

able mass of air is warmed, and since warm air is less dense than cold, it begins to rise, sometimes nearly vertically. If there is plenty of moisture in the soil and vegetation, these rising air currents carry up water vapor; which on cooling in the upper levels condenses into clouds.

If, however, there has been a drought of several weeks' duration, as frequently happens in the West in late autumn and early spring, the vertical air currents carry up quantities of fine soil particles, and these, swept along by the northwesterly storm winds, later descend on areas farther to the east as blinding clouds of dust.

Dust storms are possible even in the depth of winter, if there are areas left free of snow for any length of time. Such dust storms frequently become mingled with snow to form the blizzards that have well earned the soubriquet, "the gray tiger of the North," for such blizzards have so much dust in them that the air appears not white but gray.

The dust storms that seem so distressing to us nowadays are mere zephyrs by comparison with those that swept the mid-latitude of the earth at the close of the last great Ice Age. These, raging for probably scores of thousands of winters, piled up thick deposits of that peculiarly fine-grained soil known as "loess."

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MEDICINE

Smallpox Virus From Eggs "Takes" in Vaccination

SMALLPOX virus grown on fertile hen eggs has been used successfully to vaccinate eleven persons in Nashville, Tenn., Prof. E. W. Goodpasture and G. J. Buddingh of Vanderbilt University Medical School report in *Science*.

The vaccinations "took" as well as those performed on a group of controls vaccinated with the usual virus from calf lymph. Further studies are in progress to test the durability of the protection this method gives.

The method was developed by Prof. Goodpasture and his associate, A. M. Woodruff. German and British investigators have recently repeated the experiments successfully. Some advantages of the method are the ease with which the vaccine may be produced at any time fertile hen-eggs are available and the absence of bacteria or other contaminating agents.

Science News Letter, December 2, 1933

PHYSICS

10,000 Observations Yield New Cosmic Ray Theories

Conclusions That Rays Are Positive and More Abundant Conflict With Lemaître and Millikan Hypotheses

COSMIC rays are probably the hearts of atoms of ordinary matter, positively charged by the action of starlight on interstellar gas, and accelerated in some cosmic or possibly terrestrial electric field.

Ten thousand observations of cosmic ray intensities just completed in Panama and Peru and earlier studies in this country and Mexico have led Dr. Thomas H. Johnson of the Franklin Institute's Bartol Research Foundation in Swarthmore, Pa., to this conclusion, which is contrary to other theories of cosmic ray formation.

Using a sort of cosmic ray "telescope" that "sees" on a motion picture film only the cosmic rays that pass through three-in-line Geiger-Mueller counting devices and set off in them simultaneous electrical pulses, Dr. Johnson has now definitely established that the western sky is "brighter" with cosmic rays than the eastern sky. If our eyes could see the cosmic ray corpuscles as they do the waves of ordinary visible light, they would see more cosmic ray light in the west. This difference in cosmic ray brightness between the east and west is also greater at higher elevations and nearer the magnetic equator.

Less Near Magnetic Equator

Dr. A. H. Compton, University of Chicago Nobel in physics, and Dr. J. Clay, a Dutch physicist, have shown by their researches that the local intensity of the cosmic radiation decreases towards the magnetic equator. The lower equatorial intensities were readily explained by the supposition that part of the primary radiation consisted of electrified particles but these studies could not determine whether the electrical charges were positive or negative. By the same physical laws that make it possible to determine which way the electric current is flowing in the wires of a motor from the direction in which its armature rotates it is also possible to determine whether the charges of the cosmic rays are positive or negative

from the way their paths are bent by the magnetic field of the earth. The fact that they are bent towards the east and therefore enter from the west means that the rays are mostly positively charged as any high school physics student can verify. This fact was first indicated a year ago as a result of Dr. Johnson's studies on Mt. Washington.

No Negative Rays

His most recent work on the equator in Peru now gives him data which allow him to conclude that all of the cosmic ray corpuscles in the energy range which is affected by the earth's magnetic field in equatorial latitudes are positive and there are no negative rays. The fraction of the total radiation which now can be directly attributed to the electrified radiation is also much higher than had been supposed previously. In fact, these measurements show that at least forty per cent. of the total radiation is of this nature.

Most of the rays which are actually observed are known to be of secondary origin, produced in the atmosphere by the bombardment of the primary radiation. These secondary rays are positively and negatively charged corpuscles in about equal numbers, as Dr. Carl D. Anderson of California Institute of Technology has shown, but since their directions of motion are the same as those of the primary rays it is possible to use their directions as an indication of the directions of the primary rays before they enter the atmosphere.

His results lead Dr. Johnson to challenge several proposed theories of cosmic ray origin and propose a theory himself.

Favored Theory

One of the most favored theories was advanced by Abbé Georges Lemaître, the Belgian priest-cosmologist now lecturing at the Catholic University of America. The Lemaître theory supposes that cosmic rays were produced during the earliest stages of the evolution of the universe by the disintegration of huge