ing is required. Application forms are available from the Meetings Officer, Institute of Physics and the Physical Society, 47 Belgrave Square, London S.W.1, England.

The Society for **Cryobiology** will hold its annual meeting 8–10 August in Boston, Massachusetts. Papers on all areas of the field are invited. Abstracts: 200 words; deadline: *15 May*. (C. Huggins, Department of Surgery, Massachusetts General Hospital, Boston 02115)

Evaporites and related rocks will be the topic of an **earth science** conference in Banff, Alberta, 8–13 May. The purpose of the meeting is to provide practicing geologists with an opportunity to keep up to date with new advances in their field. Fee: $100; deadline: *21 April*. (Phyllis Laking, Extension Department, University of Alberta, Edmonton, Canada)

Scientists in the News

The University of Missouri has appointed **James O. Davis** professor and chairman of the physiology department, effective 1 July. He is now a heart research specialist and chief of the section on experimental cardiovascular diseases at the National Heart Institute.

J. Harry DuBois, president of Molecular Dielectrics, Inc., has received the highest award of the Society of Plastics Engineers, the international award in plastics science and engineering. He received a $1000 honorarium for "continuing efforts and success in expanding and disseminating the technology of plastics engineering."

John B. Stanbury, director of the thyroid research unit and associate clinical professor of medicine at Harvard, will become professor of experimental medicine and director of the MIT clinical research center on 1 April.

Hamish N. Munro, former professor of biochemistry at the University of Glasgow (Scotland) has become professor of physiological chemistry at MIT.

Walter S. Owen, professor of metallurgy and dean of the faculty of engineering science at the University of Liverpool, has become the T. R. Briggs Professor of engineering and director of the department of materials science and engineering at Cornell University.

Robert C. Horton, mining engineer with the Nevada Bureau of Mines, University of Nevada, has been named administrative head of the bureau, with the rank of associate director.

The new director of the Smithsonian Institution's museum of natural history, is **Richard S. Cowan**, formerly assistant director. He succeeds **T. Dale Stewart**, who has become senior scientist in the Smithsonian's division of physical anthropology.

Hunter Rouse, director of the Institute of Hydraulic Research and a professor of mechanics and hydraulics at the University of Iowa, has been named dean of the university's college of engineering.

Recent Deaths

Laurence M. Ames, 65; research professor of microbiology at American University; 2 February.

Ralph C. Corley, 64; professor of chemistry at Purdue University; 24 January.

Robert Fries, 89; director of the Bergius Institute and botanical garden of the Royal Swedish Academy of Sciences from 1915 to 1944; 29 January.

Gilbert Grosvenor, 90; editor for more than 50 years of *National Geographic* magazine and chairman of the Society's board of trustees since 1954; 4 February.

Ernest Scott, 88; retired associate professor of physiology at Columbia University's College of Physicians and Surgeons; 19 January.

REPORT FROM EUROPE

Decision Time Approaches for European Rocket Programs

London, 16 February. The managers of the six-nation European rocket development organization ELDO are preparing to ask for commitment to a second-generation program that will probably cost about twice as much as the present one.

But as they do so, the ground seems to be slipping underneath even the first program. It became known today that the British government has "serious doubts" about financial, commercial, and technological aspects of the present ELDO program, which it estimates will cost a total of $420 million, not $200 million as agreed 5 years ago, or even $300 million as estimated last year.

Under the leadership of Britain's new minister of aviation, Fred Mulley, the British will express these doubts at a meeting of ministers from ELDO countries to be held in Paris from 29 to 31 March. Such doubts could be crucial to the initial ELDO program, for Britain contributes not only the largest share of ELDO's cost (about $165 million) but the Blue Streak first stage of the planned three-stage Europa or ELDO-A rocket now being developed.

There is a distinct possibility that Britain will withdraw from ELDO before the ELDO-A rocket is used to launch even one satellite (an event now scheduled for 1968), and long before it could be used in projected tests, planned for 1969, of communications satellite equipment which might be sold to the world system. The withdrawal might occur at the end of this year.

Informed sources were saying, naturally, that the doubts about ELDO had no effect on Britain's generally friendly attitude toward international scientific and engineering collaboration (for example, activities of ELDO's sci-

entific partner ESRO, or the Anglo-French project for developing an "air bus"). These sources also noted that the doubts were entertained reluctantly, since a British proposal had launched the whole project. But now it is a question of considering whether "scarce resources" can profitably be spent on ELDO, these sources said.

Even though such financial worries have existed for some time, the ELDO managers have not been able to provide the member governments with solid figures on what their proposed second-generation program will cost. Educated guesses have been running anywhere from $600 million to $1100 million.

In budgetary terms, the new program would entail a gradual increase of ELDO's spending from an annual average around $60 million over 7 years to at least $120 million and perhaps $200 million. By American or Russian standards, these are modest amounts, but they appear huge in Europe, where only France is spending significant amounts on a national rocket development program in addition to her ELDO contribution.

Liquid Hydrogen Rockets

In technical terms, the new program will mean commitment to serious development of liquid hydrogen rockets in Europe. These rockets would be used as upper stages above the British Blue Streak rocket, which is the first stage for the Europa or ELDO-A rocket now under development. (The Blue Streak, which owes much to the technology of the American Thor rocket, has been successful in its first three launches. A test with dummy upper stages is planned soon. After the 1968 launching of a satellite, the complete rocket, plus an extra apogee rocket, will be used for launching experimental communications satellite equipment.)

With fulfillment of the first program fairly near, ELDO managers think it is time to start intensive cooperative development of the liquid hydrogen rockets. To review this proposal, ministers from the six nations contributing money to ELDO—Britain, Germany, France, Italy, Holland, and Belgium—will meet around the end of March.

The second-generation program is similar to the program proposed by French engineers in January 1965 and then withdrawn for more study after ELDO's other members objected to the idea that the second-generation effort should immediately supersede the first, for which there appeared to be no mission in sight (*Science*, 25 June 1965).

In proposing to move on to rockets called ELDO B-1 and ELDO B-2, ELDO's managers are undeterred by vigorous American progress with liquid hydrogen–fueled upper stages such as the Centaur, fired with Atlases, and the J-2, which will be used in clusters and singly on the Apollo moon rocket. They feel that liquid hydrogen rockets are an unavoidable next stage of European rocket development in any attempt to preserve at least a hope of European participation in launchers and satellites. The ELDO managers feel that both launchers and satellites are potentially such an important business that Europe cannot stay out of them, even if it chooses not to duplicate the moon race.

Despite the imminence of a decision, the ELDO officials in Paris appear not to be pushing their views very hard before generally skeptical public and parliamentary opinion. Maintaining an option in rocket development, or fighting for a small share in the supply of equipment for the world communications satellite system—neither of these aims has the focus or glamor of the American moon program. Furthermore, ELDO officials seem not to have followed the example of the leaders of the European Nuclear Research Center (CERN) at Geneva, who, in the face of similar skepticism, have been producing fairly accurate blueprints of what their rather ambitious programs will mean in terms of annual spending. By doing this, CERN has made large and growing budgets look manageable.

The hopes of ELDO's managers and the difficulties in realizing them were both thrown into relief recently in London. ELDO's secretary-general, Renzo di Carrobio, spoke on 2 February to members of the "Britain In Europe" committee, which includes members of Parliament. Carrobio expressed the view that space programs are of great importance to economic strength. He also urged initiation of the second-generation program in order to avoid disbanding scientific and technical teams assembled for the first ELDO program (which employs about 4500 to 5000 scientists, engineers, technicians, and industrial workers in the member countries and about 70 engineers and scientists at ELDO's Paris headquarters). Moreover, Carrobio asserted, the rocket program constitutes one of the magnets needed to prevent serious net losses of talent to the United States.

In contrast to a "present hesitancy" about space programs in Europe, Carrobio said, there is a positive position in the United States: the Americans are not only "convinced of the importance of space activities, but also . . . fully aware of the benefits which can accrue to the commercial sector of their economy from the technological applications of space research. [They] are making great efforts to ensure that the spin-off from their heavy investment in space research is put to good use in the industrial sector.

"They recognize also that space activity is of wider interest and influence. Its ramifications extend not only to the applications of techniques developed for space purposes in other fields but also into the realm of medicine with the problems of maintaining life in space and consequent developments in techniques; of law because of new complexities internationally; of education, in the light of the increasing need for the training of specialists and the extension of subjects of study."

Need for Launchers

Carrobio asserted that "the primary instrument of space activities is the launcher. To be able to develop launchers of one's own is a threshold below which there can be no independent space policy. Without this capability the alternative would be to look elsewhere, to our friends of the United States of America for example. The questions would arise of whether the type of launchers required could be made available and of the necessary work of adaptation to carry payloads. There would moreover be the further problem that even with their expressed goodwill, the Americans might find it impossible to fit others' launchings into their crowded program at the times required. [Thus] independence would be lost."

Carrobio linked the current and future rocket-development programs in Europe to the idea of participation in communications satellite development. He and ELDO's technical director, W. H. Stephens of the United Kingdom, stressed that such participation would not involve competition with the proposed single world system but, rather, maintenance of a "minimum capability" with a view to gaining "a reasonable share" of contracts for components and satellites.

Carrobio said that the 17-nation European Conference on Satellite Communications had defined a three-stage

program of tests: (i) orbital tests of communications equipment in 1968 and 1969; (ii) launching of an experimental communications satellite in 1970; and (iii) work toward such future applications as the development of satellites that are capable of omnidirectional television broadcasting direct to community or home antennas on the earth's surface.

The members of ELDO, however, had not yet agreed on "a long-term common policy for space activities in Europe," Carrobio said. Their hesitancy constituted a grave danger. "We need to spend more on European effort in space . . . A choice must be made now."

What was the source of the present hesitancy? Carrobio said: "It is no doubt due in great measure to the high cost of space activities and to the tremendous lead of the United States and Russia, which gives rise to the belief in some quarters that we in Europe cannot expect to enter the field with the confidence that we can achieve results of comparable value, even by combining our efforts."

To counter such arguments, Carrobio noted the wide gap in per capita spending on peaceful space activities in the United States and in ELDO member countries. In the United States, with a space budget of more than $5 billion, the per capita figure is $26 a year. In Europe, the total spending on space is less than $200 million, Carrobio said, or about $1.15 per person per year.

He also noted wide variation between European countries in the amounts they commit to their own national space programs. Such programs are needed to provide competition and to provide essential technical background for international collaboration, he said. In 1965, France spent about $56 million on space, and about two-thirds of this was for national programs. Of Germany's $48-million budget, only one-third was for national programs. The same proportion held for Italy, which spent $14 million. But Britain spent only $5 million on its own effort and $38 million on international space programs. Belgium and Holland spent hardly anything on national space efforts.

Such figures could be used to illustrate how much more individual governments might do in space, but they also illustrate the extent of present skepticism about space programs in Europe, hence serve as warnings to ELDO's managers as they seek considerable budgetary increases to develop rockets.

The problem is especially serious in Britain, which has so far put most of its eggs in the international basket. Britain has the option of developing its own launcher of scientific satellites, the so-called Black Arrow, which would be an extension of the evolving Black Knight rocket now being used for joint U.S.–British antimissile experiments in Australia. It is reliably reported in Britain that a committee, headed by mathematician Hermann Bondi, which is considering Britain's military and civilian space programs, has backed the Black Arrow concept. Presumably the new British minister of aviation, Fred Mulley (who succeeded Roy Jenkins, recently named Home Secretary), will have to decide before he goes to the ELDO ministerial meeting in March about going ahead on the Black Arrow.

The Black Arrow, which might cost as little as $25 million and take as little as 3 years to develop, could of course be used for some of the proposed tests of communications satellite equipment, because it is expected to be able to launch 100 kilograms into a circular polar orbit at an altitude of 480 kilometers.

French Program

One national program, however—that of France—serves as pressure on ELDO to push ahead on liquid hydrogen rockets. Reports keep coming out of France of programs to develop much larger rockets than those now in use, not only for military purposes but also for civilian research and development, should ELDO falter. The most recent report appeared in the latest issue of the French monthly *Air et Cosmos*; the British monthly *Science Journal* gave a detailed report in October 1965. According to *Science Journal*, French thinking now tends to favor, for its future rockets, use of large solid-fueled first stages and liquid hydrogen–fueled upper stages.

Not only is there a plan to give the Diamant rocket, which launched a French satellite from Algeria in November and was scheduled to launch another in February, a liquid hydrogen–fueled second stage but there is also a plan to substitute a liquid hydrogen rocket for Diamant's present spin-stabilized third stage. Very soon there should be a static firing of the four chambers of a new liquid hydrogen–fueled stage, which will have a total of 6 tons of thrust.

Solid-fueled rockets like one exhibited in Paris in June 1965 might be used in a large rocket called Régent. The exhibited rocket would have a thrust of 28 tons, and three such rockets in a cluster would provide Régent's planned first-stage thrust of 80 tons.

At the London meeting where Carrobio spoke, he and technical director Stephens were asked what France's position toward ELDO is. Carrobio replied that France is not at present in a mood to compete with ELDO. Expanded Diamant rockets, at least, are not competitive with ELDO plans, he said, but if ELDO chose not to develop liquid hydrogen–fueled upper stages, then France's position might change.

Stephens added that the best evidence from budget figures is that France so far has not decided to go ahead with full-scale development of the larger rockets. He said that the amounts approved for the civilian space program in France during the 5-year period 1966–70 were about one-third the amounts first requested.

The implication was that the French were waiting for ELDO to go ahead. French engineers have had a strong part in planning the proposed ELDO B-1 and B-2 rockets.

The ELDO B-1 would combine a Blue Streak with a single-engine upper stage, and would have double the lifting capacity of the present ELDO A rocket. Hence, ELDO B-1 could lift about 300 kilograms into a geostationary orbit at 36,000 kilometers. Stephens said that this rocket could be ready in 1972 or 1973.

The ELDO B-2 would use a modified Blue Streak. Its second stage would be a cluster of four liquid hydrogen–fueled engines, and its third stage would use the single-engine second stage of ELDO B-1. Such a rocket, which could be ready in 1974 or 1975, could lift several tons into a low orbit. Hence it could launch a satellite to broadcast directly to television antennas, or could launch a man into space. Stephens added that such a European man-in-space program would make sense only if a manned satellite were needed for scientific observation.

Neither Carrobio nor Stephens could give even a general idea of how much these ambitious projects would cost.

—VICTOR K. MCELHENY