aid bill might be killed and the vocational education bill substantially delayed by the rise of the church-state issue.

Mrs. Green at one point said regretfully she felt college aid was dead. Representative Albert Quie (R–Minn.) was somewhat less pessimistic but observed, "If the higher education bill is killed this time, it's had it. The states and the universities better find ways to finance expansion because the federal government won't be able to do it in time."

Quie was referring to the population wave, which projections show will double enrollment in colleges and universities in this decade. Visions in Congress of these potential throngs in search of classroom space were among the factors impelling the legislators to find a way to resolve the differences over what had become an education-legislation package deal.

Strong pressure was also coming from "impacted" public school districts. The federal program actually expired last June, and many districts were literally counting their federal money and spending it before it was hatched. More than 300 congressional districts are affected by the impacted areas legislation, so the pressures were considerable.

The NDEA is also a broadly popular act, affecting both schools and institutions of higher education. The act would have run out next June, and failure to extend it in the next few weeks would have seriously impeded planning for next year and prevented the award of fellowships in March, the normal time.

The provision extending the NDEA, incidentally, also embodies two major changes. Federal funds available for undergraduate loans are increased from $90 million a year to $125 million for this year and $135 million for the next fiscal year. And the ceiling on loan funds for individual institutions is raised from $250,000 to $800,000.

President Kennedy's death obviously gave strong impetus to efforts to reconcile the House and Senate bills. Kennedy had, from the beginning of his administration, spoken eloquently and urged action in behalf of a number of federal programs benefitting education. With the single exception of the medical education facilities bill earlier this year, however, Congress had given him no major new education bills.

The college aid and vocational education bills are in a genuine sense posthumous Kennedy bills, although there is little question that some timely telephone calls by President Johnson, in the critical days when the conferees appeared to be deadlocking again, expedited matters.

A compromise proposal on the allocation formula in the vocational education bill by House Education and Labor Committee chairman Adam Clayton Powell on 9 December seems to have set the stage for the final truce and treaty.

House conferees accepted the equalization principle, but instead of the poorest state getting payments of three times as much per person as the richest state, with the other states ranged between, the ratio was compromised at 3 to 2.

The bill authorizes $1.6 billion over the next 4 years in addition to vocational education measures which now cost about $57 million a year. Most important, perhaps, the new bill provides new programs and a more flexible approach to problems in vocational education (*Science*, 14 June).

One thing that the recent action on education did not settle is the church-state issue. A fairly strong effort, spearheaded by Senator Samuel J. Ervin (D–N.C.), was made in the Senate to attach amendments to the college aid bill (i) to deny grants and loans to educational institutions operated by religious denominations, and (ii) to enable any taxpayer to file a suit for judicial review of the constitutionality of any proposed grant or loan.

In the final debate on the college aid bill, Morse headed off a test on a judicial review clause with the explanation that hearings were coming up on a judicial review bill in the House Judiciary Committee and that he and Senator Joseph Clark (D–Pa.) and others were sponsoring a similar measure, which the Senate Judiciary Committee, on which Ervin serves, can take up.

The judicial review question, therefore, could be the next major embroilment for Congress in the area of education legislation. There remains, however, a disinclination in Congress to concede defeat on the problem by so baldly passing the buck to the courts. And among the strongest partisans on both sides of the church-state issue there seems to be a reluctance to force a decision, akin to that of two small boys in an argument who hesitate to press the issue to a showdown because each one feels he might lose.

—JOHN WALSH

## COMSAT: Private Satellite Firm Working Out Ties with Government; Basic Decisions Are Still Open

Not surprisingly, the man who turned out to be one of the most far-sighted participants in the 1962 debate on communications satellites was the vice-president of Western Union, who predicted that if a private satellite company were to be established, "for an appreciable period of time it would sit on its hands." In the 11 months since its official incorporation last February, the Communications Satellite Corporation has not been exactly sitting on its hands, but it has been dealing with a host of backroom problems and organizational decisions of a very preliminary nature, and it is only now beginning to seek out the precise technical information on which the construction of its satellite system will rest.

The reasons for the slowness are not hard to discover. Trying to get a commercial satellite communications system going, one of COMSAT's incorporators told a congressional committee last spring, is like "being required to put in operation a world-wide airline the day that the Wright brothers invented their airplane." The experimental work in satellites done by the military and space agencies, and private industry, since 1958—the Advent, Telstar, Relay, and Syncom satellites—is a start, but only a start, in the direction of a commercially viable system. From the experimental work, it is known that a network of satellites, as reliable as undersea cables but accessible to all parts of the earth, capable of transmitting television as well as voice and telegraphic messages, and greatly increasing the number of channels open for simultaneous communication, is technically feasible. What is not known is how it can best be done and how the political and economic readjustments its existence will bring about can best be accommodated. Accordingly, the basic decisions facing COMSAT—how the corporation itself ought to be organized, what kind of satellite system to use, the relationship of the corporation to the U.S. government and to foreign governments—are all, within certain limits, still open.

The limits, for the most part, are the basic requirements laid down by Congress, which legislated COMSAT into existence in August 1962 as the U.S. participant in, and international mastermind of, a global satellite network. Both the nature of its job and the

anxieties of congressional liberals about a "give away" of space to big business ensured that COMSAT, though a private outfit, would be uniquely intwined with the government. NASA, the Federal Communications Commission, the Department of State, and the President himself are each charged with overseeing various aspects of the corporation's progress. COMSAT needs the government's support if it is to get on with its work; and the government, now heavily committed to a demonstration of what free enterprise and American technology can do in space communications, needs a successful COMSAT—and also needs to keep an eye out, lest the potentially free-wheeling operations of a profit-minded company upset some delicate balances of both foreign and domestic policy. A large part of the job this year has been to work out appropriate relationships.

### Preliminary Maneuvering

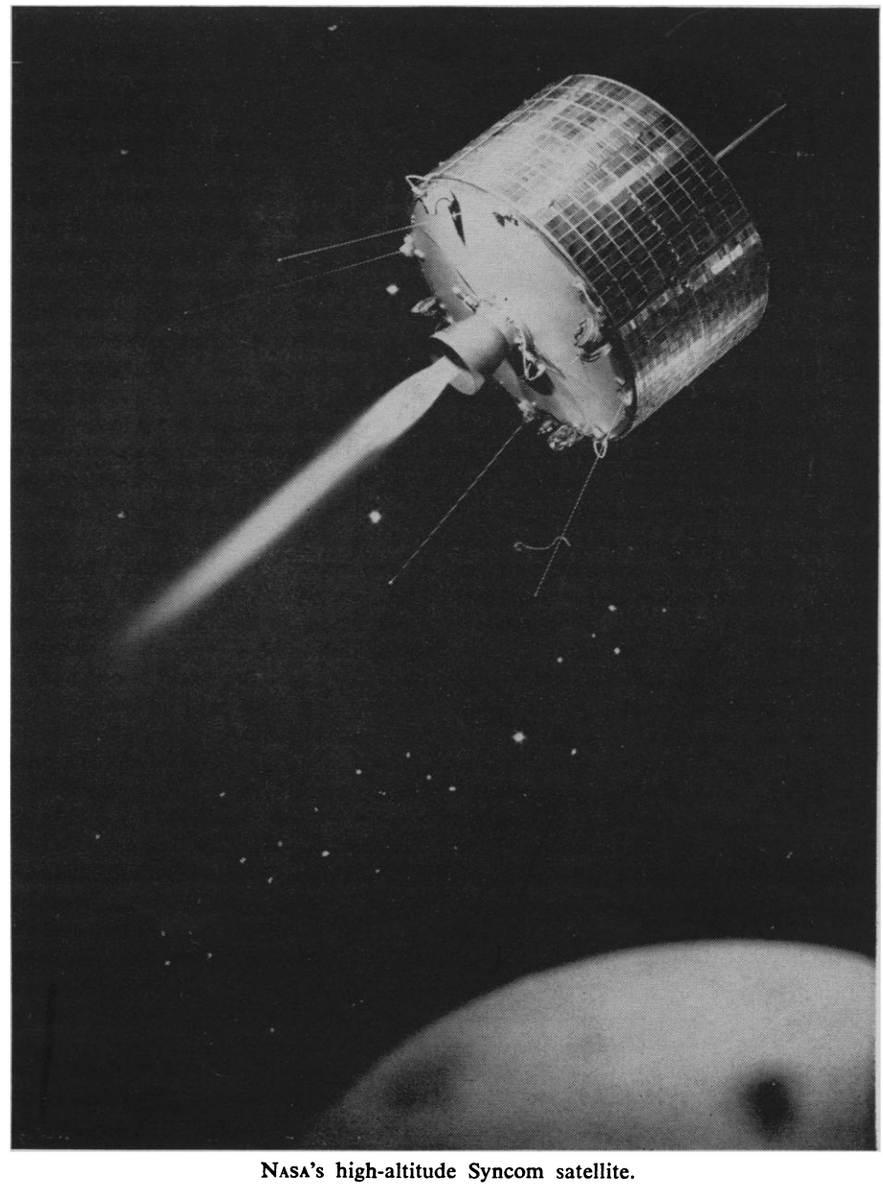
COMSAT, at the moment, consists of the 14 incorporators appointed by President Kennedy and confirmed by the Senate, and a small technical and legal staff of about 40 people. The corporation lives on borrowed money (about $1.5 million so far, drawn from a $5 million line of credit authorized by the FCC) at an elegant, though incongruous, rented Washington estate, the former home of U.S. Ambassador to Moscow Joseph E. Davies. Between its complex links with the government and the ad hoc quality of the corporation itself, COMSAT has acquired a rather diffuse structure of power. Dealing with it is reminiscent of dealing with the first foreign cars imported here: you are never too sure where the motor is.

The chief executive officer and chairman of the board is Leo D. Welch, former chairman of Standard Oil of New Jersey. Joseph Charyk, a former undersecretary of the Air Force and chief scientist of Ford's space subsidiary, Aeronutronics Systems, Inc., is COMSAT's president. The job of the directors and of their small vanguard is to guide the corporation in making the initial technical and economic decisions that will satisfy its requirements for a sale of stock and turn COMSAT into a business in a more conventional sense.

COMSAT's delay in offering stock has created a certain amount of tension in its relationship with the FCC, the independent agency which regulates all U.S. communications companies. According to the law 50 per cent of the stock will be held by the public and 50 percent by the communications carriers. Each sector will then elect six directors, and three more, representing the government, will be appointed by the President. The corporation, afraid that, until the basic technical decisions are made and the stockholders know what they're getting, a stock offering would be highly risky, has held off. But the FCC fears that the interim directors are making decisions that should be left to a representative board, elected by the stockholders.

After an exchange of letters late last summer in which COMSAT's Welch charged FCC chairman E. William Henry with an "invasion of the managerial functions of the corporation," an agreement was reached which in effect okays what the corporation had in mind all along but which is diplomatically described by both sides as a compromise. Plans now call for stock to be issued sometime "early in 1964," after the corporation has a clearer idea of the technical alternatives but presumably before the final decisions have been made. According to this timetable, proposals on satellite designs will be solicited from industry within the next few months, with construction contracts awarded in the fall of 1964 and the first satellite launchings sometime in late 1966 or 1967. The job can be done, Welch has estimated, for about $200 million. The company is also thinking about launching preliminary vehicles, outside the basic system, which might be put into commercial operation much earlier.

COMSAT officials are sensitive to hints that their high salaries (Welch and Charyk make $125,000 and $80,000 a year, respectively) are in any way con-



NASA's high-altitude Syncom satellite.

nected with their more leisurely view of the stock issue, but this too is a matter of concern to the FCC, which is supervising the company's interim financing. The company and FCC have also collided lately on FCC's proposal to insure, as it is charged with doing, competition in the procurement of satellite hardware down to the supervision of contracts in the amount of $2500. COMSAT called this an "unprecedented exercise of regulatory interference with normal procurement procedure." Together with some allies among the communications carriers who have managed to escape this type of FCC regulation over the years, the company is trying to get FCC to raise the levels at which such supervision begins. What may turn out to be the principal issue between COMSAT and the FCC, and what was a major item of liberal concern at the time the corporation was established—the regulation of rates charged by the company to its users—is still in the future.

### The Technical Choices

The basic choice facing the directors is that between a system of low- or intermediate-altitude, random-orbit satellites, such as Telstar or Relay, and a high-altitude synchronous satellite such as Syncom, or a combination. Both are active repeater systems, and both are thought to have their pros and cons.

In the medium-altitude system, as many as 40 satellites might be needed to provide continuous world-wide communication, and because it is harder to track moving satellites, the network of ground stations would be more complex. Five or six satellites, however, can be launched simultaneously, the satellites are less complex and not as likely to break down, and a single breakdown would not cut off as much of the world as breakdown in a high-altitude system. The medium-altitude system is thought to be cheaper.

The synchronous satellites hover 22,300 miles above the earth, circling it in 24 hours and thus appearing to remain stationery. If it can be learned how to keep these satellites in a fixed position, only three satellites will be needed to cover the entire earth. With synchronous satellites, however, while ground stations are somewhat simplified, the cost of failure would be immense. Only one can be launched at a time, and very delicate guidance is required to place it in precisely the right position. Because of this and the complexity of the parts, replacement would be more costly and difficult.

An additional problem with the synchronous system is that, because of its height, there would be a time delay of 0.6 second in all two-way voice communication. A.T.&T. has already suggested that such a delay might be unacceptable to consumers. Since A.T.&T. controls over 90 percent of the telephone service originating in this country, since it is unlikely to invest in a system which it feels has major flaws (especially when the satellite system may be replacing the cables on which it presently has a monopoly), and since COMSAT's future depends heavily on A.T.&T. cooperation, the corporation was inclined to take A.T.&T.'s opinion to heart. At the moment, however, COMSAT, in conjunction with NASA, FCC, and A.T.&T., is devising "real life" tests, to see if the delay really does disturb the consumers. Recenty, A.T.&T.'s alarm was seconded by a technical committee of the International Telecommunications Union, which announced that the time delay would virtually rule out the use of synchronous satellites for voice transmission. Welch, speaking for the corporation, has denounced this evaluation as premature. But, as in the case of A.T.&T., should the system established prove unacceptable to the Europeans, COMSAT would be in trouble.

Below the top decisions about the nature of the system are a host of problems involved in making the transition from the experimental to the commercial stage. Only five communications satellites have been placed in orbit (one Relay, two Telstars, and two Syncoms), and in all of them, things other than durability and comprehensiveness—the two most important factors from a commercial point of view—were the prime objects of investigation. No communications satellite has operated for any longer.

The result is that there are a lot of technical details about satellites still unknown. From COMSAT's viewpoint, one of the most important is how to keep satellite antennas pointed at the earth instead of radiating energy into outer space. Solving that problem, Welch estimated recently, would "make a difference of 500% in the number of channels brought into use." Another problem is perfecting components to assure a lifetime of at least 2 years, because, as Welch has pointed out, "replacement is expensive, with satellites at about $1 million apiece and because of the high cost of boosters." A related effort is that of developing rockets that can place several satellites in orbit simultaneously, thus reducing launching costs. COMSAT has initiated a variety of studies on these and other problems; any one of them could have an immense impact on its future.

### COMSAT and NASA

The existence of COMSAT has had an unsettling effect on NASA's work in space communications. One of the many residual effects of the original debate over establishing a private company was that this year, at appropriations time, Congress began to ask why the taxpayers, who have already given COMSAT the basic technology on which its profits will rest, should continue funding the refinements. When he died, Senator Kefauver was leading an attack on the "giveaway." He was joined, significantly, by John Pastore (D–R.I.), who shepherded the original bill through the Senate on behalf of the Kennedy administration, and by several others who initially supported the arrangement. COMSAT officials point out that so-called "giveaway" works both ways, since the corporation is studying things NASA doesn't know, as well as the other way around.

NASA will get its money for communications satellites this year (about $42 million), but there is no assurance the practice will continue. And the agency is specifically prohibited from carrying out any research that would exclusively benefit COMSAT, except on a reimbursable basis—the same basis on which, when the time comes, the space agency will launch COMSAT's satellites. In Congress the feeling is growing that it's time COMSAT started standing on its own feet; for their part, NASA officials wonder how they will be able to provide the corporation with sensible technical advice, as charged by law, if deprived of their own in-house capabilities; and COMSAT officials know perfectly well that without NASA, they would be lost.

In the last analysis, however, all of the American partners in the venture are likely to fall into line because of a mutual desire not to preside over an American debacle. The Communications Satellite Corporation will probably succeed or fail not on the basis of its domestic problems but on whether it can persuade the rest of the world, especially the Europeans, to go along with the kind of world-wide system it has in mind. A future article will report on the delicate international negotiations that lie ahead.—ELINOR LANGER