raphy and characteristics of the lunar surface.

The view at NASA, however, is that, with reasonable luck with the unmanned investigations now planned and no rug-pulling surprises, enough will be learned soon enough to answer the necessary engineering questions for Apollo.

In addition to the four Rangers on the ways, NASA has scheduled 17 flights of Surveyor unmanned spacecraft, a bigger and more sophisticated successor to Ranger, and five to ten lunar orbiters which will be designed primarily to fly photographic missions.

Officials in the lunar and planetary program are banking heavily on Surveyor, which is another Jet Propulsion Lab project with Hughes Aircraft serving as contractor. Precisely which experiments will be aboard the first Surveyors has not been decided, but the spacecraft is intended to demonstrate soft-landing techniques—a formidable maneuver which can be likened to a launching in reverse—and will probably carry the first movable TV cameras and instruments to test physical and chemical properties of the lunar surface at its landing point.

The Surveyor flights are scheduled to begin in 1965. Some observers outside NASA, however, suggest that a possible joker in the Surveyor deck is the new hydrogen-fueled Centaur rocket, which serves as the upper stage of the Atlas-Centaur launch vehicle for Surveyor. After initial difficulties, the Centaur has been performing promisingly in recent tests, but payload problems have arisen. Atlas-Centaur was first rated as able to lift 2500 pounds, but its maximum payload now stands at about 2100 pounds, a figure which limits quite sharply the instrumentation in any payload.

One reason the lag in obtaining results from the unmanned program is not regarded as crucial at this point is that the Apollo program has "slipped," so that the whole moon project has been set back substantially. An order to slow down development work on the Apollo Lunar Excursion Module and the Saturn 5 moon rocket, issued recently as a result of the economy drive, is likely to delay Apollo even more.

Going further, one scientist, who is not a NASA employee but is closely familiar with the unmanned-investigations program, says that planners responsible for the manned lunar landing are not counting on data from unmanned investigations at all and are insisting that Apollo lunar-orbit and landing hardware be designed according to a conception of the moon's surface so pessimistic that it would be possible to proceed without data from unmanned spacecraft.

NASA's lunar and planetary program, however, is going ahead on the assumption that information is wanted and needed. NASA officials feel that the projected series of Ranger, Surveyor, and orbiter flights provide a "balanced program" of unmanned lunar exploration, but they concede that some researchers interested in the space sciences might be disappointed because the Surveyors may focus on possible Apollo landing areas rather than range more widely over the surface of the moon.

The planetary part of the space-sciences program is likely to be affected more severely than the lunar part by the current budget squeeze. Mariner flybys of Venus set for 1964 have been canceled, and there are reports that two Mariners scheduled for a Mars probe next year also will be more lightly instrumented than was contemplated, in the interest of saving money.

As yet, however, there seem to be no clear signs that, as some have suggested, the space sciences are being sacrificed on the altar of economy. At the same time, informed persons inside and outside NASA agree that, as the Apollo program matures, choices in allocating limited funds between the manned program and space sciences will grow increasingly difficult.

Test is the Budget

It will be instructive, obviously, to see what funds are finally channeled this year into the main space-sciences category of unmanned investigations in space, which covers spacecraft development and operation, geophysics and astronomy, lunar and planetary exploration, bioscience, and launch-vehicle development. The budget for unmanned investigations has risen steadily year by year, reaching $547.2 million for fiscal 1963. The request for fiscal '64 was $754.7 million, but this has already been cut sharply by Congress, and final decisions within NASA will doubtless reduce it further.

Some of the pressures clearly would be relieved if, as some of the space industry magazines unconfirmably report, the administration is considering moving the moon date into the 1970's.

If, however, 1970 remains the target date, if the Russians make no sudden moves toward the moon, and if Congress maintains tension on the purse strings, pressures are likely to build inside the NASA budget for more funds for Apollo.

What happens, then, is up to top NASA management. NASA and the scientists need each other, and the space-sciences program has given NASA a solid and valuable link to the scientific community. A knowledgeable scientist, who has watched this relationship grow, credits key NASA administrators with earnestly seeking to understand what the scientists want and trying to give it to them. The years ahead are likely to put these administrators to a stern test.—JOHN WALSH

COMSAT: Europeans Wary of U.S. Plan for American-Dominated Commercial Satellite Enterprise

The main job now facing the Communications Satellite Corporation is to persuade the Europeans that joining with the U.S. in a U.S.-sponsored international satellite communications network is in their economic self-interest and not detrimental to their political prestige. A related task is to convince the underdeveloped countries that what is going on is not an imperialist plot to expropriate outer space but an attempt to make sensible, all-inclusive use of an exciting new turn in communications technology. Of the two jobs, convincing the Europeans to participate in the U.S. system is of more immediate economic consequence to COMSAT, for if the Europeans, either as a group or separately, decide to use traditional methods of international communication, or to launch a competing satellite system of their own, the volume of transatlantic business that flows through COMSAT's satellites might be reduced far below the profitable level.

Persuading the Europeans is not easy, for satellite-communications development is afflicted with a political tag that has never troubled traditional communications arrangements. For years, an international network of cables has linked a large part of the world in businesslike fashion, regardless of politics. A.T.&T. alone, for example, has over 175 technical agreements with other countries, including countries from which the U.S. has been estranged—the Soviet Union, Red

China, Cuba. These agreements have been concluded between the U.S. company and the responsible telecommunications authority in the opposite country—most often, unlike here, a government agency; the foreign offices of the respective countries have been involved, if at all, only peripherally.

Somehow, however, the great romance of space has put an end to the era of purely technical agreements, and political finagling is playing a key role in all of COMSAT's negotiations. Part of the explanation is that the new technology requires multilateral rather than bilateral bargaining, and when any group of nations gets together around a conference table, issues in addition to the one immediately at hand are likely to get mixed up together. But political involvement in the satellite system is high for other reasons, too —partly because the U.S. haste in organizing COMSAT had the frank political goal of "beating the Russians," and partly because the international diplomatic corps, particularly at the United Nations, has been quick to see the political future of a procedure which televises their activities in faraway New York to the folks back home in, say, Togo—a service performed for the 17th General Assembly by A.T.&T.'s Telstar. The result of the political interest is that there is no technical decision—from international allocation of radio frequencies to the forms of international ownership—that is not also heavily, intensely, political.

So far, COMSAT has participated in the negotiation of only one international agreement, and that of a highly technical nature—the allocation of radio frequencies for space activities (*Science*, 6 December). This agreement, reached in Geneva on 8 November under the auspices of the International Telecommunications Union, is described by all concerned as the cornerstone for development of an international satellite communications system. Without it, it is said, there would be no assurance that satellite transmissions could be carried out without either causing interference with terrestrial or other space radio facilities or experiencing such interference.

The frequency agreement, widely if indiscreetly heralded as a U.S. diplomatic triumph, was political in two ways. In the first place, the Russians, who came to the conference with proposals that differed greatly from ours, dropped many of their demands and went along with generous compromises. And in the second place, the underdeveloped countries, which, as the U.S. official communiqué described it, had gotten the idea that "the major space powers of the world would somehow preempt the frequencies allocated by the conference and thus prevent small-nation participation in a global system," were comforted into believing that this was not the case, and that "the allocations are properly viewed as having been made for the benefit of all nations." Actually, however, the smaller nations, when and if they find themselves ready to conduct independent experiments in space communications, may find little room in which to do so, and will probably be propelled toward the then-existing system as a result. Pressed privately on this point, a State Department official said, "Let's face it. The United States is acting like any major space power would who wanted to get on with the job without waiting for, say, Gabon, to catch up."

In sum, what the Geneva conference did was to clear the way for the U.S. corporation to develop its satellite system largely free of at least one variety of technical impediment. That was precisely what it was intended to do; in fact, knowledge that the conference had long been scheduled for October 1963 was one of the major reasons for the early establishment of COMSAT. It had been felt that this conference, which made decisions affecting use of radio frequencies through 1980, could be worked to the advantage of the U.S. only if we went to the meeting with plans and objectives well in hand. The results of 2 years of preparation supported the U.S. team, which consisted of COMSAT officials and representatives of the State Department, the Federal Communications Commission, NASA, Congress, and the President.

The Home Team

The delegation is a good example of the success of the sometimes bickering domestic partners in the COMSAT venture in presenting a united front to what they jointly view as possible foreign trouble-makers. After an uneasy start, COMSAT and the State Department seem to be working together in a friendly way. Who will negotiate what has never been formally decided; the general line at the State Department, however, is to let COMSAT proceed without interference as long as it makes no moves which violently conflict with U.S. foreign policies.

One possible source of conflict, which has received little attention so far, is that the legislation that created COMSAT, in August 1962, gave it the explicit mandate of "providing service to economically less developed countries and areas as well as those more highly developed." A U.N. resolution has adopted virtually the same language, stressing that a global system should be available to all on a nondiscriminatory basis. The conflict here is with the logic of economics, which dictates that unless satellite communications are first established between countries where there is a high volume of traffic, the experiment will be a financial disaster —and, it is feared, other countries will be left to pick over the bankrupt skeleton of the U.S. corporation. So far, however, there are no indications that the State Department will try to force COMSAT into economically unprofitable positions or otherwise interfere with its plan to provide service first to advanced countries, letting others into the system later. A higher U.S. objective than immediate equality in use of satellites is that COMSAT be a success.

The problem of frequency allocations could be resolved in favor of the U.S. largely because the U.S. came to the conference table with specific proposals no other nation was technically in a position to counter. A question far stickier is the form of international ownership of the network of satellites habitually described as a "single global commercial communications system."

Although preliminary talks have gone on between COMSAT and representatives of France, West Germany, Italy, Britain, Japan, the Scandinavian countries and Canada, none have proceeded beyond the stage described by a State Department official as "choreography"—that elaborate maneuvering to and fro that precedes the hardening into a final negotiating stance. (There have also been some very tentative chats with the Russians.) Even the question of precisely what it is that is being negotiated is not yet entirely clear. Officials at COMSAT and the State Department say, virtually in chorus, that what is being negotiated is, ultimately, to be "a whole international system—satellites, ground stations, the works," that membership in it will consist of "buying into the club, purchasing stocks," and that eventually some "international management team will run the thing."

For the moment, however, all con-

cerned stress that the U.S. is to be the dominant power, both in terms of investment in the new invention and in its control and management. These conditions mean that the Europeans' role in the partnership will be limited to cold cash, on the one hand, and acquiescence on the other—and they have somewhat dampened European enthusiasm for a single system. What the Europeans want is a managing role in the project—not only in ownership, but in the design of the system, in its day-to-day operation, and especially in some of the hardware contracts that, for a long time, will be the only feature of the satellite system that will produce any money. COMSAT's view is that while such an arrangement would be satisfactory in the long run, in the short run the U.S. has pretty much of a monopoly on technical expertise in the field. Sharing full responsibility with the Europeans now would, as a COMSAT official put it, "put something of a drag on our operations."

The Europeans, however, are not without some bargaining points of their own. Although no continental European country singly could launch a competing satellite communications system, there is some reason to think that the Common Market countries together could manage it in fairly short order. In Britain, which probably could do it alone, there has been talk of a consortium of communications companies organizing a satellite venture. In addition, it is no secret that the motive behind the U.S. campaign is American prestige, not necessity, for new developments in cable technology could put off the need for communications satellites for a good many years to come. This knowledge gives the Europeans the secure feeling that the U.S. needs them, for once, more than they need the U.S., and they are shrewd enough diplomats to exploit their advantage. In the end, the Europeans will probably decide to go along with the U.S., not from a sense of cold war fellowship, but because they have plenty of other prestige items to spend their money on, and because, in the long run, competing regional satellite systems would probably not be as profitable for anybody as a single worldwide system, realistically and equitably divvied up. In the meantime, in their negotiations with COMSAT, the Europeans will see to it that neither their sense of importance nor their economic self-interest is neglected.

The coming of the satellite age is particularly painful to England, the cable communications center of the large parts of the Middle East, Asia, and Africa around which, in the old days, the British ruled the waves. You cannot, for example, call from New Delhi to Cairo without going through London, or even from New Delhi to Karachi. You cannot call even from East to West Pakistan except by way of London—a matter of some distress to the Pakistanis, who have expressed great interest in remedying the situation via satellite. The British, however, with so few remnants of their colonial heyday to comfort them, are understandably reluctant to be displaced in this respect too, and have begun making a great fuss about cables. A new Commonwealth cables, linking Britain, Canada, Australia and New Zealand as well as other points in the Pacific was put in operation on 2 December with the fanfare usually reserved for events of greater novelty; the Queen herself presided. The British are also making clear their interest in the new high-capacity transistorized cables being developed by A.T.&T., stressing the "old ways are best" attitude that characterizes so much of their political life. So far the British have been immune to the lures of COMSAT, and they are trying to influence other European nations to hold out as well.

A.T.&T.—The Giant's Role

Intimately linked with the question of the international future of COMSAT is the question of its relationship with A.T.&T., a subject of bitter debate in the U.S. liberals' attack on the COMSAT bill last year. Senate opponents led by Russell Long (D–La.) and the late Estes Kefauver, wanted to set up a satellite communications system which would compete with existing means of transoceanic communications (specifically, the cables operated by A.T.&T.), arguing that only such competition could keep prices to the consumer down. The form in which the corporation was finally authorized insured neither competition nor cooperation. Congress permitted the communications carriers together to own 50 percent of the stock, but it added the proviso that no company could vote for more than three of the corporation's 15 directors, theoretically insuring that even if A.T.&T. bought all the stock open to a single carrier, it would still not dominate the company. COMSAT was specifically designed, as one congressman later put it, "to keep A.T.&T. in its place."

Whether or not this goal was thoroughly realized, enough was accomplished to leave relations between A.T.&T. and COMSAT in a somewhat unsettled state. The fact of the matter is, at least from COMSAT's viewpoint, that you cannot both keep A.T.&T.—the world's largest corporation—"in its place" and run a successful satellite communications system. If A.T.&T., which controls virtually all of the overseas phone calls originating in this country, does not choose to send them abroad via satellite but prefers to continue using its own cables, again—as in so many other contingencies—the volume of business for COMSAT would stand no chance of reaching profitable levels. COMSAT has no choice but to make the system as attractive as possible to the carriers.

For A.T.&T., however, the mandate is not so simple. In the cable world, A.T.&T. is king. It not only makes the cables and installs them but negotiates with foreign governments deals for their operation which customarily include at least 60 percent of the profits for A.T.&T. It aso sets the rates to domestic users for their calls, virtually unimpeded by the FCC, which has never held a rate hearing on the company's foreign charges. In the satellite system its role, and its proportion of revenue, would be far less. In addition, the company's recent development of transistorized cables with high capacity has the potential of absorbing, at least for about a decade, all the anticipated growth in international communications without recourse to satellites.

Concern over the possibility that new cable developments would diminish the role of COMSAT has prompted much discussion among communications companies on how to insure that the satellite venture, which all felt was crucial to U.S. prestige whether or not it was economically viable, could be rescued from the threat. No decision was reached, however, and much of the zest went out of the discussion 2 weeks ago with an announcement by A.T.&T. vice-president John Dingman that A.T.&T. would slow up its plans to lay the new cables across the Atlantic if COMSAT, in 1964, could make an explicit commitment that the same number of circuits, equally reliable, would be made available via satellite sometime in 1966 or 1967.

A.T.&T. gave, as reasons for its gesture, the "value in diversity of communications" and the belief that the satellites would allow even more room

for expansion than the new cables. The new cables handle 720 channels, and while the satellites are expected to start off with around 270, within 5 years they would have about 1400, and they could also transmit television, which cables cannot. The unstated reason for the A.T.&T. move, however, was the company's wish to demonstrate the solidarity of U.S. business in facing the threat of recalcitrance from abroad. The A.T.&T. decision is expected to take a good deal of the steam from British resistance to satellites, since the British argument was predicated, in part, on the availability of the new A.T&T. cables. In any event, the move was a real break for COMSAT and seems to resolve the competition-versus-cooperation question in the direction of cooperation—which is pretty much what everyone expected all along, despite the entertainment value of a bit of suspense.

Though fresh from victory with A.T.&T., COMSAT was set back a bit this week with the Pentagon's announcement, after a year of delay, that it planned to construct its own system of communications satellites—another cut into the government business COMSAT had hoped to be able to count on. Discussions are going on, however, in the hope that COMSAT can persuade the Pentagon that its secret messages will be safe on channels leased from the corporation. It is probable that the Pentagon will build its own system, however, and that because it has its own form of diplomatic immunity from the laws of economics, it will still turn its routine communications over to the commercial corporation.

In sum, though optimism is plentiful, a hard road lies ahead and the future of the Communications Satellite Corporation is far from settled.

This is the conclusion of a two-part series on COMSAT.—ELINOR LANGER

Announcements

Walter Sullivan, science news editor of the New York *Times*, and **Dean E. Wooldridge**, former president of Thompson Ramo Wooldridge, now a research associate at California Institute of Technology, will receive the 1963 AAAS-Westinghouse Science Writing Awards, and $1000 honorariums.

Sullivan, who received honorable mention in the 1962 competition, won this year's newspaper writing award for three stories: on a Soviet project for boring into the earth's crust; on an echo device which has disclosed what may be the original crust of the earth; and on the possibility that island chains may have been formed from single volcanoes.

Wooldridge won the magazine writing prize for his article, "Man's Mysterious Memory Machine," a description of research on memory processes, which appeared in the June 1963 issue of *Harper's* magazine. This is the second successive year that an article appearing in *Harper's* has won the award.

Honorable mention for newspaper stories will go to Ian Menzies, science editor of the *Boston Globe*, and Jerry Lochbaum, science writer on the *San Antonio News and Express*. For magazine articles, George Boehm, an associate editor at *Fortune*, and Albert Rosenfeld, science editor of *Life*, received honorable mention.

The awards were established in 1946, in cooperation with the Westinghouse Educational Foundation, in a move to help improve the quality of science writing for laymen and to stimulate public interest and understanding of scientific topics.

Grants, Fellowships, and Awards

The Boris A. Bakhmeteff fellowship in **fluid mechanics** is available for the 1964–65 academic year. Applicants must be full-time graduate students, working toward the master's or doctor's degree. The recipient will carry out an original research project, at the institution of his choice; the stipend is $3600. Deadline for applications: *15 February*. (W. Allen, School of Engineering and Architecture, City College of New York, New York 31)

The Atomic Energy Commission is offering fellowships for work leading to a doctoral degree in **health physics**. The fellowships last for 1 year, but are renewable for 2 more years. Applicants must be U.S. citizens, preferably under 32 years of age; they must be working in the health physics field, and have had at least 2 years' experience, aside from training. The stipends are $4000 a year, plus $500 for each dependent, and travel allowance to the university, tuition, and fees. Recipients must have security clearance from the AEC before starting fellowship work. Application deadline: *1 February*. (Fellowship Office, Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn.)

Meeting Notes

The **Health Physics** Society is accepting abstracts of papers to be presented at its ninth annual meeting, scheduled 14–18 June in Cincinnati, Ohio. Topics to be discussed include environmental monitoring, radiation physics and biology, instrumentation and dosimetry, radium and thorium, man-made radionuclides, radioanalyses, and environmental cycling of radionuclides, and bioassay. Deadline for receipt of abstracts: *1 February*. (C. P. Straub, Taft Sanitary Engineering Center, Cincinnati 26, Ohio)

The 15th annual mid-America symposium on **spectroscopy** is scheduled for 2–5 June in Chicago. The call for papers has been issued for the following areas: emission, flame, magnetic absorption; nuclear magnetic resonance; ultraviolet, visible, and x-ray spectroscopy; gas chromatography; infrared and raman. Deadline for titles and abstracts: *14 February*. (E. N. Davis, Sinclair Research, Inc., 400 E. Sibley Blvd., Harvey, Ill.)

The call for papers has been issued for the 16th conference of the Southwestern Institute of **Electrical and Electronics Engineers**, 22–24 April, in Dallas, Texas. Emphasis of the meeting will be on technical areas of interest to both power and communications engineers. Abstracts of approximately 200 words are required. Deadline: *1 February*. (F. E. Brooks, Jr., LTV Military Electronics Division, P.O. Box 6118, Dallas, Texas 75222)

Papers are invited for presentation at the sixth international symposium on **global communications**, 2–4 June in Philadelphia, Pa. The meeting will emphasize the relationships between computers and communication networks. Abstracts of 35 words and summaries of 300 to 500 words are required in triplicate. Deadline: *28 February*. (R. Guenther, RCA Communications Systems Div., Bldg. 1-3-1, Camden, N.J. 08102)

Courses

Applications are being accepted for a summer institute in **anthropology**, scheduled 22 June to 14 August at the University of Oregon, Eugene. Participation is limited to 30 junior college and college teachers; preference will be