varying magnetic fields are inserted into the plasma at each end of the copper cylinder. Figure 3, *b* and *c*, shows the magnetic field detected by each of these coils as an Alfvén wave is propagated down the cylinder. The Alfvén wave velocity can be obtained from the observed transit time and the distance between the two coils. The measured velocity has been compared with that obtained from the formula $V = B/(4\pi\rho)^{\frac{1}{2}}$ by using the known magnetic field B and the spectroscopically measured plasma density ρ.

This experiment and the theory agree within the experimental uncertainty of a few percent. For fields of about 14,000 gauss these waves travel at a velocity of about 4×10^7 centimeters per second and therefore take about 2.5 microseconds to travel through the tube. The formula predicts that the wave velocity will be a linear function of magnetic field, and this is observed experimentally, as shown in Fig. 4. The attenuation of the Alfvén wave can be obtained by comparing the amplitudes of the wave at the two different coil positions. The tube is essentially a coaxial wave guide in which the plasma is the dielectric. In a solid dielectric energy is stored by displacing atomic or molecular bonds, whereas this plasma dielectric stores energy in the form of kinetic energy of rotation of the plasma itself. The characteristic impedance of this hydromagnetic wave guide can be predicted and is in close agreement with the experimental ratio of the voltage and current at the driving electrode. The wave-guide aspect of the experiments may find engineering application, as in a hydromagnetic resonator.

At the far end of the tube the plasma density goes to zero in a distance that is short as compared with the wavelength. Therefore, waves should reflect from this abrupt discontinuity. This behavior is observed experimentally, and the reflected waves have the theoretically predicted phase changes. It is also possible to fill the tube half full of plasma, as shown in Fig. 5. An Alfvén wave propagating in the plasma should reflect off this boundary, and a reflected wave is indeed observed experimentally. This laboratory situation is somewhat similar to the conditions at the lower boundary of the ionosphere. The plasma density of the ionosphere goes to zero in a distance that is short as compared with the wavelength, so that much of the wave should be reflected back into the ionosphere. As mentioned earlier, however, in the ionosphere some of the energy is propagated past the boundary by ordinary electromagnetic radiation.

Summary

We have described a set of laboratory experiments which establish the primary properties of Alfvén waves and have mentioned natural phenomena in which these waves exert a strong influence. To date, there have been few technological applications of Alfvén waves, although the waves are being considered for use in hydromagnetic amplifiers and in connection with plasma heating techniques associated with controlled thermonuclear fusion devices. As with any new findings, detailed prediction of future applications is impossible.

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News and Comment

Test Ban: U.S.S.R., G.O.P. Concur in Opposition to Administration's Newly Presented Proposal

The United States' new test-ban position was outlined last week in Geneva and was promptly termed unacceptable by the Russians and the Republicans. The two reactions constitute a bitter dose for the Administration, which has sought to keep its disarmament efforts above political suspicion at home while seeking an arms control formula that would meet Soviet objections without impairing American security. Toward this dual goal, it has staffed the top levels of its disarmament effort with people whose political image was considered every bit as important as their professional competence. For example, Administration officials are quick to point out that a Republican, William C. Foster, was made head of the Arms Control and Disarmament Agency, and Arthur Dean, another Republican, is the chief disarmament negotiator. With the home front supposedly secured against attacks from the right, the Administration, including the President himself, has devoted a great deal of its energies to the 20th-century version of alchemy, the quest for arms-control plans that can transmute East-West hostility into at least a live-and-let-live state of affairs. The first reactions to these efforts have been aroused by the test-ban proposal, and the Administration does not find them at all encouraging.

Valerian A. Zorin, the Soviet negotiator, said the U.S. proposal was "only a tactical maneuver"; Governor Rockefeller, in the liberal wing of the Republican Party, concluded that the Kennedy Administration was "weakening" the U.S. disarmament stand and moving "steadily toward the Soviet position"; and his party colleague, Senate Minority Leader Dirksen, who is generally situated over to the right, said the Administration had gone to Geneva "hat in hand."

The rejection by the Soviets, while disappointing, was at least up to par, but the Republican reaction introduced a new element into the East-West bargaining process. Heretofore, the U.S. negotiating positions, though subject to public criticism, had been considered outside the bounds of party attack. It is not clear whether the Rockefeller-Dirksen response constituted a pair of uncoordinated potshots or a calculated decision to declare the disarmament negotiations fair game for the fall elections. In either case, the incident has had a chilling effect on the Administration, casting up specters of a "soft on communism" campaign to plague it at home while it tries to entice the Soviets from truculence and rigidity at the bargaining table.

Despite the fanfare attending the new U.S. position, the Administration contends that nothing substantive has been conceded to the Soviets; that, in effect, the U.S. has not changed its stand on the amount of information it considers necessary to make certain that the Soviets are not conducting secret underground tests. The details, however, have not yet been made public.

Project Vela

On the basis of improved seismic techniques, developed, the Defense Department says, at a cost of $75 million under Project Vela, the U.S. is willing to reduce its earlier demands for a 180-station seismic network around the world; it would also cut down its demand for 12 to 20 on-site inspections each year in the Soviet Union. The extent of these reductions has not been officially disclosed, but it has been reported that this may be more than 50 percent. The U.S. would also be willing to have Soviet personnel man the stations inside the Soviet Union "under international supervision"; no details have yet been provided on what such supervision would consist of. But on the crucial issue of non-Soviet inspectors going into the Soviet Union to investigate suspicious earth disturbances, the U.S. has not changed its position at all. The position still rests on the principle that someone other than the Soviets will ultimately have to check on whether the Soviets are living up to a test-ban agreement. The Soviets contend that they can be trusted in the dual role of suspect and policeman, and they equate outside inspection with espionage. There the matter rests, very much as it has throughout nearly 4 years of negotiations.

While the Republican reaction is no source of cheer for the Administration, the Soviets' steadfast intransigence is also creating gloom by dispelling some cheery notions about the possibility of arriving at an agreement. A number of the Administration's disarmament advisers came to their jobs with the belief that past failure to work out the techniques of a disarmament agreement were a principal barrier to arriving at an agreement. Soviet agressiveness was not forgotten in taking this approach; nevertheless, something of a fetish has developed about devising the right scheme for implementing a disarmament agreement. For example, before becoming the President's science adviser, Jerome Wiesner wrote, in the *Daedalus* arms control issue, that "to succeed, arms-control measures must be of such a nature that their implementation gives participants a feeling of greater security, not less, and they should also be of such a character that they promote mutual understanding and trust. The problem confronting us is to design a comprehensive arms-control system which commences with low-risk measures that can be carried out in the atmosphere of suspicion and fear, but which clearly leads to the ultimate objectives. Thus, by having clear-cut and desirable goals, it may be possible to gain acceptance of the initial steps."

The considerable amount of manpower now being devoted to the development of disarmament plans possibly reflects the fact that plans can be drawn at will, while the underlying East-West hostility that creates the market for such plans is not susceptible to easy change.

One source of the gloom felt by the Administration is that the Geneva talks have not taken a new turn despite what is probably the most carefully prepared U.S. attempt at a technical approach to an East-West détente. The Arms Control and Disarmament Agency is under criticism inside and outside the Administration for what is considered to be a fairly unimaginative and snail-like approach to the vast research problems involved in working up proposals, but in comparison with past sessions at the negotiating table, the U.S. delegation is better prepared and is able to offer what the West considers more enticing proposals than ever before. The results, however, have not been at all encouraging.

Zorin flatly rejected the new test-ban proposal even before the U.S. negotiator, Arthur Dean, had an opportunity to spell out its details. The Soviet representative followed this by rejecting as "unacceptable" the ingenious and carefully devised zonal inspection system that seems to reconcile the Soviet call for disarmament with the Soviet insistence that its military forces remain secure from surprise attack while a disarmament agreement is in the process of being carried out. Under the plan, each nation would be divided into a number of zones and it would be agreed that armament in each zone would not exceed a given level. Each country would then have the option of picking any zone in the other for inspection to make certain that the agreement was being observed. The plan would thus provide for limited but possibly continuous arms reduction and inspection without the Soviets having to lift their veil of secrecy in one move. The motivation for developing the plan was the assumption that the Soviets were insisting on the destruction of weapons before inspection could take place because they feared the United States might deliver a sneak blow once it learned the location of Soviet missile forces. It was believed that the plan would appeal to the Soviets since, in its early stages, it would permit them to retain secrecy concerning the bulk of their missile forces while going ahead with partial disclosure and limitation.

Zorin's rejection of the plan was reported to have been considerably less emphatic than his rejection of the new test-ban proposal, but the grounds for optimism still appear to be very slight. He pointed out that by inspecting one zone, a great deal of information could be obtained about a nation's defense establishment. Furthermore, he said, there is no assurance that inspection could determine with certainty that armaments were actually no higher than the agreed-upon level. The issue thus comes back to the question of good faith and motivation for an arms agreement, elements for which inspection techniques are not likely to be adequate substitutes.

Although the Geneva meeting is not showing signs of producing an East-West arms agreement, it is doing well by the United States in propaganda dividends. The Soviets for a long time dominated the propaganda scene by demanding "complete and general dis-

armament" whenever the United States offered a piecemeal proposal. "Complete and general disarmament" has now become the official policy of the Kennedy Administration, and any step en route can be justified in terms of the ultimate goal. One of these steps is the newly proposed test-ban agreement, which, happily for the United States, conforms to the terms of a memorandum offered last spring by the eight non-aligned nations at the disarmament talks. A key point in the memorandum —the authority of international inspectors to conduct on-site investigations— is subject to varying interpretations, since it was phrased to avoid offending East or West: (". . . the party on whose territory [an unexplained seismic] event had occurred should consult with the commission as to what further measures of clarification, including verification in loco, would facilitate the assessment"). But the memorandum reflects the view that outside inspectors have a role to play in the enforcement of a test ban, thus putting the U.S. in a good position to claim that it is responsive to the neutral proposal.

The strenuous efforts that have been devoted to devising a mutually acceptable test ban have imbued the goal with a Holy Grail quality, and little thought has been devoted to the unpleasant possibility that, after all, a test ban might not be very important in the broad context of East-West relations. The immediate benefit would be the elimination of fallout-producing tests by the United States and Russia, but at this late stage in the arms race it is not certain what other benefits might result. It is said that the existence of a Soviet-American test-ban agreement would constitute a moral force against the development of nuclear weapons by other nations, but it does not seem likely that France would feel compelled to end its nuclear weapons development program simply because the United States and Russia had called off testing; nor does it seem likely that Communist China would be willing to drop out of the race. The very existence of a test ban might be a symptom of better relations between the two major nuclear powers, and thus it could be valuable as a first step toward more significant agreements, but it should be kept in mind that a test ban might reflect nothing more than the conclusion, East and West, that further testing is not a military necessity at this point in the arms race. A test ban itself would not forestall further weapons development or refinement—such work could still go on in the laboratory, as it did prior to the Soviet resumption of testing last fall. Nor would the long sought after test ban affect existing stocks of weapons. In view of the inability of East and West to come to any sort of arms control agreement, a test ban, in relative terms, would be a major achievement, especially if it involved a Soviet willingness to open its territory to foreign inspectors. But the volume of energy that has been devoted to arriving at a ban has obscured the considerable possibility that, once achieved, a test ban might actually mean very little in relation to the vast range of differences that separate the two nations.

Soviet Motives

Attempts to divine Soviet motives on the issue of a test ban lead to a variety of conclusions, all of which should be viewed against the fact that no one outside the Kremlin can claim any grounds for certainly. (A useful preparatory exercise for those who seek to read the Soviet mind would be to analyze the various American test-ban positions over the past few years; along the lengthy and contentious route, evidence can be found that at various points the U.S. government had very mixed views about the desirability of achieving a test ban.)

The evidence at present indicates that the Kennedy Administration is overwhelmingly dedicated to working out a test ban. The Soviet interests in this area can only be a matter of speculation, but it is widely felt that Khrushchev shares Kennedy's concern about the hazards implicit in the arms race and is interested in steps, such as a test ban, that would help to reduce East-West tension. Working against this interest, however, is the determination of both sides not to be second in the arms race. Khrushchev has said that since the U.S. tested first, the Soviet Union reserves the right to test last. Kennedy has said that if it is determined that the new Soviet test series produced important advances, the United States would not deny itself the opportunity to regain ground. With the Republicans suspiciously looking over Kennedy's shoulder and the Soviets showing no inclination to soften their opposition to foreign inspection, the prospects for a test ban—whatever its worth—appear fairly dim.—D. S. GREENBERG

Announcements

A **Commission on Drug Safety** has been established by the Pharmaceutical Manufacturers Association to improve the detection of toxic effects in drugs. The PMA, comprising most of the nation's major drug manufacturers, set up the commission after disclosure that the drug thalidomide has caused malformation in infants.

Members of the group are:

Lowell T. Coggeshall, chairman; vice president of the University of Chicago.

Paul Cannon, pathologist and editor of the American Medical Association's *Archives of Pathology*.

Thomas Francis, Jr., chairman of the department of epidemiology at the University of Michigan Medical School.

Philip S. Hench, Nobel prize laureate currently with the Mayo Clinic.

Hugh Hussey, dean of the Georgetown University School of Medicine.

Chester S. Keefer, director of Boston University, the Massachusetts Memorial Hospitals Medical Center, and a member of the National Research Council's executive committee.

John Litchfield, director of Lederle Laboratories' experimental therapeutic research section, Pearl River, N.Y.

Maurice R. Nance, medical director of Smith, Kline and French Laboratories, Philadelphia.

Leonard Scheele, senior vice president of Warner-Lambert Pharmaceutical Company, Morris Plains, N.J.

Leon H. Schmidt, research professor in biochemistry at the University of Cincinnati College of Medicine.

Austin Smith, president of the Pharmaceutical Manufacturers Association, editor of all American Medical Association publications, and executive editor of the *World Medical Journal*.

Theodore Klumpp, president and director of the Winthrop Laboratories, New York.

Thomas B. Turner, dean of the medical faculty at Johns Hopkins School of Medicine.

Josef Warkany, fellow of the Children's Hospital Research Foundation, Cincinnati.

The Air Force Cambridge Research Laboratories plans to establish facilities for investigating the **neural structure of mammals**—primarily rats. A Linc computer, now being assembled at AFCRL, will be used to process electrical signals from the mammals'