Our Porous Matter

Physics

A. S. Eddington, in *The Nature of the Physical World* (Macmillan):

Between 1905 and 1908 Einstein and Minkowski introduced fundamental changes in our ideas of time and space. In 1911 Rutherford introduced the greatest change in our idea of matter since the time of Democritus. The reception of these two changes was curiously different. The new ideas of space and time were regarded on all sides as revolutionary; they were received with the greatest enthusiasm by some and the keenest opposition by others. The new idea of matter underwent the ordinary experience of scientific discovery; it gradually proved its worth, and when the evidence became overwhelmingly convincing it quietly supplanted previous theories. No great shock was felt. And yet when I hear today protests against the Bolshevism of modern science and regrets for the old-fashioned order, I am inclined to think that Rutherford, not Einstein, is the real villain of the piece. When we compare the universe as it is now supposed to be with the universe as we had ordinarily preconceived it, the most arresting change is not the rearrangement of space and time by Einstein but the dissolution of all that we regard as most solid into tiny specks floating in void. That gives an abrupt jar to those who think that things are more or less what they seem. The revelation by modern physics of the void within the atom is more disturbing than the revelation by astronomy of the immense void of interstellar space.

The atom is as porous as the solar system. If we eliminated all the unfilled space in a man's body and collected his protons and electrons into one mass, the man would be reduced to a speck just visible with a magnifying glass.

This porosity of matter was not foreshadowed in the atomic theory. Certainly it was known that in a gas like air the atoms are far separated, leaving a great deal of empty space; but it was only to be expected that material with the characteristics of air should have relatively little substance in it, and "airy nothing" is a common phrase for the insubstantial. In solids the atoms are packed tightly in contact, so that the old atomic theory agreed with our preconceptions in regarding solid bodies as mainly substantial without much interstice.

The electrical theory of matter which arose towards the end of the nineteenth century did not at first alter this view. It was known that the negative electricity was concentrated into unit charges of very small bulk; but the other constituent of matter, the positive electricity, was pictured as a sphere of jelly of the same dimensions as the atom and having the tiny negative charges embedded in it. Thus the space inside a solid was still for the most part well filled.

But in 1911 Rutherford showed that the positive electricity was also concentrated into tiny specks. His scattering experiments proved that the atom was able to exert large electrical forces which would be impossible unless the positive charge acted as a highly concentrated source of attraction; it must be contained in a nucleus minute in comparison with the dimensions of the atom. Thus for the first time the main volume of the atom was entirely evacuated, and a "solar system" type of atom was substituted for a substantial "billiard-ball". Two years later Niels Bohr developed his famous theory on the basis of the Rutherford atom, and since then rapid progress has been made. Whatever further changes of view are in prospect, a reversion to the old substantial atoms is unthinkable.

The accepted conclusion at the present day is that all varieties of matter are ultimately composed of two elementary constituents—protons and electrons. Electrically these are the exact opposites of one another, the proton being a charge of positive electricity and the electron a charge of negative electricity. But in other respects their properties are very different. The proton has 1840 times the mass of the electron, so that nearly all the mass of matter is due to its constituent protons. The proton is not found unadulterated except in hydrogen, which seems to be the most primitive form of matter, its atom consisting of one proton and one electron. In other atoms a number of protons and a lesser number of electrons are cemented together to form a nucleus; the electrons required to make up the balance are scattered like remote satellites of the nucleus, and can even escape from the atom and wander freely through the material. The diameter of an electron is about 1/50,000 of the diameter of an atom; that of the nucleus is not very much larger; an isolated proton is supposed to be much smaller still.

Thirty years ago there was much debate over the question of aether-drag—whether the earth moving round the sun drags the aether with it. At that time the solidity of the atom was unquestioned, and it was difficult to believe that matter could push its way through the aether without disturbing it. It was surprising and perplexing to find as the result of experiments that no convection of the aether occurred. But we now realize that the aether can slip through the atoms as easily as through the solar system, and our expectation is all the other way.

Science News-Letter, May 25, 1929

Science Outrunning Ethics

Philosophy

Dr. Carl Barus, in a letter to the American Philosophical Society:

"The dilemma of our present civilization is that its advance in ethics and esthetics is not comparable with its advance in science. I am by no means sure that to teach the people at large more science will not do more harm than good. Science lends itself to the arts of war, of aggression, of exploitation, of sabotage, quite as much as to the arts of peace."

Science News-Letter, May 25, 1929

Still Work for Diogenes

Philosophy

Dr. F. W. Clarke, in a letter to the American Philosophical Society:

"The world's intellectual need seems to me to be a more general development of intellectual honesty."

Science News-Letter, May 25, 1929

No Snake Suicides

Zoology

Karl P. Schmidt, in *The Truth About Snake Stories* (Field Museum):

It is widely believed that rattlesnakes when confined, and especially if tortured, will strike themselves and thus commit suicide. All available information, however, indicates that snakes are immune to their own venom, and in experiments I have made personally, causing a rattler to bite himself, there was no visible effect. There is a foundation for the story in the fact that a snake, if sufficiently excited, will lash out in every direction and may then catch his fangs on one of his coils. The Blow Snake, when going into the convulsion preceding its death-feint, frequently catches its fangs on its own body.

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