modern study of genetics gives no means of distinguishing a new factor from one long in existence. He suggests that the mutations studied by De Vries in plants, and the modifications obtained by Castle in mammals, are due to the combination of pre-existing factors, while the famous mutations in flies elucidated by Morgan "are in the nature of modal fluctuations having no definite cumulative value." Prof. Walton's own definite contribution in this paper is found in his summary of the direction of axial rotation in Euglena and other Protozoa which "is best explainable on the basis of the apparent east-west motion of the sun having influenced the movement of the organs of locomotion." This seems an insecure foundation for such a generalisation as the author's statement that "the primary factors in evolution are environmental, and thus dynamic."

G. H. CARPENTER.

CHEMISTRY OF "BURGUNDY MIXTURE."

THE chemistry of "Burgundy mixture" is practically important, because to give it the greatest efficiency it should possess a maximum fungicidal power and a minimum potentiality for injuring foliage. The reaction of sodium carbonate and copper sulphate solutions has been studied by Pickering and by Ravaz, but, according to a paper contributed to the August Journal of the Chemical Society by Messrs. Robert L. Mond and C. Heberlein, the problem is more complex than they considered. The latter authors have studied the reactions of copper sulphate with varying proportions of sodium carbonate and of sodium hydrogen carbonate; have determined the amount of absorbed sodium carbonate and the ratio of copper oxide to carbon dioxide in the various precipitates and the amount of basic copper sulphate in the mixtures; and have studied the solvent action of carbon dioxide and the change of the colloidal precipitate to a crystalline form. As a result of their experiments Messrs. Mond and Heberlein conclude that three distinct copper compounds are formed when sodium carbonate and copper sulphate solutions are mixed:—(1) Insoluble hydrated basic copper carbonate (the bulk of the precipitate); (2) insoluble hydrated basic copper sulphate; and (3) soluble basic copper sulphate in the form of a hydrosol; the proportions of which vary with the conditions of precipitation. One molecule of copper sulphate is completely transformed by 0·93 molecule of sodium carbonate instead of the one molecule theoretically necessary. In a 1 per cent. mixture of copper sulphate and sodium carbonate (in the proportion 1 : 0·93 mol.) made at 15°, 9·6 per cent. of the copper is present as soluble basic sulphate, the basic carbonate contains copper oxide and carbon dioxide in the ratio 2·2 : 1, the insoluble basic sulphate contains copper oxide and sulphur trioxide in the ratio 15 : 1, the precipitate contains absorbed sodium carbonate in the proportion of 1 part to 74 of copper oxide, and 52·4 per cent. of the carbon dioxide is evolved. At higher temperatures more carbon dioxide is evolved, all being expelled on boiling. The amount of basic sulphate formed decreases as the proportion of sodium carbonate increases, the proportion in solution (but not that of the basic carbonate) increasing with the amount of free carbon dioxide. At first the precipitate is wholly colloidal, but eventually it becomes crystalline, the colloidal condition apparently being conditional on the absorbed sodium carbonate. The transformation is accelerated by free copper sulphate, carbon dioxide, or sodium hydrogen carbonate, but retarded by sodium carbonate or 0·02 per cent. of glue.

ÆTHER AND MATTER: BEING REMARKS ON INERTIA, AND ON RADIATION, AND ON THE POSSIBLE STRUCTURE OF ATOMS.[1]

PART II.—THE POSSIBLE STRUCTURE OF ATOMS AND THEIR RADIATION.

HOW, then, are we to explain the different kinds of matter? Here we enter upon territory so recently annexed as to be still very debatable; but progress has been and is still being made, and it is only through the work of recent explorers that we can attempt to answer the question at all. It is invidious to select names, but I must mention Rutherford, Soddy, Barkla, Bragg, Moseley, Nicholson, and Bohr, among many others. Moseley—as brilliant as any of them, and patriotically self-sacrificing like all our splendid youth—was killed, alas! by a Turkish bullet at Gallipoli; though not before he had made an immortal discovery. How much more might he not have accomplished had it not seemed good to evil Powers to impose by force their dominance on the world!

To give a certain and definite answer to questions about the structure of the atom is premature. I can only state the answer which at present tentatively appeals to me and, I think, to others. Your professor of natural philosophy (Sir J. J. Thomson) is lecturing, I see, on Saturday afternoons concerning spectroscopic evidence on this great subject, and he will, no doubt, carry the matter further.

Meanwhile, and very briefly, the idea about the atom which at present seems most likely to be on the path towards truth is a central positive nucleus surrounded by a system of negative electrons—so much is pretty certain—while according to one theory the system is composed of revolving electrons moving under an inverse-square law in regular orbits, very like the sun and planets. The orbital movement is governed by electric force instead of by gravitation, but the laws of motion, and the perturbations which may be caused by outside forces, are very like those familiar to astronomers.

According to Moseley's experimental counting and Bohr's theory, hydrogen seems to be like a sun with one planet, just a positive and a negative electron, the two being equal electrically, but differing in inertia, the positive being the more massive, though probably for that reason the smaller or more concentrated of the two. Helium seems to have two central unbalanced positive charges and two revolving negative; lithium, three of each; beryllium, four; boron, five; carbon, six; nitrogen, seven; oxygen, eight, and so on, according to the number of the element in Mendeléeff's series—a number something like half the number expressing its atomic weight.

The number of positive atoms in the nucleus was counted for several elements by Rutherford, and the number of negative corpuscles in the orbit was counted by Moseley; the two numbers agree. Normal atoms are therefore electrically neutral, so that their external electric attraction at any reasonable distance is nil; but it is supposed that at atomic or molecular distances the outer or orbital electrons which can interlock with those of others determine the atom's chemical affinity and all the chemical behaviour of the substance. An atom with one or two outlying planets—let us surmise—would be an active chemical element, a monad or dyad perhaps. An atom with a close-grouped, self-contained system would be an inert element of the argon-neon-helium series. These

[1] Amplified from a discourse delivered at the Royal Institution on Friday, February 28, 1919, by Sir Oliver J. Lodge, F.R.S. Continued from p. 19 (September 4).