What are the chances of getting a reprint if you are interested? The chances are good if you are a manager, but if you are a scientist you must be patient. *Harvard Business Review* makes available reprints of any article in an issue for $1, but the entire issue costs only $2. *Chemical and Engineering News*, in its issue of 23 May 1960, announced the availability of reprints at a cost of 40 cents a copy; the complete issue costs 50 cents. *Dunn's Review* offers reprints for 20 or 30 cents a copy; the full issue costs 75 cents. These journals are not scientific, but their example points to a possible trend. Publishers of scientific journals may be able to utilize some of the new printing methods to bring reprint costs more in line with economic reality.

It should be possible to set up, in the near future, a procedure whereby one can either subscribe to scientific journals on a yearly basis or purchase single articles at a unit price. Such a system would give scientists greater opportunity to select reading material on the basis of subject and would provide greater return for publishers. It would also make the new scanning tools more valuable by increasing the availability of items discovered in them. A meeting of publishers, librarians, and scientists should be called to consider this next step, so necessary for improved scientific communication.

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Science and the News

The Test Ban Hearings: Congress Presses for Kennedy's Decision

The Joint Committee on Atomic Energy held three days of hearings on the problem of detecting underground nuclear tests, which added nothing to hopes of reaching a solution of the problem. As happened in a similar set of hearings last year (*Science* 29 Apr. 1960), the testimony was dominated by evidence that even if the control system embodied in the draft treaty presented by the U.S. and the British were put into effect, it would not guarantee that there would be more than a modest possibility that any given violation would be detected and exposed. There seems to be no serious dispute on this point among the scientists who have worked on the problem. Neither of the two scientists who produced the greatest impact at last year's hearing appeared this time. At the earlier hearing Hans Bethe, of Cornell, argued vigorously in favor of going ahead with a treaty; Edward Teller, of the Livermore weapons laboratory, argued equally vigorously against the treaty. But the two men were in general agreement on the technical points involved, with Bethe, in effect, agreeing with Teller that the proposed control system could not, by itself, assure that a violation would be detected. The disagreement between the two men stemmed from broader considerations of national policy affecting the wisdom of striving for an agreement rather than from a dispute over the technical adequacy of the control system.

These broader considerations included such things as the value to the Russians (and hence the temptation) to attempt clandestine testing, and the importance of test-ban agreement as a step towards broader disarmament agreements.

This year's hearings drew less public attention, partly because both Teller and Bethe declined invitations to appear again, on the grounds that they were not closely familiar with the research that has been conducted since the earlier hearings. The essential point of the testimony of those who did appear was that as yet no major technical breakthrough had been made that would greatly simplify the problem of detecting tests.

On the political side, Arthur Dean, the chief American negotiator at Geneva, appeared at the closing session to outline what presumably is the Administration position. He reviewed the dismal course of the negotiations since they resumed last March. He said we were still prepared to sign the draft treaty we had offered, and that despite the technical testimony on the adequacy of the control mechanism, both British and American scientific advisers agreed that it would provide "reasonably adequate" controls, presumably when supplemented by intelligence from outside the technical system which would help decide which unidentified events should be investigated. Dean described how, after the Russian scientists had agreed on the need for a research program, including nuclear explosions, the Russian political leaders, after the summit collapse last spring, had overruled their scientific advisers and decided that the research program was not necessary after all; how the Russians had, since March, not only failed to offer any counterconcessions to the concessions included in the Western draft treaty on the number of inspections and other matters, but had backed down on agreements already reached, most notably through their new insistence on a veto over the administration of the control mechanism.

Dean, nevertheless, argued that the talks should continue, and that Project Vela, the Defense Department's detection research program, should be pushed. Dean stressed, as he has in private briefings with reporters in recent weeks, that there is always a pos-

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