

state & society

NBS focuses on problems of energy and innovation

No major changes are planned for the National Bureau of Standards, according to its new director, Richard W. Roberts. However, he feels the Bureau is a body that by its very nature has always changed its focus as the needs of the nation have changed and always will. Roberts made these reflections in a recent interview with *PHYSICS TODAY* about the organization he has directed since February (*PHYSICS TODAY*, May, page 87). He pointed out that at the time of its creation NBS was concerned with energy—electrical energy and the standardization of its units—and that today its concerns have again focused on energy problems.

At a recent one-day symposium organized by Ernest Ambler, formerly director of the Institute for Basic Standards (IBS) and now deputy director of the Bureau, papers were presented on 28 different NBS projects that are energy related. These activities include standards for the controlled thermonuclear fusion program in developing techniques to measure and characterize plasmas, use of the electron linac to measure neutron cross sections to an accuracy required by breeder reactors, and research on liquefied natural gas and electrical power generation and transmission. The Bureau also has a coordinated program to improve the measuring devices for air pollution under its Measures for Air Quality Program. Developments to date include detectors for sulfur dioxide, nitric oxide and particulates.

Roberts was also enthusiastic about the Bureau's new Experimental Technological Incentives Program. Under this program NBS is sponsoring experiments to determine what policies are most effective in stimulating technological innovations in private industry. ETIP aims in three directions. The first is the area of procurement: Because the government is the largest single purchasing agent in the US, it has the power to demand innovation in the design of the products it buys. For example, the Government Services Administration is awarding a contract for a building in Manchester, N.H. to the design that will use only 60% of the energy normally required by a structure of its size. The Center for Building Technology of NBS is providing the specifications and technological moni-

toring for the Manchester building.

The second area of ETIP concerns government regulations: Regulations designed to protect public health and safety should be formulated to encourage rather than hinder new developments. The third area is related to the small inventor or small R&D firm: NBS will experiment with new forms of assistance that the federal government could adopt to help innovators in those groups to put their goods and services in the marketplace. Close coordination with the Small Business Administration is being maintained in planning and executing experiments in this area. The budget for ETIP is \$7 million and is expected to remain at the same level next year.

The total operating budget of NBS has grown faster than the rate of inflation over the past few years. Congress now supplies about 60% of the budget of \$86 million, with the rest coming from other agencies such as HUD,

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NBS director Roberts holds model of standard volt—a small ac Josephson junction.

Helium question still up in the air

Helium users are watching with interest the outcome of litigation that may affect future helium supplies and technology. The administration is trying to terminate a Congressionally authorized helium extraction and purchase program (set up in 1960) for reasons of diminished helium demand and high program costs, while physicists and other helium users fear a helium shortage will occur somewhat sooner without the extra government supply. Three companies involved in helium extraction for the government are involved in court cases and have thus far obtained injunctions against termination.

A major reason for the establishment of the program was to extract helium from more natural gas (the richest known source) before the gas is burned by the user, and the helium released to the atmosphere. An important time element is involved because most helium-rich gas fields are expected to be depleted by 1990.

The program, which was provisionally terminated in 1971, was established under authority of the 1960 Helium Act Amendments. It authorized the

Secretary of the Interior to negotiate 25-year contracts for the purchase of helium to be stored for future use. The costs for the program were to be paid with funds from helium sales and all money borrowed from the Treasury for initial expenses was to be repaid within 25 years, with the possibility of extending the payoff period to 35 years. Congress approved \$47.5 million per year for helium purchases, and in November 1961 contracts to buy helium for 22 years were signed with National Helium Corporation, Northern Helix Company, Cities Service Helix Inc. and Phillips Petroleum Company. These companies built plants that processed natural gas from the helium-rich Kansas-Oklahoma-Texas fields (0.3% helium or more), extracted the helium and sent it through a pipeline owned by the Bureau of Mines for underground storage in the Cliffside structure near Amarillo, Texas.

Unique element. For many purposes helium has no substitute, including many cryogenic uses. It is presently used widely as a pressurizing and purging gas for the space program, for controlled atmospheres in industrial

Helium Costs from Various Sources

Source	Present cost (dollars per thousand cubic feet)	Cost in 30 years
>0.3% natural gas	13	230 ^a
0.1% natural gas	50-80	380-610 ^b
0.006% natural gas	500-700	3800-5300 ^b
atmosphere (0.0006%)	1000-3000	7600-23 000 ^b

^a 3% real rate of return + 7% inflation compounded annually for helium extracted during 1973

^b 7% inflation compounded annually

Interest and inflation rates are based on Office of Management and Budget assessment of 10% interest applied to new programs.

processes and underwater research, and as a gas for reactor cooling, chromatography and leak detection. Perhaps the most important future use is in the electrical power industry with helium needed for superconducting generators and transmission lines and for magnets used in MHD and fusion generators.

Problems with the helium program. After being set up, the helium purchase program operated smoothly, putting away about 3500 Mcf (million cubic feet) per year. However, the program ran into some problems during the late 1960's. Charlotte Price, economist at Sarah Lawrence College, who has studied the helium conservation program explained, "Two things seem to have happened in the 1960's. One was that helium demand fell, the demand being largely a function of the space program, and secondly, owing to the high price of government helium [\$35 per kcf (thousand cubic feet)] as compared to the cost of extraction of \$12 to \$15 per kcf, private industry entered the business and began to compete with government sales. Some government contractors began to buy the cheaper helium and it is not even clear that some agencies did not buy because of their internal budget constraints. So, the helium program which had been set up to pay off debts in 25 years wasn't able to, as operated."

Thus, the government lost much of the helium market and by 1970, the private sector, which had not even existed in 1960, had about 60% of the helium sales. The Interior Department tried to force government contractors to buy its helium, but the department lost the case when it was brought to court. The court suggested that this problem could be corrected by the issuance of an executive order (which was not forthcoming) to force government contractors to buy government helium. Further, government use of helium dropped from 680 Mcf in 1967 to 280 Mcf in 1972. The helium program costs grew from an expected in-

crease in the rate of interest charged for money that had been borrowed from the Treasury to finance the program. The interest increased from 4% initially to 6¼% by 1969. The Office of Management and Budget has subsequently applied a 10% rate for evaluative purposes. Charles Laverick (Argonne National Laboratory), principal investigator of an NSF-sponsored helium study, told us that this 10% rate is normally applied to new programs and that it is hard to understand why it had been applied to the helium program, which has been underway since 1961.

The first of the court cases against the government came during December 1970 when Northern Helix filed suit claiming breach of contract. When the program termination was announced in January 1971, the other three companies obtained an injunction on the grounds that no environmental-impact statement had been issued. The final statement was issued 16 November 1972, and on 11 June, the US District Court in Kansas ruled that the environmental-impact statement was inadequate and the injunction against termination remains in effect, pending government appeal.

Future needs. Based on population projections, a Bureau of Mines estimate says that the annual US demand by 2000 AD would be between 1400 and 3600 Mcf. The Stanford Research Institute estimates 2370 to 3221 Mcf for the same year from user projections. As of January 1971, known reserves including storage amounted to 180 500 Mcf with the termination of the contracts resulting in a dissipation of 20 700 Mcf of this supply. From projected figures for 2000 AD, this implies a four- to fifteen-year portion of the supply. Higher-than-predicted demand would cause the helium reserves to be exhausted before or shortly after 2000 AD. The extra 20 700 Mcf obtained if the contracts run to their expiration date would be a several-decade supply, however, if helium de-

mands are lower than anticipated. Economic and environmental considerations are closely involved in the decision whether or not to extract and store this 20 700 Mcf. The figures on the accompanying table, provided by Laverick, show some of the costs involved with the various helium sources now and 30 years hence. Related to the large expense of air-derived helium is the large amount of energy needed to run the process—26 000 megawatt-years per 1000 Mcf (total US generating capacity in 1971 was 330 000 megawatt-years) resulting in 670 000 lb/hr of pollution and 4×10^{12} Btu/day in thermal pollution. To avoid these harmful effects then, an expanded helium-conservation program would be required if high demand is expected. It is also likely, however, that a high-demand industry or process would not become established unless an adequate supply of helium could be assured.

Helium for all? A further controversy has arisen concerning the beneficiaries of the program. Was it set up to satisfy only essential government needs or to help conserve helium for all users? Laverick told us, "There seems to be a deliberate misrepresentation of the Helium Act. The government has made a great deal of play over the fact that the act was for essential government purposes. Upon reading the act, this is hard to believe. What officials are doing is misquoting from a section of the act . . ."

This opinion has recently been substantiated by the Kansas District Court in its ruling of 11 June. Laverick also commented, "What is necessary is an honest study of the helium problem in which future demands are related to future supply and price. It may be necessary to specify priorities for some of the possible helium uses. This will have to be done if a helium deficiency for essential purposes is to be averted." —SMH and RAS

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DOT, DOD and AEC. Roberts believes the support from Congress will increase because, he feels, NBS is uniquely capable of responding to national needs in energy, in pollution measurements and in clinical techniques. He has been given a warm reception from members of Congress and senses that they all feel the need to place greater emphasis on developing the technology to attack the problems of energy and pollution.

Physicists can take heart that employment of physicists at NBS has remained constant over the past few years, although Roberts did admit to some layoffs in certain specific areas.

NBS hired 36 physicists both last year and this year. Of the technical staff of about 1600, 16% are physicists.

Work on the major task of the Bureau's mission—establishment, dissemination and improvement of standards—still continues. Roberts showed us his model of the new standard of the US volt—a small ac Josephson junction—that replaced a bank of cells as the legal standard last year (PHYSICS TODAY, October 1972, page 20). Roberts and Ambler also spoke of the need to develop standards of illumination relevant to the new types of lighting, such as lasers and light-emitting diodes. But the recurring theme of research at the Bureau, as reviewed for us by David T. Goldman, acting director of IBS, appears to be that work on measurement standards invariably leads to unexpected applications.

For example, the search for a standard of length more accurate than the wavelength of krypton has centered on the use of highly stabilized lasers. NBS now favors as a working standard the wavelength of a helium-neon laser stabilized by saturated molecular absorption in methane. Last year work with this laser led to a more precise determination of the speed of light. Further development effort has resulted in stabilized lasers, tunable over a wide frequency range, that have potential applications to pollution detection and laser chemistry. Much of the work in time and frequency standards is devoted to ways to disseminate the standards more accurately and less expensively, by satellite or commercial television. The Bureau developed technology to use the blanking interval of a television set (the black strip above and below the picture) to transmit time to an accuracy of one microsecond or better. They have since shown that the same technology could be used to caption television programs for the hard-of-hearing or non-English-speaking viewers without interfering with normal television reception. The black box necessary to receive information is estimated to cost around \$25.

The standard of mass remains the most awkward one but hope continues that research now going on will yield a more accurate measurement of Avogadro's number. This number, together with a nearly completed, accurate determination of the density of a well characterized sample of silicon, would enable the kilogram to be defined in terms of the mass of a single silicon atom. For practical applications, effort is directed to measuring the rate of mass flow in fluids. Goldman pointed out the need for a flow meter for cryogenic fluids and for more accurate meters for fluids of all types.

Goldman believes some of the most

sophisticated physics is done in the area of temperature standards and measurements. To maintain the temperature scale, the Bureau measures very accurately the fixed points of several pure metals and gases over a wide range, from 1337.58 K (the freezing point of gold) to temperatures as low as a few millikelvins. Research in practical temperature measurement is of great interest to the medical community, which needs to determine the accuracy and reliability of digital thermometers. Hospitals also rely on the Bureau's work on radiation standards and measurement of dose rate. Recently the Bureau has coordinated a program with selected hospitals to ascertain the combined effect of inadequate instrumentation and improper measuring techniques on potential exposure of patients to unnecessarily large radiation doses.

Measurement of atomic spectra now appears essential to characterization of plasmas. To assist further in the fusion program, NBS has developed hydrogen and deuterium arcs as far-ultraviolet radiation sources, is using synchrotron radiation as a source of vacuum ultraviolet (see page 17) and is developing detectors for this range of radiation. The hydrogen arc was of interest to NASA as well: It was used as a calibration standard for the measurement of the sun's corona during the recent Skylab flight. —Barbara G. Levi

Teem appointed to new post in AEC shuffle

The Atomic Energy Commission has undergone many organizational changes including the establishment of the position of Assistant General Manager for Physical Research and Laboratory Coordination. John M. Teem has been appointed to this position and is responsible for the Division of Controlled Thermonuclear Research, the Division of Physical Research and the newly created Office of Laboratory Coordination. This office will be involved with development and policy with respect to Commission laboratories. Teem will continue to serve as director of the Division of Physical Research.

Other important organizational changes show the AEC's increasing emphasis on reactor safety. A new position, the Assistant General Manager for Biomedical and Environmental Research and Safety Programs, will help to achieve greater coordination among these related areas. A new Division of Reactor Safety Research has been established at a high level in the AEC—answerable directly to the general manager. Herbert J. C. Kouts, formerly at Brookhaven National Labora-

tory, will head this new division. The Division of Reactor Development and Technology, which formerly included all reactor safety research, will retain control over safety research and development for the liquid-metal fast breeder reactor.

A new position created in the general manager's office will coordinate a broad range of activities including the coordination of relations with Congress, industry, and foreign countries with regard to energy development. John J. Flaherty of the Energy and Development Programs Division will fill the new position.

in brief

Physics in Perspective, Vol. II, Part A:

The Core Subfields of Physics can be obtained from the National Academy of Sciences, 2101 Constitution Ave, Washington, D. C. 20418, for \$13.50 per copy. Part A and the companion parts of Vol. II complete the report of the Physics Survey Committee of NAS, headed by D. Allan Bromley of Yale University.

The AEC is seeking nominations for the 1974 Ernest Orlando Lawrence Memorial Award. Inquiries and nominations, which are due by 1 October, should be directed to the Chairman, General Advisory Committee, US Atomic Energy Commission, Washington, D. C. 20545.

John S. Laughlin has been appointed to represent the American Association of Physicists in Medicine on the governing board of the American Institute of Physics. Laughlin is currently chief of the division of biophysics at the Sloan-Kettering Institute for Cancer Research in New York.

Applied Physics, a journal that reports on experimental and theoretical work in applied physics, has begun publication. Annual subscriptions are available from Springer-Verlag Inc, 175 Fifth Ave, New York, N. Y. 10010, for \$109.00.

The Atomic Energy Commission has named its Los Alamos Meson Physics Facility for New Mexico's Senator Clinton P. Anderson.

Avco Everett Research Laboratory, Inc, a new wholly-owned subsidiary of Avco Corp, has been created to continue the research work of the laboratory previously operated as a division of Avco. The chairman and chief executive officer of the new corporation is Arthur Kantrowitz, a director of Avco and of the laboratory since its founding in 1955. Harry Petschek, associate director of the laboratory since 1968, has been named president.