sibility that the Russians will have another change of mood, and that therefore we ought to be very patient and continue talking as long as the Russians are willing to talk. He cited the case of the Austrian peace treaty of 1955, where, after extremely protracted and discouraging negotiations, the Russians quite suddenly changed their mood and a treaty acceptable to both sides was quickly worked out.

But on this point committee members from both parties raised the point that whereas on the Austrian treaty we had nothing to lose by talking indefinitely, on this matter there are substantial risks involved in continuing the talks indefinitely if that means we are going to continue the present unpoliced moratorium on testing indefinitely. "My heart goes out to the President," said Senator Pastore of Rhode Island. "This is a terrible decision he has to make. But he has the responsibility, and he is going to have to make a decision."

Committee Attitude

The Joint Committee has, for a long time, taken a dim view of the possibility of agreeing on a satisfactory treaty, and last year's hearings were intended to publicize the committee's concern over the immense technical problems of designing a satisfactory control mechanism. But the Administration has apparently convinced the committee that its draft treaty was a reasonable balancing of the risks involved in continuing the ban, and until recently committee members from both parties had avoided making public statements over their misgivings. At the hearings, chairman Chet Holifield, of California, revealed publicly for the first time that the committee had agreed to go along with the Administration and recommend to Congress changes in the Atomic Energy Act which would allow the Administration to let the Russians inspect the devices to be used in the proposed detection tests, in order to assure themselves that we were not conducting clandestine weapon tests ourselves. This involved no real concession, since the Russians could learn nothing they did not already know from the devices, but Holifield pointed out that this was nevertheless a politically awkward thing for the committee to do, since there were bound to be charges that we were giving away atomic secrets to Russia, while we would not show the devices to our own allies. Holifield's point, of course, was that despite the committee's misgivings, they were not only prepared to support the Administration but even to stick their necks out to cooperate on a delicate political issue. Now, despite the committee's reluctant cooperation, things have gone from bad to worse, and the committee clearly expected the President to make his tough decision and either to resume testing or to supply the committee with a convincing new argument over why we should not.

Within the Administration, though, there was no rush to resume testing. For one thing, world opinion appears to have become sympathetic to the American view on the issue for the first time, and a good part of this change in mood has stemmed from the elaborate display of patience the West has shown since the talks reopened in March. The result was that the American White Paper on the dispute issued in June, culminating in a reminder to the Russians that the U.S. could not allow the current unpoliced moratorium to continue indefinitely, impressed much of the world as an unavoidable response to Russian recalcitrance rather than an attempt to find an excuse to resume testing.

Under the treaty the West has proposed, at least 2 years would pass after the ratification of the treaty before the control system would be ready for operation. The Administration, and the Joint Committee for that matter, presumably must have been convinced, then, that the risks in continuing an uninspected ban for two more years would not necessarily be unacceptable. One thing that would make these risks acceptable, of course, would be a signed treaty, but even under present circumstances there are good, though perhaps not compelling, reasons for taking some risk to avoid a prompt resumption of testing: for example, to avoid any impression of eagerness to take such a serious step, and, at the present moment, to avoid confusing the world about our motives in instituting a defense build-up to meet the Berlin crisis by taking almost simultaneously another tension-provoking step that has no connection with the immediate crisis. Thus, the general mood in Washington is one of great pessimism over the course of the Geneva negotiations, but despite congressional restiveness, this mood is not accompanied by an expectation that an announcement to promptly resume testing is likely.———H.M.

News Notes

Solid and Liquid Propellants

Astronaut Virgil Grissom's recent suborbital ride in space took only 15 minutes, but 2 days of additional preparation were required when his flight was postponed because of poor weather. Weather alone might have held up the flight only a few hours. It was the use of liquid fuel to propel the Redstone launch vehicle that forced the extended delay.

The Redstone uses liquid oxygen, which boils at −185° C. It is difficult to maintain this low temperature in the Redstone rocket, in which insulation is limited because of weight. A slight rise in temperature of only a few degrees above the boiling point is considered hazardous and also means loss of fuel from evaporation. Such a temperature rise may be reached 7 to 8 hours after the rocket is fueled.

The Redstone rocket was fueled 2 to 3 hours before scheduled take-off, allowing a maximum delay of 5 hours. When the delay went beyond 5 hours, it was necessary to remove the liquid oxygen and to begin a tedious 2-day procedure of washing, drying, and checking the rocket engine for contamination before refueling. Even a speck of dirt may clog a valve.

Such procedures are costly in time, money, manpower, and material and have prompted criticism of the continued emphasis on liquid fuels in the national space effort. But such criticism fails to take into account the important advantages afforded by liquid-fuel engines that, at the present stage of the art, far outweigh the penalties imposed. Liquid fuels are more powerful and permit better guidance and control.

The power of a booster is measured by its specific impulse—the number of pounds of thrust released by each pound of burning fuel per second. Liquid fuels presently available have a specific impulse as high as 430; most solid fuels operate with a specific impulse of 235 to 240. A solid fuel with a potential of 290 is still under development.

Guidance and control can be maintained in a liquid-fuel system by the complex of pumps and valves that makes it possible to limit the flow of fuel into the combustion chamber and, if desired, to cut it off entirely. Such control is important in getting a vehicle

through the atmosphere, where winds may affect a planned route and may require a change in rate of acceleration. In solid-fuel boosters the rate of acceleration is fixed. Some measure of control may be provided by segmenting the solid fuel with inert material which will cut off energy at predetermined intervals, and by a device that will reignite the rocket on command from the ground.

The major advantages of solid-fuel boosters are ease in handling, low cost, and reliability, because of their comparatively simple design and construction. They are self-contained and can be held indefinitely on a launching pad without hazard. A launch vehicle using solid-fuel boosters can be reloaded and rechecked in a matter of minutes. There is no evaporation of costly fuel; and, since there is no need for valves, pumps, and other moving parts, solid-fuel engines can be produced at about one-third the cost of their liquid-fuel counterparts.

Most nations now developing launch vehicles for space research (among them Japan, Great Britain, Australia, and Israel) have turned to solid fuel because of these advantages, particularly that of low cost. There is reason to believe that the U.S.S.R. has not neglected this technology.

Canada has developed a family of three solid-fuel research rockets capable of carrying scientific payloads of up to 250 pounds to altitudes of 600 miles. She is currently trying to interest the National Aeronautics and Space Administration and the U.S. Department of Defense in the all-solid-fuel two-stage systems, as part of a bilateral defense and research-sharing program. The Department of Defense already has an extensive family of highly reliable solid-fuel boosters, including the Minuteman, the Cajun, and the Polaris. NASA has developed the Scout, a four-stage solid-fuel engine capable of putting a 150- to 250-pound payload into orbit at 300 miles altitude or a 50-pound payload into orbit at up to 8400 miles altitude.

In the United States, several companies, some independently and some with government sponsorship, are working to develop large, solid-propellant rocket engines. This fall United Technology Corporation plans to test-fire a solid-fuel engine of half a million pounds thrust. Last July the same company successfully fired a two-stage solid-fuel booster with a thrust of 250,000 pounds. It was developed independently at a cost of $5.5 million. Four firms now are seeking government contracts to produce solid propellants for the third stage of the Nova space rocket, which is being designed for NASA and the Air Force for the primary purpose of landing a man on the moon. Although still on the drawing board, plans are to use a cluster of eight liquid-fuel F-1 engines, of 1.5 million pounds thrust each, for the first stage. Hopes are that the Nova will be operational by 1970.

Work is now under way on the Saturn C-1 vehicle, a three-stage liquid-propellant rocket of 1.5 million pounds thrust. It is scheduled to be operational in 1964 and will be able to put 7-ton payloads in orbit. Proponents of solid-fuel engines claim that a concentrated research and development program, with government support, would yield by 1964 a booster with a thrust in excess of 2 million pounds. The present Administration has allotted $50 million for research in large solid-fuel engines to the Air Force, which now has the main responsibility for developing large boosters.

If large solid-fuel boosters with a specific impulse comparable to that now available with liquid fuel can be developed, the ideal launch vehicle for heavy payloads and deep excursions into space could be built. This vehicle would combine the reliability and economy of solid-fuel boosters, in the first stage, with the ease of control attainable with liquid-fuel engines, in the upper stages.

Atomic Attack: Alert, and Shelter

In his speech on Berlin, President Kennedy said those not hit by a nearby nuclear blast "can still be saved—if they can be warned to take shelter and if that shelter is available." Within 24 hours thereafter, the following government action was taken to provide the necessary warning and shelter. The Administration asked Congress for $10 million to put into operation a National Emergency Alarm Repeater (NEAR) buzzer system which will furnish each home, office, and factory with a direct alarm for any impending attack or disaster. The Department of Defense outlined plans to set up completely stocked fallout shelters in basements and hallways of existing large office, industrial, and apartment buildings at a cost of $169 million. The Federal Housing Authority ruled that family fallout shelters may be built under FHA home improvement loans up to $10,000 at an interest rate not to exceed 6 percent, to be financed over a 20-year period.

According to Civil Defense officials, NEAR would make it possible to alert the entire nation within one minute after a signal from the Air Defense Command. The system is housed in a small black box that can be plugged into any 110-volt circuit. Through the local power company, it will sound a loud buzzer for 50 seconds, with a 10-second pause between signals, by superimposing a 240-cycle signal on the regular 60-cycle current until the danger has passed. The buzzer is intended to alert listeners to turn on the radio to Conelrad frequency—640 or 1240 kilocycles—for civil defense information. The $10 million requested by the Administration is intended for special equipment for the utility companies to produce and send out the 240-cycle signal. The black box device, developed by General Motors after 5 years of research, will sell at a retail price of $5 to $10.

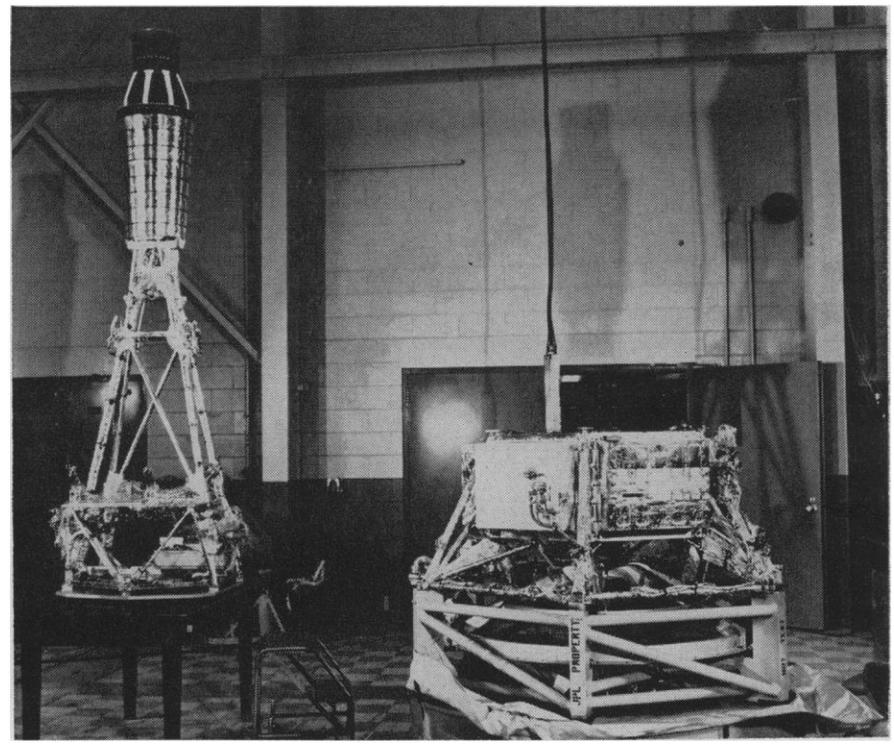
Government plans for fallout shelters do not include any for single-family dwellings. The first shelters probably will be set up in government buildings and will be stocked with radiation-measuring equipment, first-aid kits, sanitary supplies, and tools for clearing debris, in addition to a 5-day supply of food and a 2-week water supply.

Only a relatively few private-family fallout shelters have been built in the United States, but interest has greatly increased since the Berlin crisis, a Civilian Defense official said. Prior to the new ruling, loans for shelters were limited to $3500, repayable over 5 years, at interest rates over 9 percent. Under the old program, only 235 loans for fallout shelters have been approved by the FHA, all in the Great Plains states, where the shelters have been useful for protection against the recurrent threat of tornadoes. To qualify for FHA loans, the shelters must satisfy building specifications set up by the Office of Civilian Defense Mobilization as well as pass FHA inspection. Fallout shelters qualify for loans under home improvement because, as the official FHA announcement stated, such facilities improve the basic livability of a home.

Step to the Moon

The successful launch of the Ranger space craft this week, which may put it into orbit around the sun, is a major step forward in the National Aeronautics and Space Administration program for exploring the moon. The trajectory planned for the test flight should place Ranger in an elliptical earth orbit as far as 500,000 miles and as close as 37,500 miles before it returns, in about 50 to 100 days, to burn up in the earth's atmosphere; but it is possible that the launching rockets may speed Ranger to an earth-escape velocity that will place it in orbit around the sun.

The launch was designed to test the vehicle NASA hopes may be the forerunner of space craft capable of landing instruments on the moon, and the mechanics of a parking orbit, in which a second-stage rocket is used as a mobile launching platform in space. The parking-orbit technique was devised to correct the navigation problems imposed, in shots aimed at the moon, by the location of the Atlantic Missile Range. The Ranger probe also will test a basic hexagon-shaped space "bus" (see cut), which will carry as many as eight scientific projects on Ranger missions. The bus and its equipment are standard and can be adapted to many studies. Electronic equipment in the bus carried by Ranger I will telemeter back to earth data on the nature and activity of cosmic rays, magnetic fields, radiation and dust particles in space, and other phenomena believed to result from variations in solar activity.



Basic hexagon space bus, at right, carried by the first Ranger satellite. Both hexagon and Ranger, at left, were developed by the Jet Propulsion Laboratory operated by the California Institute of Technology for NASA. [National Aeronautics and Space Administration]

The domestic art of hand quilting is being used in the construction of the $29-million **Zero Gradient Synchrotron** (ZGS), a 12.5 billion electron volt "atom smasher" at Argonne National Laboratory, which will be able to produce all known subatomic particles believed to form the basis of matter. An atomic-age seamstress, using an ordinary needle and cotton thread, will spend about six months stitching and quilting 25 to 70 layers of chemically treated Fiberglas, cut in patterns, to line the 16 transition chambers. Two hundred yards are required for each of the chambers, which serve as links to the magnet-encompassed vacuum, the heart of the synchrotron, where the particles will be accelerated and studied for reactions. The Fiberglas quilting reinforces the vacuum.

When completed, the ZGS will produce greater numbers of accelerated subatomic particles than any other multibillion-volt atom smasher now in operation or under construction.

Brookhaven's **Alternating Gradient Synchrotron** accelerated a beam of protons to an energy of 33 billion electron volts in its first full series of basic physics experiments last week, in which it ran at full power for three consecutive days. This is the highest energy achieved by any accelerator.

The AGS will have to shut down for several weeks while thousands of tons of shielding are moved, equipment is realigned, and special beam separators are installed for the next research project. Each series of experiments may require different configurations, so the accelerator facility has been built to permit changes. An overhead crane and tracks in the floor facilitate the heavy moving job.

Nearly as powerful as the AGS is the 25-Bev synchrotron operated by CERN, the European nuclear research agency near Geneva. The Russians have a 10-Bev machine at Dubna, near Moscow, and have announced plans for constructing a 50-Bev accelerator near Leningrad. Other large atom smashers are the 6-Bev Bevatron at the University of California, Berkeley, the 4-Bev Cosmotron in Saclay, France, and the 3-Bev Cosmotron at Brookhaven in Upton, Long Island, New York.

The **National Science Foundation budget** will be up 60 percent in the current fiscal year. Eisenhower had recommended a $34-million increase over last year's $175 million. Kennedy's budget revision recommended another $65 million. Representative Thomas's (D-Tex.) House appropriations subcommittee recommended its customary 10-percent cut; the Senate appropriations committee made its customary recommendation restoring almost everything that Thomas had cut. The Senate passed its version of the bill this week. A conference will compromise the difference, leaving the NSF with about 5 percent less than the Administration has recommended but, at around $263 million, still $87 million above last year's budget.

The U.S. has given $350,000 to Greece for its **atoms-for-peace** program to help pay for the recently completed 1-thermal-megawatt pool-type research reactor at the Democritis nuclear research center near Athens.

The reactor achieved criticality last month. Ten other nations have received such U.S. aid. They are Austria, Brazil, the Republic of China, Denmark, West Germany, Italy, Japan, Spain, Venezuela, and Norway.

Last month the **United Arab Republic** also **produced a nuclear reaction** in its reactor of 2000-kilowatt power, built near Cairo with the help of the U.S.S.R. Selah Hedayet, director of the UAR's atomic energy commission, in announcing the reactor's operation, said it will be used for peaceful purposes.

AT&T and NASA have signed a contract permitting the telephone company to sponsor the launching of two experimental **communications satellites**. The space agency will launch the satellites for AT&T. AT&T will pay for both the satellite and the launching, and will allow NASA royalty-free use of any patents developed out of the experiment. NASA itself hopes to launch about ten experimental "relay" satellites, similar to AT&T's. RCA, AT&T, and five other firms had bid for the NASA contract. NASA chose the RCA approach, after which AT&T, apparently convinced its version was superior, asked to be allowed to put up its version at its own expense.

Earlier last week the Federal Communications Commission, which regulates privately owned communications systems, asked the consortium of private companies that has been invited to work on a satellite proposal to come up with a detailed proposal, including such things as the amounts of money they are prepared to invest, "as soon as possible, but in any event no later than 13 October."

An Air Force plan to shoot a cloud of **350 million inch-long metal needles** into a 2000-mile orbit to serve as a passive communication system has alarmed astronomers, who fear the needle belt may obscure optical and audio observations in space. The needles, thinner than a human hair, would serve as miniature antennas to reflect radio signals from earth. Optical astronomers fear the needle cloud might obscure stellar observation by astronomical satellites. Radio astronomers are concerned that it might interfere in radio signals from stars. As a result of protests, the matter has been referred to the National Space Council for study and a policy statement.

Announcements

The nation's first statutory **interstate nuclear agreement** became effective in June when Florida became the seventh state to ratify the agreement, the minimum number required to bring the compact into effect and create the Southern Interstate Nuclear Board. The present members are Florida, Arkansas, Kentucky, Louisiana, Tennessee, Texas, and South Carolina. The compact offers the means whereby the southern states may "concert their energies and talents, both public and private, in developing the atom for optimum peaceful applications in industry, agriculture, medicine, and research." The Regional Advisory Council on Nuclear Energy (RACNE), established in 1956 as the "first nonfederal, publicly supported, interstate nuclear-energy organization in the nation," will continue to serve the nine remaining southern states until they ratify the compact and become members. RACNE will then go out of existence.

Starting in September, NBC-TV's 6:30 A.M. "Continental Classroom" will present a two-semester graduate course on the structure and function of **American government**, taught by Peter H. Odegard of the University of California. At 6 A.M. each week day NBC will repeat the 1960–61 course in **contemporary mathematics**, taught by Frederick Mosteller of Harvard University and John L. Kelley of the University of California.

A formal educational program in **scientific hydrology** will begin next fall at the University of Arizona. The program, reported to be the first of its scope in the United States, will lead to the B.A., M.A., and Ph.D. degrees in this field. (Department of Geology, University of Arizona, Tucson)

A Soviet study on various phases of research in **processing scientific information** reveals that some Russian scientists spend "nearly half their working hours trying to keep abreast of the latest developments in their field." The report, published by the Soviet Academy of Sciences' Institute of Scientific Information, also cites a number of American studies on the subject. The Russian analysis of the reading habits of Soviet chemists coincides in certain respects with the conclusions reached by a 1960 study, sponsored by the National Science Foundation, of the same problem as it affects American chemists and physicists [*Science* **133**, 2019 (23 June 1961)]. (Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. Order No. 61-31465, $1.50)

Information of scientific or political interest on the **Antarctic** is being sought by Science Communication, Inc., in connection with a survey sponsored by the National Science Foundation's Office of Antarctic Programs. The information may be in the form of published reports, diaries, unpublished scientific data, expedition log books and other documents, telemeter tapes, or biological and geological specimens or artifacts. (Antarctic Information Project, Science Communication, Inc., 1079 Wisconsin Ave., NW, Washington 7, D.C.)

The Atomic Energy Commission has published a summary of **atmospheric radioactivity and fallout research** in progress at 36 institutions in the United States. (Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. $0.75)

Anecdotal material, letters, and other manuscripts which would be helpful in preparing a **biography of Albert Deutsch**, a journalist specializing in psychiatric research who died in June, are being solicited by the newly formed Albert Deutsch Memorial Foundation. The foundation plans, also, to publish a memorial volume of Deutsch's writings and to establish an annual journalists' award. (Deutsch Memorial Foundation, Room 1130, Dupont Circle Bldg., Washington 6)

Results of a recent survey on **current trends in scientific research** have been compiled by the United Nations Educational, Scientific and Cultural Organization. (UNESCO Publications Center, 801 3rd Ave., New York 22, $6.75)

Publication of a new paperback **Science Editions series**, for students and general readers, will be jointly sponsored by John Wiley and Sons and Basic Books. The first ten volumes, priced from $1.45 to $2.45, are scheduled to appear in September. (Belfour McMillan, Science Editions, 440 Park Ave. South, New York 16)