in their ecological associations. The safe application of both of these precepts still remains the central theme of the Atomic Energy Commission policy. These precepts are: with high-level radioactive wastes, concentrate and contain; with low- and intermediate-level radioactive wastes, dilute and disperse to nature."

"Additional significant differences from more orthodox industrial wastes are the long half-lives and the damaging properties to human tissues of certain of the materials produced. The supervision and control of some of these wastes, therefore, must be viewed, not from the standpoint of temporary expediency, but from the necessity of guaranteed supervision and control, in some instances for hundreds of years. It is obvious that such a contingency, arising from this novel industry, places a major responsibility upon and challenge to all the public and private agencies dealing with the problem.

"The protection of the public health and of the total natural resources of this and of every country entails a greater depth of continuing responsibility than for any other industrial waste hitherto confronting society."

"Various estimates have been made of high-level wastes which will result from future nuclear power generation, based on estimates of the extent of such future nuclear power production, fuel irradiation levels, and unit volumes of waste per unit of fuel processed. Without attempting the role of a prophet, and on the assumption that nuclear power generating capacity may attain in 1980 something of the order of 1.1×10^5 megawatts of heat, the accumulated waste volume in gallons will be of the order of 10^8. The total fission product activity in curies will then be approximately 10^{11}."

"All of these figures simply demonstrate that the industry will be confronted increasingly with a waste-disposal and management problem, which one is unlikely to escape in the present state of the art. Although a great deal of attention is now being paid to this problem, to many industrialists the problem of waste disposal appears to be nonexistent. The reason for this happy state of mind lies in the fact that under present procedures the Atomic Energy Commission holds itself responsible for the handling of these most difficult materials."

Prospects for the Future

"The technical feasibility of direct disposal of high-level wastes into specific geologic formations is sufficiently clear to drive one toward at least limited application of such a procedure, either in salt domes or salt beds, in deep, isolated basins, in shale formations or even in porous formations. It would certainly be inadvisable to move to these presumed solutions to the problem without far more extensive exploration and pilot-plant application than are yet at hand. The engineering and economic issues involved are still in the very preliminary stages."

"The disposal of high-level wastes in the ocean has had much discussion. It is not unfair to conclude in the present state of understanding of the ocean that such a procedure is unlikely to be sanctioned for some years to come. So many unknowns and unpredictables with respect to oceanic behavior still remain that management and government will be driven to the safer practice of keeping high-level radioactive materials under more obvious scrutiny and control than would be provided by most ocean disposal procedures.

"Sufficient has already been said in this presentation to make clear that the rapid development of the atomic energy industry is in no small measure contingent upon more prompt and more complete answers to the waste-disposal problem. If the situation is somewhat pessimistic, it is only because sufficient energies have not yet been expended in developing economic and safe improvements in waste handling and disposal processes. Progress in this field is unlikely to occur if the problems are not realistically confronted. It is a tribute to the Atomic Energy Commission operations that so many *ad hoc* solutions have been provided which have safeguarded the public during the last 10 to 15 years."

"Much thought will be required in the foreseeable immediate future as to the best way of continuing long-term responsibility for disposal of radioactive materials. It is not inevitable that in this responsibility government will always have to play a dominant role, except in a supervisory capacity. Industry must increasingly assume responsibility for the physical operation of waste-disposal plants under the criteria to be established promptly by government. The selection of sites for nuclear energy facilities is closely related to waste-handling and -disposal operations. The recognition of this close relationship is not yet dramatically obvious to many individuals concerned with the development of this industry."

Science in the U.S.S.R.

The Soviet Union continues to play a leading role in science, although occasionally the government's actions in the field are puzzling. One piece of impressive news is the confirmation of the recent report that there is activity on the moon.

Lunar Eruption

Last fall Nikolai A. Kozyrev of the Crimean Astrophysical Observatory at Partinzanskoye announced that he had seen what he believed to be a lunar volcanic eruption. But Western scientists were skeptical. The moon has long been considered a dead body, both biologically and volcanically, and in the 350 years that astronomers have been making telescopic studies, there has been no real evidence to the contrary.

Now Kozyrev has published an account of his observations, accompanied by supporting spectrograms, in the February issue of *Sky and Telescope,* a journal edited at Harvard College Observatory in Cambridge, Mass. According to the editors of the journal, which is not an official organ of the observatory, Kozyrev's findings "seem incontrovertible." The paper was translated for publication by Luigi G. Jacchia, an observatory staff member.

Kozyrev saw the lunar activity while watching a crater known as Alphonsus. His interest in Alphonsus had been stirred by some photographs taken by an American astronomer, Dinsmore Alter, which had suggested the presence of a gas cloud covering the floor of the crater.

On 3 November at about 8 P.M., Kozyrev noticed that the 4300-foot peak in the center of Alphonsus had become blurred and taken on "an unusual reddish hue.' He thought this was caused by a change in the earth's atmosphere, and after making a spectrogram, he swung his 50-inch reflector telescope away. At 10 P.M. he returned to Alphonsus and made a 30-minute exposure. This time the central peak was extraordinarily bright and white, but as he looked through the eyepiece he noticed a marked drop in the brightness, and the peak resumed its normal appearance. He then halted the exposure and made a third one. The first spectrogram, when developed, proved to be normal; the second showed the bright light characteristic of an incandescent cloud containing carbon, such as is typical in volcanic eruptions on earth. This light ended abruptly in the spectrogram and was absent in the last exposure. In his article Kozyrev says:

"It is possible that the observations [of volcanic activity] just described will be unique for some time to come. But the existence today of internal energy and the possibility of orogenic [mountain-building] processes on the moon seem to have been established.

"The coincidence of the observed phenomenon with the position of the central peak can hardly have been accidental, and may indicate that the basic relief of the moon originated from within rather

than from the impact of giant meteorites. The low heat conductivity of the lunar surface layers may result from the porous character of volcanic material rather than from a dust layer."

Statements by two leading astronomers appeared in the *New York Times*. Donald H. Menzel, director of the Harvard College Observatory, accepts the evidence of the lunar activity but is not persuaded that it is volcanic in origin. He commented that Kozyrev has provided the first definite indication of the existence of a lunar atmosphere composed of rarefied gases. He explained further that leakage of gases from the interior of the moon could be the method for replenishing such an atmosphere.

Lloyd Motz, associate professor of astronomy at Columbia University, also accepts the basic finding that there is activity on the moon, but he, too, doubts the volcanic nature of the eruption. He pointed out that the moon may have very much more uranium than the earth, if it consists of rock structure all the way down. In that case, the radioactivity of the uranium below the surface would produce a temperature gradient, which, in turn, might lead to the ejection of hot materials in volcano-like activity. However, Motz feels that while some surface features of the moon may be the result of internal energy, most of them are the result of the impact of meteorites.

10-Bev Accelerator

Another significant development in Soviet scientific news is the announcement of the successful operation of a synchrophasatron that is the most powerful in the world. The new facility, located at the Joint Institute for Nuclear Research at Dubna, 80 miles north of Moscow, can accelerate protons from the hydrogen atom to an energy of 10 billion electron volts. This is a much higher energy than that generated by the similar installation at Berkeley, Calif., which has achieved a peak of 6.3 billion electron volts.

During a press tour of the Dubna center on 23 January, visitors also saw a new, two-story-high synchrocyclotron that accelerates protons and neutrons to an energy of 680 million electron volts. In addition, they had an opportunity to talk with Bruno Pontecorvo, the Italian-born nuclear physicist who left Britain's research center at Harwell in 1952 to go to the U.S.S.R. He told reporters that Soviet science, because of the social system in the U.S.S.R., was more advanced than that of the West.

Lysenko Reinstated

If Kozyrev's work and the new accelerators are demonstrations of the effect of the Soviet social system, so, too, is the third recent event in Soviet science—the reinstatement of geneticist Trofim D. Lysenko to a pre-eminent position in his country's biology. Lysenko, who was a powerful figure in Soviet science under Stalin, holds that in some cases acquired characteristics can be passed on to future generations. His views are in sharp conflict with those of Western geneticists. In recent years Lysenko's influence appeared to have waned, and Soviet scientists who opposed him were able to voice their criticisms with impunity. Then last summer the tide seemed to turn, as evidenced by last-minute changes in the character of the U.S.S.R.'s participation in the International Congress of Genetics in Montreal. Just before the meeting was to open, cancellations were received from several scheduled speakers, and the Soviet delegation submitted further titles of papers to be delivered, so that the Soviet contributions to the meeting were predominantly from the controversial Lysenko school. As a result of the program changes, the Permanent International Committee on Genetics Congresses presented a resolution at the final plenary session of the Montreal congress that expressed concern and sympathy for "all scientists who may have been prevented from attending the Congress by their governments."

Recent events indicate that the International Committee's point was well taken. The opposition to Lysenko has centered in the Soviet *Botanical Journal*. Although it has been evident for some time that Lysenko had found a new supporter in Khrushchev, the journal has continued to publish papers that attack Lysenko's work. However, just before the Soviet Communist party's recent Central Committee meeting, the official government organ *Pravda* severely criticized the *Botanical Journal's* repeated exposures of Lysenko.

When the Central Committee met, Lysenko was allowed to address a session and criticize his detractors. In response, Khrushchev said that the editors of the *Botanical Journal* must be changed. A verbatim account of the committee's proceedings, as it appeared in the British publication, the *Manchester Guardian,* follows:

"Mustafaev [Azerbaijan party secretary]: The situation in biology is especially bad, as was shown in the *Pravda* article which referred to the incomprehensible behaviour of the *Botanical Journal* and of some of our scientists. Instead of criticising each other in a businesslike and scientific way and pointing out faults, the affair has taken on an insulting tone.

"Khrushchev: We must take a good look at the staff. Evidently people were selected for the editorship who are opposed to Michurinist science. While they remain nothing will change. They must be changed and others put in—real Michurinists. Here lies the basic solution to the question.

"Mustafaev: Nikita Sergeyevich, it is not only this journal that uses this tone. Sometimes scientists who are also party members give no thought to how they should conduct themselves. Not long ago unpleasant rumours reached me that our delegation in China, among whom there were some biologists, declared that Comrade Lysenko was finished now, not only in theory but also in fact.

"Khrushchev: It was Tsistin who said that. [Tsistin, a noted Soviet biologist, has been vice-chairman of the Academy of Agricultural Sciences and director of the Moscow Agricultural Exhibition.]

"Mustafaev: That's bad. If they have had personal relations, it still does not give anybody the right to deprecate the achievements of our science.

"Khrushchev: He should have been asked at a party meeting why he had spoken in this way, and he should have been made to answer in his capacity as a party member. [Cries of 'Hear! Hear!']"

On 20 January, Moscow radio reported that the *Botanical Journal's* editorial board had been dismissed and that the U.S.S.R. Academy of Science's Biological Department was to be "improved." V. N. Sukachev, an academician, was replaced as editor of the *Botanical Journal* by V. F. Kuprevich, president of the Byelo-Russian Academy of Sciences. Further, at a joint meeting of the Soviet Academy's Presidium and Biology Department, V. A. Engelhardt, secretary of the Biology Department, formally acknowledged that criticism of his department had been "correct."

Pathologic Effects of Radiation

The Committee on the Pathologic Effects of Atomic Radiation of the National Academy of Sciences–National Research Council has issued a commentary on the recent report of the United Nations Scientific Committee on the Effects of Atomic Radiation [*Science* **128**, 402 (22 Aug. 1958)]. An excerpt of the commentary follows.

"In those portions of the United Nations report that deal with pathologic effects there are several points on which we are not entirely in agreement and are constrained to make clear our position. These minor points should not cloud our general agreement with and admiration for the report of the United Nations Scientific Committee. We believe, however, that it would be useful to make the following particular comments:

"1) The question of induction of leukemia or other types of cancer in man by very small doses of radiation has been treated in the United Nations report to