the speaker are these of interest to NCSL:

"What are the legal implications of unreliable equipment?"
"Does competition help?"

We may have more on the subject in the next issue.

The New England Sections of IEEE and the NEREM Committee for 1969 are hard at work on the last lap of preparations for the up and coming NEREM 69. These Northeast Electronics Research and Engineering Meetings are slated for Nov. 5-7,
and appear to again uphold the high technical competence of previous meetings. Three sessions appear to hold more than passing interest for NCSL people. These are:

- Computer-Instrument Systems
- Computerized Testing Techniques
- Microwave Measurements.

Instrument Society of America

The 24th Annual ISA Conference & Exhibit will be held Oct. 27-30, at the Astrohall in Houston, Texas. Engineering and scientific people of reknown will be among the speakers on the special programs to be presented. Sessions will be devoted to such familiar subjects as:

- Precision Measurement
- Computer Control
- Laboratory Instrumentation
- Temperature.

Workshops and panels will include such topics as turbine flowmeter standards, strain-gage applications and techniques, thermal measurements, calibration, standards and facilities, and a metrology workshop programmed by the NCSL.

National Electronics Conference

Another of the perennials is the NEC 25th conference/exhibition which will be held in Chicago, Dec. 8-10. Some sessions of interest to NCSL are those on electromagnetic compatibility, impact of data communications standards on present and future data systems, threshold extension devices.

THE EDITOR HAS A FEW WORDS LEFT

One of our Newsletter readers noted a report in the Editor's Corner, last issue, in which the opinion of another reader was expressed—that the NBS and NCSL had eschewed a role in reference to hardware evaluation and specification.

Our reader forgot that neither NBS nor NCSL was being quoted—the words were those of someone not an official part of either organization. Perhaps our reader is not aware that NBS does evaluate— but only for government agencies.
Honors

Two members of the Bureau, well known to most standards people, were honored at separate ceremonies recently.

At the 1969 Annual Banquet of the American Society of Mechanical Engineers, Washington, D.C. Section, an ASME Fellow Member Certificate was awarded EDWARD C. LLOYD, chief of the Mechanical Measurements Branch, Mechanics Division.

During commencement ceremonies at Davis and Elkins College, June 1, Dr. I.C. SCHOONOVER, retired Deputy Director of NBS (Jan. 1, 1969), was awarded an honorary Doctor of Science degree. Currently, Dr. Schoonover is Director of the NBS Advisory Panels of the National Academy of Sciences, the National Academy of Engineering, and the National Research Council.

New NBS Director

On June 17, 1969, Secretary of Commerce M.I. Stans announced appointment of Dr. LEWIS M. BRANSCOMB as Director of the National Bureau of Standards. Dr. Branscomb will assume his new duties on August 31, upon the retirement of Dr. ALLEN V. ASTIN, present Director.

Dr. Branscomb was, until recently, a member of the President's Science Advisory Committee. This was a unique distinction since he was the only working scientist ever to be selected from a Federal laboratory to serve on that committee. He has been with the Bureau for 18 years, serving in the capacities of director of the work on atomic physics at NBS, and chief of the NBS Laboratory Astrophysics Division in Boulder, Colorado.

Dr. Branscomb is the recipient of many awards. In his new job, he will continue his participation in the International Union for Geodesy and Geophysics, the International Union of Pure and Applied Physics, and the International Astronomical Union. He also serves as Special Consultant to the Secretary General of the Organization for Economic Cooperation and Development, as Chairman of the Panel on Space and Technology of the President's Science Advisory Committee.
In assuming his position, Dr. Branscomb paid special tribute to Dr. Astin for his services in promoting and sustaining the Bureau's reputation for integrity, and for his steadfast devotion to scientific truth.

NBS Director Astin Retires

On August 22, 1969, at 6:30 PM, a large number of people, dignitaries and friends of Dr. ALLEN V. ASTIN assembled to pay homage to the distinguished retiring Director of the National Bureau of Standards. Included among the many tributes was this letter from the President of the United States:

"Dear Dr. Astin:

As you retire from the United States Department of Commerce after thirty-seven years in the National Bureau of Standards, you take with you the nation's appreciation for your services to science and to government.

Twentieth Century science and the National Bureau of Science have grown up together. Since its founding in 1901, and with increasing effectiveness, this agency has served as a basic resource for discoverers and innovators who have changed the face of our scientific and technological landscape. As a dedicated member of its staff - and, for one-quarter of its history, as its Director - you have ranked high in the distinguished company of pioneers of science who have worked directly for the bureau. You leave a magnificent legacy in the laboratory complex at Gaithersburg, Maryland. It is the highest tribute that can be paid to your years of careful planning and practical, skillful implementation.

The nation and its economy rely on standards and technology made possible by the measurement research, testing, and services provided by this facility. U.S. science and technology, thus supported, is increasingly relevant to the most pressing problems of our time. You have made unique contributions to the attainment of this relevance and the nation is proud to acknowledge its enduring debt to you.

Sincerely,

Richard Nixon"
Dr. Astin’s tenure was marked by exceptional leadership of the Bureau during a critical period of its 68-year history. His dedication to competence and integrity, coupled with a concerted effort to better understand, extend, and refine a national system of physical measurement, brought about the broad recognition of precision measurement as a major factor in economic growth and technological supremacy. As a scientific administrator his emphasis on the importance of a high level of performance in Federal laboratories has helped bring about an increased understanding and appreciation for the significant role of the professional scientist and engineer in Government.

Born in Salt Lake City, Utah, in 1904, Dr. Astin was educated at the University of Utah (B.S., physics) and New York University (M.S. and Ph.D., physics). (He also has been awarded honorary doctorates by Lehigh, George Washington, and New York Universities.)

Dr. Astin became a Bureau staff member in 1932. Two principal areas in which he worked were dielectrics and electronic instrumentation. Late in 1940, as NBS resources were being mobilized for defense work, he joined the Bureau group beginning work on proximity fuzes. He became Chief of the Optical Fuze Section in 1943, Assistant Chief of the Ordnance Development Division in 1944, and Chief of the Division in 1948.

In May 1950, Dr. Astin was appointed NBS Associate Director and served as Acting Director from October 1951 to June 1952, when he was named Director.

He is a member of the National Academy of Sciences and numerous technical societies and is a Fellow of the American Physical Society, and the Institute of Radio Engineers, the Institute of Electrical and Electronics Engineers, and the American Association for the Advancement of Science. He has lifetime memberships in the Instrument Society of America, the Standards Engineers Society, Inc., the American Dental Association, and the American Society for Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

He is the author of numerous publications on the standardization and improvement of measurement standards and measurement techniques.
One week after the formal ceremonies at the Smithsonian Institute, on August 28 to be exact, the NBS staff turned out en masse to say their own private farewells to Allen Astin. The entire day was given over to saying "Goodbye" to the boss and it can be said truly that Dr. Astin left the Bureau that day carrying more weight than when he went in that morning! Fortunately, he had his grandson, John, with him to share the burdens. W. Reeves Tilley of the NBS technical information office was good enough to send us some photos taken during the day.

Dr. E. Ambler of IBS gives Dr. Astin a replica of the standard kilogram, to use in calibrating his metric bathroom scale.

Dr. Astin receives from R. Walleigh (Assoc.Dir.) and Dr. L. Kushner (Dep. Dir.) a model of the 1835 scale presented to the States in 1836.
Let's consider that you are an applications engineer working for an instrument company and one day your secretary drops the following communication on your desk. How would you react?

Dear Mr. Jones:

For a number of years now work has been proceeding in order to bring to perfection the crudely conceived idea of a machine that would not only supply inverse reactive current for use in unilateral phase detractors, but would also be capable of automatically synchronizing cardinal grammeters. Such a machine is the "Turbo-Encabulator". Basically, the only new principle involved is that, instead of power being generated by the relatomotion of conductors and fluxes, it is produced by the nodal interaction of magnetoreluctance and capacitave directance.

The original machine had a base-plate of prefabulated aluminate, surmounted by malleable logarithmic casing in such a way that the two main spurving bearings were in a direct line with the pentametric fan. The latter consisted simply of six hydrocopic marzlevanes, so fitted to the ambisicient lunar vaneshaft that the side fumbling was effectively prevented. The main winding was of the normal lotus-odelta type placed in panendermic semi-bovoid slots in the stator, every seventh conductor being connected by a non-reversible tremic pipe to the differential girdle-spring on the "up" end of the grammeters.

Forty-one manestically spaced grouting brushes were arranged to feed into the rotor slop-stream a mixture of high S-value phenylhydrobensamine and five percent ruminative tetryliodohexamine. Both these liquids have specific pericosities given by $P = 2.50^n$ where $n$ is the diathetical evolute of retrograde temperature phase disposition and $C$ is Cholmondeley's annular grillage coefficient. Initially, $n$ was measured with the aid of a metaphor refractive pilrometer—for a description of this ingenious instrument, see L.P. Rimalverstein in "Zeitschrift fur Elektrotechnistatistics-Donner blitzes", Vol. VII), but up to the present date nothing has been found to equal the transcendental hopper dodoscope. (See "Proceedings of the Peruvian Nitrate Association", June 1914.)

Electrical engineers will appreciate the difficulty of nubbing together a regurgitative pugwell and a supramitive wenel-sprocket. Indeed, this proved to be a stumbling-block to further development until, in 1942, it was found that the use of anhydrous mangling pins enabled the Kryptonastic bolting shims to be tankered.

The early attempts to construct a sufficiently robust spiral decommutator largely failed because of a lack of appreciation of the large quasi-piestic stresses in the gremlin-studs; the latter were specially designed to hold the foiffit bars to the spam-shaft. When, however, it was discovered that welding could be prevented by a simple addition to the jiving sockets, almost perfect running was secured.
Undoubtedly, the turbo-encabulator has now reached a very high level of technical development. It has been successfully used for operating nofer trunions. In addition, wherever a barescent skor motion is required, it may be employed in conjunction with a deep-drawn reciprocating dingle-are to reduce sinusoidal depleneration.

Very truly yours,

TURBO-ENCABULATOR INC.

J.L. Friszt, Sales Manager

My reaction was to trace its source. I am indebted to LEE HITE of G.R.-Detroit for the answer: it came out of a computer course at Bowling Green State College in 1961 and he couldn’t resist passing it on to G.R. headquarters. Note: Lee granted permission for publication but didn’t recommend it. Can any reader top it?

TECHNICAL TRAINING

Unified Approach to Measurement Engineering

Arizona State University will present its ninth annual measurement engineering short course January 26 to 30, 1970. Essential unity between theoretical and experimental approaches will be stressed as is also, the application of engineering principles to the design of measuring systems. Contact Prof. Peter K. Stein, Engineering Center, Arizona State University, Tempe, Arizona for information.

Seminar on Strain Gage Techniques

On January 19-23, 1970, the University of Miami will present a program of lectures related to basic theory and practical details of foil, wire, and semiconductor strain gages. Write to the Conference Coordinator, Division of Continuing Education, P.O. Box 8005, University of Miami, Coral Gables, Fla. 33124, for details.

Test Equipment Management

Property Management Systems will be offering seminar/workshop sessions to offer help in solving the problems involved in the effective utilization and control of test equipment. Present plans call for sessions in Los Angeles on December 3-5, and sessions in Boston immediately ahead or behind those dates. For details write to Property Management Systems, P.O. Box 997, Pacific Palisades, Cal. 90272. or call (213) 459-2997.
TECHNICAL REFERENCES


C. "It All Started With Silk!" , H.L. Grant, Quality Assurance, June '69. Principles of the Moiré fringe, and how this optical phenomena can be applied to quality control problems.


IEEE Trans on Inst. and Meas., March '69

H. "Wheatstone Bridge Sensitivity" , G. Weiss

I. "VHF and UHF Attenuation Measurements to 140 dB" , S.B. Pulliam

J. "Measurement of Microphonic Noise" , M.R. Millet


IEEE Trans on Inst. and Meas., June '69

L. "Impedance Bridge Balancing Using Perturbation Theory" , K.J. Sternees and J.C. Looney

M. "Essential Nonlinearity of Phase-Sensitive Detector Characteristics" , B. Leokovkar


O. "Measurement of High Q @ High Frequencies" , R.D. Ryan and J.E. Eberhardt
P. "Digital Instrumentation for Angular Velocity and Acceleration", A. Dunworth

Q. "Modulation Measurements - Theory and Technique", J.N. Warfield

R. "Measurement of Microwave Parameters by the Ratio Method", B.O. Weinschel, Microwave Journal, August '69. Application of method to determination of reflection and transmission coefficients, as well as SWR and insertion loss.


Y. "Measurement of Short-Time Changes of Cavity Q and Resonant Frequency", IEEE Trans on MTT, June '69. Technique based upon observed changes in reflection coefficient.


MM. "Data Distribution," Staff, Meas & Data, Jun 69. Continuation of home-study courses.


RR. "Pinning Down Frequency Stability," I. Engelson, EDN, May 69. Review of progress in definitions; criteria for frequency or time domain measures.


TT. "How to Measure Delay," S. Black, EEE, May 69. Brief description of four different methods to measure delay of pulse through a passive device.


Some NBS Publications


"CONSIDERATIONS IN COMPUTING THE USEFUL RANGE OF PIEZOELECTRIC ACCELEROMETERS", Technical Note 487, N. Newman, 30¢ from the Supt. of Documents. Advantages and disadvantages of two techniques determining the range of these accelerometers: application of sinusoidal acceleration of constant amplitude to accelerometer housing, and application of sinusoidal voltage of constant amplitude to the piezoelectric element.

"RADIO-FREQUENCY MEASUREMENTS IN THE NBS-IBS", R.S. Powers and W.F. Snyder, $1.00 from the Supt. of Documents. Background of the measurements services available to the public. Explanation of errors inherent in the systems.


"MEASUREMENTS BULLETIN NO. 7", a still later supplement to NBS Publication 250, affecting in particular, these sections devoted to Part 4-MECHANICS.


APPLICATION FOR MEMBERSHIP
NATIONAL CONFERENCE OF STANDARDS LABORATORIES

Name of Laboratory or Organization ________________________________

Address __________________________ City __________ State ______ Zip Code ______

duly applies for membership in the National Conferences of Standards Laboratories and appoints as its Delegate:

Name ________________________________

Title ________________________________

who will serve until further notice. The sum of fifty dollars ($50.00) is enclosed for membership dues for the calendar year 1970. Of this amount, two dollars ($2.00) is for our subscription to the NCSL Newsletter for that year.

Appointed by: ________________________________

Title: ________________________________

Date: ________________________________

The NCSL is a continuing non-profit association whose members are either measurement standards and calibration laboratories, organizations maintaining such activities, or other organizations which have related interests and are operated under academic, scientific, industrial, commercial or governmental auspices.

Applications may be mailed to: National Conference of Standards Laboratories
c/o National Bureau of Standards (200.01)
Washington, D. C. 20234

Checks should be made payable to the National Conference of Standards Laboratories. If an otherwise qualified organization finds it impossible to become a member organization by payment of dues as such it may be granted member privileges by payment of an equivalent registration fee in advance of the Delegate's Assembly.