Medium-energy research budgetary levels

	(millions of FY 1975 dollars)				
	FY 1975	FY 1976	FY 1977	FY 1978	FY 1979
High level	35.2	44.8	49.0	50.2	52.1
Intermediate level	34.9	38.2	42.2	45.9	46.9
Low level	29.7	30.0	31.1	32.2	32.7

Budgetary levels were assumed by the ad hoc committee to review US medium-energy science. Figures include machine operation, capital equipment, minor construction, in-house research, service to all laboratory users, users, nuclear-structure research at high-energy machines and research at foreign accelerators.

intensities and expected to produce very intense beams at 200 to 800 MeV in 1975; the isochronous cyclotron at Indiana University, which will have the unique capability of producing variable energy, highly-resolved beams of various particles, is scheduled to begin operation in 1975; and the electron linear accelerator at the Bates facility at MIT with full operation expected in 1975.

Austerity level. At the low level budget—termed an "austerity" level (see table) in the report—the committee found a number of "disagreeable consequences." One of the most important of these is that "sustained funding at the given low level without reasonable expectation of improvement (or funding even for one year below that level) will . . . force the complete shut-down of at least one of the new machines." In addition the number of operating shifts and accessible beams per shift at the new facilities would be cut to less than half the number needed for efficient operation. All major new construction of beams, experimental areas and auxiliary apparatus would be halted. Laboratories would be able to provide only minimal support for outside users, with the fraction of outside users falling to about half of the desirable number under an intermediate or high-level budget. The committee further concluded that there would have to be an immediate phase out of medium-energy support for either the LBL 184-inch or the SREL 500-MeV cyclotron.

The intermediate-budget level considered by the committee would not threaten the survival of the new machines. However, delays would be necessary in most of the proposed machine additions and improvements, and no major new construction would be possible until FY 1976. The committee concluded that several projects could be completed or initiated during FY 1976–FY 1979, including a second experimental area at Bates, the initiation of a high-duty factor electron accelerator, a polarized source and initiation of tandem injector at Indiana, an increased beam at Nevis, and a staging area, improved duty factor and mass separator at LAMPF. Under this budget the number of shifts of operation and available beams would more than double that for the low funding level and university groups would be able to make independent contributions to the program rather than working mainly as collaborators with in-house groups.

The high-level budget "would allow a vigorous program with nearly full exploitation of new machines by the end of the decade," according to the report. The high level, while not an affluent level, would allow construction of facilities on a much more favorable time schedule, the committee said; they recommended that plans for existing machines should be modified as new-beam opportunities develop. It also recommended that a study be conducted in two years to examine the state of research with medium-energy electrons, the possible programs to develop a medium-energy high-duty-factor electron accelerator and to determine the appropriate laboratory for this development. Recommendations at this high-level budget may be moot since NSF and AEC spokesmen point out that budgets are likely to be more in line with low or intermediate levels through FY 1979. The budget this fiscal year is close to the intermediate level.

Encouragement. The committee also noted that there appears to be no manpower shortage in the medium-energy field. However, "the related theoretical effort is at a lower level than seems appropriate," according to the report, "and special encouragement may be desirable during the next year or two."

—Madeleine Jacobs

Paul Flory wins Nobel Prize for Chemistry

Paul J. Flory, the first winner of the APS High-Polymer Physics Prize in 1962, has added the 1974 Nobel Chemistry Prize to his list of accolades. For 40 years Flory's research into the physical chemistry of macromolecules has been of fundamental importance. The Nobel Prize comes just one year after his winning the American Chemical Society's top award, the Priestley Medal.

Flory's early work dealt with the relation between polymerization kinetics and molecular-weight distribution. He delineated the role of chain transfer in free-radical polymerization and described the features of polymer network formation, where the entire system becomes one huge molecule. He made major contributions to the understanding of rubbers including an analysis of swelling, which he revealed to be a powerful probe of polymer properties. The key to concentrated-solution thermodynamics, he showed, was a consideration of the number of ways a volume could be filled with polymer chains without their overlapping.

In dilute solutions, Flory focused his attention on the excluded-volume prob-

FLORY

lem—the effect of the relative repulsion between polymer units in a good solvent. He found the answer by treating an individual molecule as a swollen mass and then he pointed out that the problem could be experimentally simplified at a particular temperature, now called the Flory Theta temperature. At that temperature a solvent would be so poor that it induced forces just as repulsive as the polymer's own units, and the molecule would exist as if it were in a non-interactive, ideal state, analagous to the Boyle point of a real gas. This was the key to the interpretation of many polymer characteristics. Furthermore, it led to Flory's wide-ranging research on the relation between microscopic forces and macroscopic configurational properties of synthetic polymers and biopolymers.

Flory's more recent work is concerned with configurational statistics. He and his students have devised versatile methods for averaging configura-

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tion-dependent properties (such as chain dimensions, dipole moments and optical polarizability tensors) over all configurations of virtually any macromolecular chain of specified chemical structure.

His career has carried him through a number of industrial and academic positions including stays at Dupont (1934–38), the University of Cincinnati (1938–40), Esso Laboratory (1940–43), Goodyear (1943–48), Cornell University (1948–56), Mellon Institute (1956–61) and Stanford University (1961 to the present). He has written two books: the enduring *Principles of Polymer Chemistry* (1953) and *Statistical Mechanics of Chain Molecules* (1969).

In looking over the significance of Flory's career, polymer chemist Eugene Helfand (Bell Laboratories) commented to us, "Beyond the breadth of his research, Flory's impact is attributable to the fact that he challenged the central problems, provided practical solutions and verified them with the right experiments." —RAS

Nobel Physics Prize

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one sec of arc—a figure comparable to that of larger optical telescopes on good mountain sites.

In all these multiple-element telescopes Ryle has made perhaps his strongest contributions to the art with his elegant improvements in the electronics of receiver technique. One example is "phase-switching," a trick of interferometer circuitry that considerably improves sensitivity and stability.

Ryle's observing program has included studies of the structures of radio sources and the establishment of accurate positions for comparison with visible objects. His "Third Cambridge Catalogue" of some four hundred sources, published in 1959, has given us the familiar "3C" numbering system by which most of these objects are still known. A fourth and a fifth catalogue have followed since.

The program of detailed counting made possible by this cataloging activity enabled Ryle to pursue his cosmological interests; from the distribution of these objects in space he believes he has evidence to support the "big-bang" theory of the creation of the Universe over the rival "steady-state" theory. Although this question is still not resolved to everyone's satisfaction, there is no doubt that Ryle's statistical work on radio sources has stimulated the progress of the argument.

A Fellow of the Royal Society since 1952, Ryle was appointed the first professor of radioastronomy at Cambridge in 1959. He received his knighthood in 1966 and became Astronomer Royal in 1972. In his spare time he is a keen sailor and boatbuilder.

Hewish, now aged 50 and like Ryle a Fellow of the Royal Society, is a Fellow of Churchill College and has been a professor of radioastronomy since 1971. He first joined Ryle in the early days of the Cambridge radio observatory, (renamed the Mullard Radio Astronomy Observatory in 1957) where he assisted in the development of antenna arrays and made some observations of radio emission from the solar corona. Then he became interested in interplanetary scintillation of radio sources—a "twinkling" effect due to spatial and temporal irregularities in the interplanetary medium. This work had two aims: one, the study of the interplanetary medium itself, and the other, the detection of small angular-diameter radio sources. Only objects smaller than 1 sec of arc can scintillate in this way, and some information on their angular structure can be inferred.

In August 1967 Hewish started a thorough survey of the sky with a new fast-response antenna, specially designed for detecting scintillating sources. With this fixed horizontal array, built very cheaply with student labor and covering four and a half acres, Hewish planned to survey the entire sky once each week. But at the end of that month he and his student, Jocelyn Bell, noticed unexpected scintillations in a region (away from the Sun) where a strong effect was not anticipated. The extreme regularity of these "scintillations" became apparent for the first time on 28 November when an improved recording system showed pulses above the noise level; after ruling out all likely sources of interference the Cambridge group realized they had something very unusual on their hands. A search of the records revealed three more of these "pulsars," as they quickly became known, and by late 1968 the world of radioastronomers was in a ferment as yet more were discovered at other laboratories.

Theories of what pulsars might be abounded, of course, in those early days. Even the possibility of communication from distant civilizations was admitted—Hewish's designation of the first four pulsars, on the original data sheets, as "LGM 1," "LGM 2" and so on (for "Little Green Men") was intended as a wry reference to this remote possibility.

But soon the theoretical speculations settled down to two kinds of models—pulsating white dwarfs and rotating neutron stars. Now, six years later, neutron-star models appear to have everyone's support. In May of 1968 Hewish foresaw this possibility in a conversation with PHYSICS TODAY. "We are keeping an open mind," he said, "but we don't discount neutron stars." Noting that theoreticians "have a fair amount to play with," he added that "this is a good time to be a theoretician." Certainly pulsars have turned out to be not only very exciting for astronomers but also, as neutron stars, a very fundamental discovery for all physicists. —JTS

Election results

There were three winners among the five scientist-candidates whom we reported on in October (page 77). Incumbents George Brown Jr (D-Cal.), James Martin (R-N.C.) and Mike McCormack (D-Wash.) retained their seats. The two first-time scientist-candidates, Democrats George Seielstad (Cal.) and Lloyd Wood (Ohio) were not able to unseat Republican incumbents W. M. Ketchum and W. H. Harsha respectively.

in brief

The application deadline for National Science Foundation energy-related graduate traineeships is 6 January, with awards scheduled to be made in late April. Information is available from Fellowship and Traineeship Section, Division of Higher Education in Science, NSF, Washington, D.C. 20550.

Postdoctoral research associateships and visiting fellowships to the Joint Institute for Laboratory Astrophysics for 1975–76 are available. Applications for research associateships may be submitted at any time, although mid-February is most advantageous; visiting fellowship applications are due before 16 January. Contact G. Dunn, Visiting Scientists Program, JILA, University of Colorado, Boulder, Colo. 80302 for information and applications.

The AAAS is sponsoring a Mass Media Intern Program for advanced graduate students in the social and natural sciences for Summer, 1975. The deadline for applications is 1 February. For further information, contact W. Weisman-Dermer, Communications Office, AAAS, 1776 Mass. Av, NW, Washington, D.C. 20036.

Approximately 250 National Research Council postdoctoral research associateships of $15 000 or more in federal labs and research centers will be available in the physical, earth and biological sciences for 1975. Applications are due 15 January. Details are available from Associateship Office, JH 606-P, National Research Council, 2101 Constitution Ave, NW, Washington, D.C. 20418. □