SCIENCE NEWS

Science Service, Washington, D. C.

COSMIC RAYS

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In an interview with Donald Caley, Science Service Correspondent

The theory of the convertibility of mass into radiant energy has been called upon by astronomers for at least thirty years, because they see no other way to account for the enormous quantities of heat given off by the stars during the aeons during which we have evidence that they have been existing.

In 1905 Einstein set up the equation, energy equals mass times the square of the velocity of light, which gives the relation between the mass transformation into radiant energy and the radiant energy resulting from that transformation. All this is the orthodox astronomical theory of present-day astronomers. Similarly when we found the enormous energy of the individual cosmic rays we could see no reasonable way of accounting for these energies except by this same transformation of mass into radiant energy, and when I made my first estimates I could see no other mechanism through which such energies could be obtained, save through such transformation of mass into radiant energy. From the known mass of the hydrogen atom and the known masses of helium, or oxygen, or silicon, we could compute, with the aid of Einstein's equation, the amount of energy to be expended in an individual cosmic ray if it originated in the act of the building up of an atom of one of these common heavy elements, oxygen or silicon, for example, out of hydrogen.

This had to be a change in which matter was converted into radiant energy, for the simple reason that sixteen atoms of hydrogen are actually found to weigh more than one atom of oxygen and yet we know that these sixteen atoms of hydrogen have gone into the building up.

And I have been repeatedly pointing out for the last six years or so that my estimated energy of the chief component of cosmic radiation is of the right order of magnitude to correspond to this kind of an origin. Some have called this building up of the common elements out of hydrogen a creation of matter, though as far as I know I myself have never used that phrase.

In other words, the transformation of mass into radiant energy through the building up of the common elements out of hydrogen (which in my London paper I have called the partial annihilation of matter) is one and the same thing with what some have chosen to call the creation of matter.

There is one other suggestion as to where the energy of the cosmic rays comes from, which I have always thought untenable but which has seemed to be rendered particularly untenable by these recent experiments; so that when I say that the only cause of the cosmic rays that is yet in sight is some form of the annihilation of matter—that is the transformation of mass into radiation in accordance with the requirements of the Einstein equation—I am only reiterating the view to which I have been giving expression whenever I have speculated at all about the origin of cosmic rays. The apparent rough agreement between the estimated energy of the chief component, which is actually the least penetrating component, and the energy computed from the theory of the building up of one or another of the common elements like oxygen, silicon or iron out of hydrogen, is the only bit of evidence that we have had in confirmation of this view. This evidence is just as good to-day as it ever has been; indeed, our new experiments have given us more certainty than we have had heretofore of the energy contained in this chief component of cosmic radiation.

Our newer experiments have also brought forward convincing evidence of the existence of cosmic ray energies very much higher than those of this chief component, concerning the value of which we have heretofore been in ignorance.

We now know that there are some very penetrating components of the rays which have energies higher than those that can correspond to any such transformation of mass into radiant energy as occurs when the heaviest elements that we know anything about are assumed to be suddenly formed out of the process of suddenly building them up out of hydrogen.

There has been some discussion in the past as to whether the cosmic rays might not be produced by the complete annihilation of hydrogen atoms instead of by the partial transformation of mass into radiant energy that is involved in the building of heavier elements out of hydrogen.

I have stated in the past that this process of the annihilation of hydrogen was, in my judgment, inadequate to account for the cosmic rays, as it would furnish an energy larger than that required to account for the chief component, which represents actually something like ninety per cent. of that part of the ionization of the atmosphere that is due at all to cosmic rays. Thus I have seen no reason in the past for assuming that this process was going on where the cosmic rays seemed to be coming from—namely intergalactic space—although I have followed the speculations of most modern astronomers in assuming that this process was going on in some way inside the stars.

Our new measurements on the energies of the most penetrating component of the cosmic rays, however, directly made in our laboratory, have revealed the existence of cosmic ray energies as high as six billion electron volts, and our discovery of the fact that a few electrons come in from outside and strike the earth in the equatorial belt—this is what we all agree produces the so-called latitude effect in cosmic rays—has made it necessary to assume that some of the incoming rays have energies as high as or possibly higher than ten billion electron volts.

Energies of that sort are far higher than those that

can be obtained by the process of building up any of the heavier elements out of hydrogen; indeed ten billion electron volts is an energy coming close to that which—in accordance with Einstein's equation—would be produced by the complete and sudden annihilation of a whole atom of carbon; and if, as is at least possible, some of these enormously powerful rays have energies as high as sixteen billion electron volts that would correspond to the total energy that would be transformed from matter into radiant energy if the complete atom of oxygen were suddenly completely annihilated.

That such a complete annihilation of the whole of the atom can take place all at once will be doubted by many physicists and astronomers and I am far from asserting that it does. But it is nevertheless true that there is no other tenable source of energy in sight that will yield the cosmic ray energies which we actually observe. One can take this merely as being in evidence of the depths of our ignorance of how these cosmic rays do originate, or if he is so inclined he can take it as evidence that such annihilating processes actually take place. I was merely pointing out to a group of physicists centered in London that so far as I can see there are no other alternatives now in sight.

My whole presentation of evidence in the past has been based, as I have repeatedly stated, on the validity of the Einstein equation and the fact that this equation when applied to the building up of helium, oxygen, silicon and iron seemed to give energies close to those found in the chief components of the cosmic rays; though within the last two years we have been using the Einstein equation to compute the energies imparted to the helium atoms which we actually prove are produced when the nucleus of a single hydrogen atom—the proton—enters a lithium atom.

This is the case where we are creating two new atoms out of the interaction of two other atoms, and we have actually found cases in which heavier atoms have been produced, in this way, out of the union of two other ones. In other words, we are doing in our laboratories the same processes as those whose existence I have been assuming. By these processes we have now produced gamma rays of twelve million volts—four times higher than any gamma rays that come off radioactive substances.

The energy to be expected when matter is transformed into radiant energy is more firmly established than before by these terrestrial experiments on transmutation.

ITEMS

SODIUM MONOXIDE, rarely prepared as an academic curiosity, proves to be readily available as an intermediate in peroxide manufacture. Known also simply as sodium oxide, it is described as a "super-caustic" which exceeds even caustic lye in chemical vigor. In the form of a dry powder it acts first as a powerful desiccant, or artificial drying agent. It virtually tears water out of most organic matter, and is thereby transformed into highly concentrated lye, or sodium hydroxide. This dewatering process is attended with production of heat. As a result the normal action of the lye is accentuated, and speedy chemical action assured. In the manufacture of the new product metallic sodium is permitted to combine with oxygen in a restrained fashion, yielding a compound somewhat analogous to the rust of iron, but much more active chemically. In view of the ability of the new oxide to attack not only common vegetable and animal matter, but metals, solvents and a host of organic chemicals related to the dye, lacquer, drug and other industries, especially when in the molten state, a wide interest is being taken in its industrial future.

PROTEIN in the leaves of various plants depends on the amount of sunshine the plant receives, according to Professor Teru Fujita, of the Kyushu Imperial University. According to the results obtained from growing plants under various thicknesses of cheesecloth, and a subsequent analysis of the leaves, the more light the plant receives, the greater the amount of protein it forms. The same relations probably hold, states Professor Fujita, during day and night, the protein decreasing during the dark hours.

A NEW method of feeding vegetables to babies as young as three months of age has been tested clinically by a New York physician, and it now appears that mothers may soon be having vegetable formulas for infants as well as the old accustomed milk formulas. The tests with feeding green and yellow vegetables successfully to 70 infants between three months of age and one year were reported recently before the American Dietetics Association in Washington, by Dr. George W. Caldwell, of New York. The method tested by Dr. Caldwell consists of homogenizing the vegetables. This process explodes particles of the food during its preparation so as to release nutritive elements and make the food easier to digest.

RUSSIAN farmers have discovered a way to speed up the ripening of their cotton crops by a month or more. They use coal to warm the cotton plants without burning the coal. This seeming paradox is being performed at Kazakstan. Obtaining heat from coal without burning is the application of a simple fact of physics that dark colors absorb the heat in the sun's rays better than light colors. The Kazakstan farmers simply spread coal dust lightly over their fields; about 100 pounds to an acre. The darkened surface of the land is a better absorber of heat during the day and re-radiates more of it as warmth during the night. The higher average temperature of the land during the growing season, therefore, shortens the time necessary for the crop to mature by over a month.

SNOW in the woods, valuable source of stream-water during the ensuing summer, is caught most efficiently by hardwood stands, but held best against the melting effects of spring sun and wind by white pine. These, in closest condensation, are the high points of snow-sampling experiments performed in various types of Connecticut woodland by W. L. Maule, of the U. S. Forest Service. Mr. Maule's results will be stated in detail in a report which will be published in the October number of the *Journal of Forestry*.