ASTRONOMY—GEOLOGY

Saturn-Like Ring May Have Caused Permian Glaciation

Wreckage of Hypothetical Second Moon, Shading Tropics, Could Have Produced Sufficient Cooling to Start Ice Sheets

SOME 200,000,000 years ago the earth had a second moon, which broke into pieces. These formed a ring around our planet, like that now around Saturn. This shaded the equatorial regions of earth, cooling them sufficiently to cause tropical glaciers, in which ice flowed toward the poles.

Such, in brief, is the theory proposed by Ronald L. Ives to explain the large areas of ice which, geologists have found, covered large areas in the tropics during the Permain period. This lasted for about 30,000,000 years, ending around 190,000,000 years ago. The Ives theory is explained in a paper in the July issue of the *Journal of the Franklin Institute*.

Four Ice Ages

Records have been found of four different ice ages, and three of them can be explained by a general cooling of the earth's surface. Such cooling has been caused, it is suggested, by increased volcanic activity, which threw large quantities of dust high into the atmosphere, where it screened the sun's rays from the earth as a whole. With world-wide temperatures reduced, the ice from the polar regions extended nearer to the tropics.

But evidence for glaciation in the Permian period has been found in and near the tropics, particularly India, central and South Africa, Australia and South America. There is also evidence that the ice at this time flowed away from the equator rather than toward it.

To explain this geological mystery, Mr. Ives proposes that earth once had a second moon, which he calls "Ephemeron." This, he thinks, was much smaller and nearer than the present moon, and revolved, approximately, over the equator. It may have been a minor planet, "captured" as it happened to approach the earth's gravitational field. Then, like the inner moon of Mars, it may have traveled around even faster than the planet revolved. Under these conditions, the same forces that cause tides would have pulled it nearer to earth.

Finally it would have come within about 12,000 miles, the "Roche limit;" it was so close that the tidal forces of the earth on Ephemeron would have shattered it into small pieces. These would continue to revolve around the earth, giving us a ring like that of Saturn's, which, it is supposed, had a similar origin. At last the ring would disintegrate. Continuing tidal action, as well as collisions of the pieces with each other, would gradually pull them down, causing a continual rain of particles into the atmosphere.

"This, during nights in the early Permian, must have produced extremely spectacular meteoric effects, resembling a rain of fire in the upper atmosphere over the equatorial regions," says Mr. Ives.

In the unknown period of time while the ring was in existence, it would have partially shaded from the sun's rays what are now the tropics, cooling them to such a low temperature that ice would have covered large areas. What are now the temperate regions would have been warmer, on the average, and the ice would have tended to flow in those directions.

Watch Saturn

As a test of his theory, Mr. Ives suggests that careful watch be kept of the rings of Saturn, which may be found gradually diminishing in size, then disappearing. It is also possible, he says, that Phobos, the inner moon of Mars, and the innermost one of Jupiter, may be eventually turned into rings.

"In the very distant future," he says, "as (and if) the solar system 'runs down,' earth may capture some wandering mass of cosmic junk and again acquire a ring like that postulated to explain the Permian glaciations. Speculation concerning the time of capture of this as yet unknown body is futile, for exact data, or even sufficiently detailed hypotheses, upon which to base the reasoning, are not now in existence.

"According to a number of theories, notably those of Jeffreys and Darwin, the moon will ultimately be drawn toward earth by tidal forces, and upon reaching the Roche limit will be broken up, the fragments forming a ring of small satellites about earth. This ring will probably produce such changes on earth that life in forms resembling the present will be impossible. Calculations suggest that this cataclysm will take place in about eight billion years, an interval about three times that from the 'creation' to the present."

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CLIMATOLOGY

Aridity Coefficients Tell Dryness of Climates

HOW DRY is a desert? Is interior Australia more arid than Death Valley, or less?

An effort to find a numerical expression for aridity has been made by Dr. W. Gorczynski, noted Polish climatologist who was in this country when the war broke out last September and who is remaining here until conditions become more favorable for him to return home. Dr. Gorczynski calls his concept the "aridity coefficient."

The aridity coefficient of a given locality is obtained by multiplying a latitude factor by the seasonal temperature range and then multiplying the product of these by the precipitation ratio, which is obtained by dividing the difference between highest and lowest recorded rainfall by average rainfall for a period of 50 years.

Calculating aridity coefficients for various places in this country, the Polish scientist has found that the driest spot in the United States is Bagdad, Calif., on the road from Needles to Los Angeles. Bagdad has an aridity coefficient of 70. One of the wettest spots in the country is also in California: Eureka, in the northern part of the state, with an aridity coefficient of 2.

Driest place on earth, as might be expected, is the interior of the Sahara desert (100); Arabia (80) comes second. The 70 boasted by Bagdad, Calif., is intermediate between this and the interior desert of Australia (60). The average aridity coefficient for all North America north of Mexico is 15. The Central American-Caribbean area rates as 7.5. Europe as a whole has an aridity coefficient of less than 10, but rainy Ireland and western Britain come up with a figure of 5.

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In ten years' search for a *parasite* to fight the Oriental fruit moth, Connecticut agriculturists have observed insects from Korea, Japan and Australia, as well as native parasites.