ly those related to the degenerate ground state, have been used in particle physics.

Bardeen earned BS and MS degrees in electrical engineering from the University of Wisconsin, then worked as a geophysicist at Gulf Research and Development Corp for three years. He then went to Princeton University where he received his PhD in 1936. After three years as a junior fellow at Harvard and three years on the University of Minnesota faculty, he spent the war years at the Naval Ordnance Laboratory. He then joined Bell Telephone Laboratories, where he collaborated with Walter Brattain and William Shockley on the transistor. In 1951 he went to Illinois where he became a professor of electrical engineering and physics in the Center for Advanced Study.

Cooper did his undergraduate and graduate work at Columbia University, where he received his PhD in 1954. After a year at the Institute for Advanced Study, he went to Illinois as a research associate for two years. He then joined the faculty of Ohio State University for a year. Then he went to Brown University, where he is Henry Ledyard Goddard University Professor.

Schrieffer got his bachelor's degree from MIT in 1953; he received a master's degree from the University of Illinois the following year and his PhD there in 1957. He taught at the University of Chicago and the University of Illinois before going to the University of Pennsylvania, where he is Mary Amanda Wood Professor of Physics. —GBL

Avoid military research, Casimir tells physicists

Academic scientists should not work on military technology, and industry should not attempt to influence basic research programs in the universities. These are some of the recommendations made by H. B. G. Casimir (retired from Philips Industries, Eindhoven, the Netherlands) in his talk on physics and society at the IUPAP meeting in Washington in September. Casimir is president of the European Physical Society.

Casimir spoke on the relationships between science and technology, noting that as science and technology have developed they have become increasingly interdependent and that while their union has helped to make life easier for people, it has also contributed to their destruction and misery.

He said that there are two views of physics. In one, physics is a search for knowledge for the sake of knowledge. In the other, physics is a part of technology and that as such it is not necessarily a spiritual or philosophical adventure but rather "an activity contributing to the growth of the GNP." He said that there are physicists who view physics in both ways, although the first view probably has fewer adherents in the present time.

There is no doubt, however, that the latter view is supported by the fact that society funds physics because it expects to get concrete technological results from it and because physics depends on many of these technological advances for its own progress. Casimir described this interaction as the "science-technology spiral."

Slightly earlier in history, he said, progress in physics was usually made by physicists "doing physics for its own sake," and not for the sake of technological advances. Now, however, many branches of industry have developed that could not have existed without the preceding basic research done by physicists. Casimir cited some examples, noting that:

> "Electromagnetic induction and magnetic forces on currents, on which dynamos and electric motors are based, were not invented by industrialists that were dissatisfied with belts for transmitting power. The equations of the electromagnetic field and electromagnetic waves were not invented by managers of postal services, dissatisfied with the speed of horses, or even trains. Radioactivity and the existence of the atomic nucleus were not discovered by boilermakers or manufacturers of hydroelectric power stations looking for other sources of power nor by the military looking for convenient means of wholesale destruction. The electron was not discovered by industrialists who wanted to bring entertainment by radio and television into every home nor by politicians who looked for new ways for getting their messages across to the public."

In further characterizing the science–technology spiral Casimir said that technology does not use all the results that physics produces. Also, physics results may not be developed enough to use in technology. According to Casimir it is in the work of filling in gaps and studying details rather than work at the forefront that the functions of the academic and industrial physicist are most similar. "Although motivation and rewards systems may be different, there is not much difference in their methods or in their way of thinking once they have chosen their problem."

One feature of the science–technology spiral is that technology never uses results at the forefront of science. Lead times of 15 to 20 years are typical. Casimir cited the cases of the electron, known of in 1900, but not used in triodes until 1910; of positive holes in semiconductors known in 1930, but not used in transistors until 1945, and of the idea of stimulated emission, known in 1917, but not used in lasers until fairly recently.

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The other side of the spiral is that science has become very much dependent on technology, especially in the cases of such products as large computers and advanced electronics. Astronomy, Casimir noted, has been even more enterprising than physics in the adoption of technology in research.

Given that the science–technology spiral exists, Casimir said, we can see it as a good thing that has improved the way of life of its users and that has the inherent capacity to overcome the problems it has caused, or we can view it as an "ominous monster . . . a force that is getting out of control and that will lead to havoc and destruction." To support this latter view he cited the overabundance of material wealth that has resulted in a partial breakdown of some aspects of society and the destructive uses to which many of the products of well-intentioned physical research have been put.

He called the support of particle physics a "gentle farce" in which society claims to support particle physics because it is interested in knowledge when it really wants practical results, and particle physicists hold out the promise of practical results to gain backing although they are interested only in the basic results. Casimir voiced the fear that if practical applications of particle physics ever became a reality, the science–technology spiral might create from them a grave danger to mankind.

Casimir did not say whether he ascribes to the benign or the hostile view of the science–technology spiral, although he did say that he is "increasingly inclined not to speak about the efficient, the fruitful, the glorious spiral, but the ominous, the inexorable spiral." He did offer a number of guidelines for the conduct of science and technology:

- Physicists must assume at least some responsibility for their research and its applications.
- Although it may be impossible to control the science–technology spiral fully, a plurality of controls should be established to do as much as possible.
- Universities should maintain independence of industry, and industry should respect their independence.
- Industry should not attempt to influence university research programs other than suggesting certain themes or supporting work in a general way.
- Universities should not accept conditions of secrecy and industrial security.
- Industry should not insist on exclusive rights to inventions developed in the universities.
- Scientists should be informed of the military implications of their work.
- Relations between the military and the universities should *at the very least* follow similar rules as those between industry and the universities.

In conclusion, Casimir said, "No scientist in an academic position should of his own free will be active in or advise on military technology." He said that although this might be called hypocrisy, since the scientist would still enjoy the benefits of governmental protection, it still could be a meaningful gesture.

John Teem to direct AEC's physical-research division

John M. Teem is the new Director of the Atomic Energy Commission's Division of Physical Research effective 1 January 1973. He succeeds Paul W. McDaniel, who retired recently after heading the division for 12 years.

Teem is Director, Technical Staff, Corporate Research and Development for Xerox in Stamford, Connecticut. He has been working on the long range planning of research programs and on forecasting the economic and sociological environments for research projects.

Since January 1972 he has been a member of a small group of Xerox employees on social-service leave. During this time, Teem has been working in an experimental school in White Plains, New York, teaching physics in a science program he designed that is intended to prevent students from dropping out of school.

Before joining Xerox, Teem was a vice president of Electro-Optical Systems Inc. in Pasadena. Prior to this he was at Cal Tech where he did research in elementary-particle physics and taught undergraduate physics. He received his PhD in nuclear physics from Harvard in 1954 and worked at the Cyclotron Laboratory there.

The AEC Division of Physical Research is responsible for basic research programs in the physical sciences at the AEC national laboratories and under contract at many universities and colleges. The Division budget for FY 1973 is about $350 million.

New institute will study industrialized societies

The International Institute of Applied Systems Analysis, a nongovernmental institute dedicated to the study of the problems of industrialized societies, has been established in Vienna. The staff of the institute will work with visiting scholars, systematically comparing the ways in which the various nations have sought to deal with problems arising from industrialization, and attempting to devise new methods of analysis of these problems by mathematical modeling.

Jermen M. Gvishiani, representing the Soviet Academy of Sciences, was elected to a three-year term as chairman of the council of the institute. Howard Raiffa, professor of managerial economics at Harvard University, was appointed to the full-time post of director. The institute will be run by member organizations from 12 countries: the United States, the USSR, the United Kingdom, Canada, France, Italy, Japan, West Germany, the German Democratic Republic, Czechoslovakia, Poland and Bulgaria. The Soviet Academy of Sciences and NAS will each contribute $1 million a year to the institute's annual budget of approximately $3.5 million, with the other member institutions paying the remainder.

Soviet-designed accelerator to be made by American firm

The Institute of Nuclear Physics of the Siberian Section of the Academy of Sciences of the USSR has signed an agreement with an American firm, licensing the use of Soviet patents and technology in the production of low-energy electron accelerators for commercial applications.

The company, Energy Sciences Inc., of Burlington, Mass., which has been producing commercial accelerators with energies between 50 and 500 keV, will now offer Soviet-designed accelerators with higher energies. The accelerators can be used in industry for high-speed continuous curing of polymers and sterilization.

Those involved in the licensing agreement on the Soviet side include Gersh I. Budker, the director of the Institute of Nuclear Physics in Novosibirsk, V. A. Sederov and Vadim Auslander, Secretary of the Institute. The Institute has been active in accelerators and controlled thermonuclear fusion.

The agreement gives ESI permission to use the knowledge, experience and patent rights of the Institute in producing electron-beam equipment, accelerator systems and high-voltage power supplies. Also, the Institute will give ESI technical drawings and data and will supply any parts that ESI might find difficult to manufacture quickly.

Sam V. Nablo, Vice President of ESI, told us that according to the agreement the Institute will provide technical assistance to ESI and will send technicians to the US if necessary. The Institute also agreed to "do all in its power" to allow ESI personnel to visit members of the Institute staff if it becomes necessary. Nablo said that several visits have taken place and "were handled very professionally by the Russians."

The actual licensing agreement was negotiated with Licensintorg, the Soviet government branch that deals with foreign licensing of Soviet technology.

ESI has so far taken delivery on an 800-kV resonance transformer accelerator (Elit 0.8) and has begun the manufacture of other units under the terms of the agreement.

in brief

A film about Lawrence Livermore Laboratory's Baseball II controlled-fusion experiment is available on free loan from the AEC film library, PO Box 62, Oak Ridge, Tennessee 37830 and Lawrence Livermore Laboratory, Technical Information Library L-3, Livermore, California 94550.

New addresses and telephone numbers for the offices of the American Association of Physics Teachers, the American Institute of Physics Education Division and the Society of Physics Students are: AAPT, Drawer A-W, Stony Brook, N.Y. 11790, (516) 862-8700; AIP Education Division, PO Box 617, Stony Brook, N.Y. 11790, (516) 862-8787; SPS, PO Box 775, Stony Brook, N.Y. 11790 (516) 862-8787.

The new Duane Physical Laboratories of the University of Colorado, including the buildings of the Joint Institute for Laboratory Astrophysics, the Laboratory for Atmospheric and Space Physics and the George Gamow Tower, were recently dedicated.

A telescope designed for both solar and stellar observations was installed at the Bartol Research Foundation in Swarthmore, Pa. A 36-inch light collector sends light to a fixed-position 24-inch image-forming telescope on the floor below. □