Now the Bothe-Kolhörster experiments of about a year ago show that when the energies of the incident photons are sufficiently high the beta rays released by Compton encounters do indeed become abnormally penetrating so that it is to be expected that, for the cosmic rays produced by the formation of the heavier of the common elements like silicon and iron out of hydrogen, the observed absorption coefficients will be somewhat smaller than those computed from the energy available for their formation. This is precisely the behavior which our cosmic ray depth-ionization curve actually reveals. At the highest altitudes at which we have recently observed (14,000 feet) the helium rays have reached equilibrium with their secondaries, and the observed and computed coefficients agree as they should. For the oxygen rays the observed coefficient is a little lower than the computed value—about 17 per cent. lower—for the silicon rays still lower—about 30 per cent.—and for the iron rays considerably lower still—about 60 per cent.—all in beautiful qualitative agreement with the theoretical demands as outlined.

The foregoing results seem to point with much definiteness to the following conclusions:

1. That the cosmic rays have their origin, not in the stars, but rather in interstellar space.

2. That they are due to the building in the depths of space of the commoner heavy elements out of hydrogen which the spectroscopy of the heavens shows to be widely distributed through space. That helium and the common elements oxygen, nitrogen, carbon and even sulphur are also found between the stars is proved by Bowen's beautiful recent discovery that the "nebulium lines" arise from these very elements.

3. That these atom-building processes can not take place under the conditions of temperature and pressure existing in the sun and stars, the heats of these bodies having to be maintained presumably by the atom-annihilating process postulated by Jeans and Eddington as taking place there.

4. All this says nothing at all about the second law of thermodynamics or the "Wärme-Tod," but it does contain a bare suggestion that if atom formation out of hydrogen is taking place all through space as it seems to be doing, it may be that the hydrogen is somehow being replenished there too from the only form of energy that we know to be all the time leaking out from the stars to interstellar space, namely, radiant energy. This has been speculatively suggested many times before in order to allow the creator to be continually on his job. Here is perhaps a little bit of *experimental* finger-pointing in that direction. But it is not at all proved nor even perhaps necessarily suggested. If Sir James Jeans prefers to hold one view and I another on this question no one can say us nay. The one thing of which you may all be quite sure is that neither of us *knows* anything about it. But for the continuous building up of the common elements out of hydrogen in the depths of interstellar space the cosmic rays furnish excellent experimental evidence. I am not unaware of the difficulties of finding an altogether satisfactory kinetic picture of how these events take place, but acceptable and demonstrable facts do not, in this twentieth century, seem to be disposed to wait on suitable mechanical pictures. Indeed, has not modern physics thrown the purely mechanistic view of the universe root and branch out of its house?

SCIENTIFIC EVENTS

ANNUAL REPORT OF THE DIRECTOR OF THE U. S. GEOLOGICAL SURVEY

THE annual report recently issued by Dr. George Otis Smith, director of the U. S. Geological Survey, states that the fifty-first year of the U. S. Geological Survey has been the largest and broadest of its history in expenditure and in activities. The sum of more than four million dollars was expended in highly specialized service, yielding results much varied in type but alike in contributing to the industrial development of the country.

The Geological Survey has been most intimately connected with western development, and that development is far from completed. The strictly exploratory work of the survey is now in large measure confined to Alaska, but the more intensive phases of agricultural, industrial and mining development have barely begun in much of the western territory.

Some measure of the increasing activity of the survey is afforded in the statistical record of its fifty-first year. As compared with the previous year, the fiscal year 1930 shows increases of nearly 10 per cent. in total expenditures, nearly 20 per cent. in new maps issued, and nearly 30 per cent. in number of book publications. The personnel, of which more than 80 per cent. is professional in type, was larger than even in the years when the Bureau of Mines was a branch of the organization. Indeed, the appropriations this year exceeded by 50 per cent. those for 1910, the last year before the Bureau of Mines was separated from the Geological Survey, and the total expenditures in 1930, including cooperative funds, were more than

double those in 1910. This 20-year period since the separation of these two services especially directed to the promotion of the mining industry has been one of notable growth for both; yet because of the postwar economies their growth has not approached that of the industry they serve.

The discovery of geology by industry in recent years has placed the small corps of government scientists under new and larger obligations. The army of geologists and engineers in commercial work necessarily looks to the federal service for the collection of geologic facts and the working out of new generalizations and principles. High-pressure industrial development throughout the country has involved an increasing demand for raw materials, with a corresponding larger need for basic engineering information. The demand for intensive study of ore possibilities is most active in the same mining states—Colorado and Nevada—where the first mining work of the Geological Survey was done, the production of the epoch-making monographs on Leadville, Eureka and the Comstock, which had as their purpose to meet the anxious desires "of miners as well as of students of geology and economy."

Another phase of governmental activity hardly foreseen in the beginning is the degree to which the public domain is administered on a scientific basis. In the twenty years beginning in 1907 approximately a million dollars was spent for geologic work in areas in which the federal government owns coal lands. Upon this investment of appraising its property the government is now collecting between $400,000 and $500,000 a year in royalties from coal mined from government leases. The oil and gas leases have been still more productive, although the chief contribution of this service to the public interest has been the conservation of the natural resources belonging to the people. The enforcement of the best economic practices by the federal engineers is their contribution to the conservation of life and health, both the zinc and the coal mines under federal supervision showing better accident records than other mines in the same states.

THE NATIONAL PARK SERVICE

THE cooperation of the National Park Service in affording relief to local unemployment during the past season is outlined in detail by Horace M. Albright, director of the National Park Service.

Upon telegraphic receipt last spring from the Washington office of the signing of the 1930 appropriation act of the Interior Department, throughout the national park system action was immediately taken to get construction under way and to purchase equipment. The headquarters office kept in close touch with the field, making adjustments and transfers of funds where necessary to enable the park superintendents to carry on to the best advantage.

In addition to beginning construction and improvement work early in the season, these activities were carried on all summer under full steam and as late into the fall as weather conditions permit. Yosemite National Park, California, reports that it already has continued operations five weeks longer than last year, and proposes to continue until heavy snowfall shuts up the last activities. A few days ago it was reported that despite the heavy snows which necessitated shutdowns of work in the mountainous back country, 358 people were still on the pay roll. This is in addition to the highway construction being carried on under contract.

One of the highway jobs, that of building a tunnel through solid rock, will continue all winter, and the contractor in charge has agreed to take many men from the park forces as other work is suspended through climatic necessity.

In Carlsbad Caverns National Park work will continue all winter on the construction of an elevator shaft, 750 feet deep, and the installation of elevator equipment. Contracts will be awarded within a few days to enable work to commence at once.

At Hot Springs National Park award has just been made covering the construction of a complete hot-water system collecting all hot water from the springs, and also for the construction of concrete reservoirs, pumping station, pipe lines, etc. Much labor will be employed directly by the government.

Contracts will soon be let for the purchase of the pumping and electrical equipment. This project will cost approximately $140,000 and will materially improve the unemployment situation in the Hot Springs region during the period of greatest winter stress.

Work will also be continued during the winter in Wind Cave National Park, where a lighting system will be installed, and in the Mesa Verde, where a deep water well—probably 3,600 feet or more deep—will be drilled.

In Grand Canyon National Park, work will be in progress all winter on the reconstruction of the Bright Angel Trail. This trail is one of the long-remembered features of Grand Canyon by all those who either hike or ride mule-back into the depths of the canyon. It passes along ledges and through clefts in the solid rock walls. The new trail now being constructed will still be just as spectacular as the old one, but of sufficient width and ease of grade to afford perfect safety.

THE NIAGARA FRONTIER RESEARCH COUNCIL

THE Niagara Frontier Research Council has completed its organization to include investigators repre-