

# state & society

## Nobel laureates for 1970: Hannes Alfvén and Louis Néel

The 1970 Nobel prize in physics has been awarded to Hannes Alfvén of the Royal Institute of Technology in Stockholm and the University of California at La Jolla and to Louis Néel of the University of Grenoble, the Center for Nuclear Studies and the Laboratory for Electrostatics and the Physics of Metals. The prize of \$78 400 will be shared by the two men.

Alfvén was cited "for fundamental work in magnetohydrodynamics with fruitful applications in different parts of plasma physics." One of the founders of plasma physics, Alfvén was one of the first after Thomas G. Cowling to realize that the universe is full of conducting gases. He pointed out that the magnetic lines of force move with the fluid, an extremely simple but powerful concept that enabled Alfvén and others to interpret many phenomena both in laboratory physics and cosmic physics, such as the cause of sunspots, the magnetic field in the interstellar medium, the geomagnetic field and its secular variation.

Alfvén established the existence of electromagnetic waves in highly conducting fluids. Because the ionized gas is essentially glued to the lines of force, an ionized gas can transmit transverse waves like those produced in a stretched string. The Alfvén waves propagate with a speed (the Alfvén speed) that is the square root of the tension in the field divided by the density of the medium. Many other kinds of plasma waves were quickly found, thereby opening up the study of the dispersion properties of a plasma.

The "guiding-center" approximation and the concept that the magnetic moment of the particle is approximately a constant were introduced by Alfvén to delineate the motion of charged particles in strong magnetic fields. Applicable to motions in which the cyclotron radius of the particle is small compared to the scale of the field, the ideas have been applied to cosmic-ray propagation, to trapped particles in the earth's magnetic field, to auroral particles and to controlled thermonuclear fusion. It was now possible to visualize many complicated plasma phenomena.

Applying the guiding-center approximation to the earth's magnetic field,

*continued on page 62*



ALFVEN



NEEL

## Haggerty, McElroy, Bromley stress relevance

How science is helping and can further help to solve society's problems was the subject of an evening session of the October annual meeting for society officers and for corporate associates of the American Institute of Physics. All three speakers, Patrick E. Haggerty, chairman of Texas Instruments, William D. McElroy, NSF director, and D. Allan Bromley of Yale University, discussed the need for basic research and for more emphasis on its technological applications.

Haggerty's stress was on science and technology as the crux of the US economic strength and on the need for maintaining and improving this strength so that the US will have the financial resources to meet the demands of today's society. "The Gross National Product available," he said, "is estimated as being below potential from 1970 until 1972 as a result of the policies to slow inflation. . . . The significant thing is that present claims completely exhaust available output through 1972, and it will be 1975 before there is room

for major additions." According to analyses done by the Department of Commerce, he stated "only in technology-intensive manufactured products does the US have a favorable commercial balance in its trade with the rest of the world." Yet even this asset, he warned, is currently threatened by competition from Western Europe and especially from Japan, where "a modest US favorable balance in 1962 had shrunk by 1968 to a negative \$0.5 billion."

Simultaneously, the strength of the economy determines the US standard of living, so that "only as long as what we were accomplishing per person went up faster than what we paid ourselves for our work would the standard of living increase." Productivity projections made by the US Department of Labor, noted Haggerty, showed that "during the 1970's the total private economy will have an average increase in productivity per person of 3% as against 3.4% for the years 1947 through 1968. In terms of Gross National



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Product available in 1980, this 0.4% per year represents a whopping \$91 billion less the nation will have to use in 1980." This makes it clear, Haggerty felt, that sustaining some and improving other annual rates of productivity are essential if the US is to tackle and solve major problems. "This certainly calls for the application of increasing quantities and sophistication of technology." Haggerty saw the present problem as how to balance the need for more and better science and technology with the present economic situation. He recommended a policy-making "Council of Science and Technology Advisers, similar to the Council for Economic Advisers," which would include the present Office of Science and Technology.

**For McElroy** the important problem was how to diminish the gap between science and technology. "For centuries we have been fragmenting scientific knowledge . . . perhaps now we are come full circle, back to the realization that science is in fact an integrated body of knowledge and processes." Science must and can be responsive to society's wishes, yet it must, he said, "respond as an entity, not as the assemblage of institutional and disciplinary fragments it is largely today."

An NSF program, "Interdisciplinary Research Relevant to the Problems of Our Society" (IRRPOS), is aimed at reducing some of this fragmentation, but McElroy felt that another "I" for "inter-institutional" would further unite the scientific community. "Lines separating

disciplines have been eroding . . . but there still remains, virtually inviolate, barriers separating one kind of science-performing institution from another. Governmental, university and industrial laboratories exist side by side, often performing related work, using similar talents and sometimes serving identical masters." McElroy went on to say that "if scientists are to concentrate maximal scientific resources on the problems of our times, they must develop new ways of articulating and of using all the talents they have in hand, rather than wait and see what ideas develop almost randomly . . . and then dip into one pot or another as the need appears. . . Such a development would insure the widest participation of scientists in solving pressing national problems. Just as important, the participation of industry would be a built-in guarantee that answers, as they develop, would find their way into application by the shortest possible route, . . . instead of the present gap between a scientific advance and its application, which often spans 20 or even 50 years." A step in this direction, he said, is now being taken by NSF; it plans to appoint a "blue-ribbon" panel of industrial consultants to advise NSF on its support of basic and applied research.

**Bromley.** More flexibility was also one of the key ideas expressed by Bromley. "It is a flexibility, a willingness to include within its structure both applied and pure scholars . . . that the US physics department has largely lost." Society, Bromley felt, would best be served "not by evolving a new breed of environmental scientist—or environmental physicist—whatever either may be, but by the universities' continued concentration on producing well trained physicists, chemists, biologists and geologists—but at the same time giving them a real appreciation of the opportunities and challenges in applied work." Bromley also pleaded for better planning in the funding of science. "It is essential that the US develop and implement long-range plans for the support of science. It is important in this that science clearly be uncoupled from development and from technology. . . We must ensure in our planning that abrupt changes do not occur. . . More gradual changes and the ability to work toward or with an accepted long-range plan inevitably permits increased effectiveness of utilization of the support which is available." A way of increasing this support could possibly be accomplished, he said, by using the well established US tradition of earmarking taxes. "If we accept the close relationship . . . between science and high technology industries might we not consider earmarking an agreed upon fraction of their taxes for support of science?"

—TJ

## Nobel prize

*continued from page 61*

Alfvén pointed out that the particles bounce back and forth, being reflected by the increasing magnetic field. This concept had been suggested earlier in Fredrik Störmer's work on auroral particles but was not well understood. The idea of magnetic mirrors became one of the fundamental approaches to controlled fusion.

Alfvén's 1950 book, "Cosmical Electrodynamics" is a classic in magnetohydrodynamics. He has also written "Origin of the Solar System" with C.G. Falthammer and a science-fiction novel, "The Tale of the Big Computer." Recently Alfvén has been advocating that we either land on a large asteroid or that a small asteroid be captured and returned to earth. He feels that investigation of asteroids would lead to an understanding of the origin of the solar system.

Born in Norrköping, Sweden in 1908, Alfvén received his PhD in 1934 from the University of Uppsala. Since 1940 he has been a professor at the Royal Institute, and since 1967 he has also been associated with the University of California.

**Néel was honored** "for fundamental work and discoveries concerning antiferromagnetism and ferrimagnetism which have led to important applications in solid state physics." In papers published by Néel from 1932 to 1936 he described the characteristics of materials later known as "antiferromagnets." Unlike ferromagnetic materials, in which atomic magnetic moments align parallel to each other at low temperature and the exchange integral between nearby ions is positive, he proposed the existence of interactions where magnetic moments could be aligned antiparallel by a negative exchange interaction.

The symmetries of the problem are then such that at low temperature magnetic ions could divide into interpenetrating sublattices so that the net moment of one sublattice would be in one direction and those of a second sublattice in the opposite direction. As the temperature is raised the ordering of the moments disappears at the so-called "Néel temperature," at which anomalies in specific heat and susceptibility occur.

In 1948 Néel published a thorough theoretical treatment of ferrimagnetism, in which he generalized his concept of antiferromagnetism by supposing that the two sublattices may have different values of magnetic moment; so their magnetizations, although aligned in opposite directions, would be unequal, thus leaving a net spontaneous magnetization. In this paper Néel predicted many properties of the ferrites and the garnets, which were subsequently verified.

The understanding of antiferromagnetism and ferrimagnetism introduced by Néel has led to a wide variety of technological applications and has given impetus to the synthesis of new ferrite materials, which revolutionized microwave electronics. Ferrites are fundamental to core memories for computers, modern magnetic tapes and the new bubble domain memories. The rare-earth iron garnets, extensively studied at Néel's institute, became a field of intense worldwide research in physics and engineering, a field largely generated by Néel's fundamental ideas.

Néel is also known for his contributions to understanding magnetic after-effects, to degaussing of ships for protection against magnetic mines, and to the "magnetic memory" of bricks, basalts and lavas, which can be used for magnetic dating. The school of Néel is internationally known as one of the leading centers of magnetism research.

He was born in 1904 in Lyons, France and received his doctorate from the Ecole Normale Supérieure in 1928. He then went to the University of Strasbourg where he succeeded to the chair

of Pierre Weiss in 1937. Néel became professor at the University of Grenoble in 1945 and is director of the Center for Nuclear Studies in Grenoble, director of

the Laboratory for Electrostatics and the Physics of Metals in Grenoble, and director of the Polytechnic Institute in Grenoble. —GBL

## in brief

The Joint Institute for Laboratory Astrophysics, University of Colorado, is soliciting applications for visiting fellowships and postdoctoral research associateships for 1971-72. About ten stipends are available for each category. The deadline for a fellowship is 15 Jan. and for an associateship, 15 Feb. Contact D. G. Hummer, Secretary, Visiting Scientists Program, JILA.

A Boris A. Bakhmeteff Research Fellowship in fluid mechanics in an amount up to \$3600 is available in 1971-72. Deadline is 15 February 1971. Contact is James R. Steven, Department of Civil Engineering, City College, CUNY, New York, N.Y. 10031.

The Institute of International Educa-

tion is accepting applications for grants for graduate study or research for the 1971-72 academic year. Applications are for US Government awards under the Fulbright-Hays Act and for grants offered by various foreign governments and universities. Contact IIE, 809 United Nations Plaza, New York, N.Y. 10017.

The American Astronomical Society has completed a roster of members who are willing to serve as consultants to academic and industrial institutions. Consultants expect to be reimbursed for expenses and most expect some compensation for services. For further information contact H. M. Gurin, AAS, 211 FitzRandolph Road, Princeton, N. J. 08540.

## Japan builds first GeV-class synchrotron in Asia

After 15 years of frustration, Japanese high-energy physicists are at last getting an experimental facility on their home soil. This is the time that it has taken to win support from the Government to build Japan's first high-energy proton accelerator, an 8-GeV machine to be situated 45 miles northeast of Tokyo. Until now, despite Japan's strong theoretical contributions to the field (Hideki Yukawa and Sin-Itiro Tomonaga both won their Nobel prizes for work on elementary particles), experimentalists have had practically no equipment to work with. The highest-energy accelerator presently is a 1.3-GeV electron machine built in 1961 at the Institute for Nuclear Study, Tokyo University. One result of the meager experimental opportunities has been that the number of theorists working in high energy has exceeded the number of experimentalists by a factor of 3-4 or just the reverse of the ratio in other countries.

Even so, the new 8-GeV machine represents a severe compromise. Originally the physicists had asked for a 30-GeV machine costing \$80 million, but finally a total of \$20 million was all that could be obtained. At first Japanese physicists were not certain that the 8-GeV accelerator that this amount could buy would be a worthwhile investment at a time when other facilities,

such as Batavia with 60 times this energy, are under construction. The conclusion was finally reached however that a high-intensity accelerator ( $10^{13}$  particles/pulse) at this energy would still make a useful contribution. This is especially clear if one thinks of the machine as a K-meson factory, a role that also looks promising for the future program of the 30-GeV AGS at Brookhaven National Laboratory (PHYSICS TODAY, October, page 20).

The newly appointed director of the laboratory, Shigeki Suwa, explained to PHYSICS TODAY that the accelerator design is very similar to that of Batavia's, with a linac injector, booster synchrotron and separated-function magnets in the main ring (105 meters in diameter). Startup time will be in 1974.

An additional problem imposed by the shoe-string budget is that the funds for experimental facilities in support of the new machine will be very tight. A smallish 75-cm hydrogen bubble chamber just put into operation at the Institute for Nuclear Study will be available at the new site. The budget also includes funds for a computer of the next-to-last-generation size. Another part of the compromise is that the location of the laboratory (to be called the "National Institute for High-Energy Physics") in the Tsukuba region has been chosen by the Government to help

in its plan to develop a "science city" in this isolated, poor-farming area—a Novosibirsk kind of situation for the staff of the new laboratory.

Even with its reduced budget the NLHEP will be the most expensive basic research facility yet to be built in Japan and is the only one of 24 such laboratories, proposed by the Science Council for various disciplines, to be approved by the Government. These facts point out the continuing financial starvation that confronts basic research generally in Japan. Although the country's rapidly growing industrial economy is presently the world's third largest and promises to be either second or third in the world by the end of the century, the support available to scientists has not experienced a comparable growth. In terms of research funds per capita, Japan ranks below nations, such as Israel or the Netherlands, that have much smaller economies. In absolute amounts, the high-energy budget in Japan for 1966 was less than one hundredth that of the US budget and one tenth of the budget available in Italy.

The harsh financial situation, however, has not discouraged dreams of the Japanese high-energy experimentalists for the future beyond the 8-GeV machine. Tetsuji Nishikawa, Chief of the Accelerator Division at