Letters to the Editor.

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The Constitution of Zinc.

THAT zinc was a complex element was demonstrated by Dempster using the method of analysis associated with his name. From the curves published in 1922, he came to the conclusion that the element contained three strong isotopes, 64, 66, 68, in descending order of abundance, and one faint one, 70. A kink in the curves at 67 suggested that this mass number was also probably present. Many attempts were made to check these conclusions by means of the mass-spectrograph, but in no case could the mass lines of zinc be obtained either by the discharge in zinc methyl or by accelerated anode rays.

Following my recent success with germanium, and using the same setting of the discharge tube, I have now obtained satisfactory results from zinc methyl which are in striking agreement with the conclusions of Dempster and disclose two additional components. The mass-spectra indicate that zinc consists of seven isotopes 64 (*a*), 65 (*e*), 66 (*b*), 67 (*d*), 68 (*c*), 69 (*g*), 70 (*f*). The letters in brackets indicate the order of intensity. Three of these mass-numbers, 65, 69, 70, are isobaric with those of copper, gallium, and germanium respectively.

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Cavendish Laboratory,
Cambridge, Aug. 22.

Corpuscular Theory.

G. L. LE SAGE, of Geneva, devoted the best part of his life to a theory of the mechanism of gravity. It appeared in the Transactions of the Berlin Academy in 1782. The fullest account of his theory was published by Pierre Prevost, as editor, in 1818 ("Deux traités de physique méchanique"). The general idea of the theory is that ultramundane corpuscles are flying through space in all directions with great velocity; that they collide with the atoms of mundane matter; and that in consequence they issue from the sun or a planet with less velocity than that with which they entered it. Thus the atoms of the moon are bombarded by corpuscles from all directions equally, except that those coming from the earth have a smaller velocity and, in consequence, the moon is driven towards the earth by the force called gravitation.

This is almost the only mechanical theory that contains the elements essential to a true theory. One other theory of gravitation also fulfilling that condition is founded upon Prof. Frederick Guthrie's experiment on the attraction of a balloon by a vibrating tuning-fork. This experiment was extended by Bjerknes, theoretically and experimentally, to the reactions of vibrating drums in a tank of liquid; and was discussed further by Lorentz.

On Dec. 18, 1871, Lord Kelvin (then Prof. Sir W. Thomson) communicated to the Royal Society of Edinburgh a paper "On the Ultramundane Corpuscles of Le Sage." The theory advanced by Le Sage is there described in great detail. The abstract of this paper occupies about 13 pp. of the *Proceedings* of the Society. The object of the paper was to remove some objections that might be raised to the theory of Le Sage. Lord Kelvin suggested also that the energy of translation lost by corpuscles in collision with atoms might be converted into vibrations, or vibrations and rotations. In this way the excessive rise of temperature in a planet penetrated by corpuscles might be reduced. Clerk Maxwell criticised this. Much later, however, Sir J. J. Thomson expressed the opinion that the kinetic energy might be converted, not into heat but "into the energy of a still more penetrating form of radiation which might escape from the gravitating body without heating it." He added: "It is a very interesting result that the machinery which Le Sage introduced for the purpose of his theory has a very close analogy with things for which now we have direct experimental evidence."

I was present at the reading of Kelvin's paper in 1871. I regret that his abstract gives no account of the nature of corpuscles and atoms which he then described. Atoms were vortex rings, and corpuscles were vortices like a serpent, in which the inside is ejected at its mouth, passes outside, and enters at its tail.

Some years later Aitken exhibited his remarkable experiments on the rigidity of endless chains in rapid motion along the tangent to the curve of the chain (*Phil. Mag.*, 1876 (?)). It then appeared that the vortex filaments in Kelvin's corpuscle would behave in the same way; and that these corpuscles might form the basis of a corpuscular theory of light.

On Aug. 15, 1878, at the Dublin meeting of the British Association, I read a paper on the "Mutual Action of Vortex Atoms and Ultramundane Corpuscles" (*q.v.*), wherein I explained the radiation, propagation and absorption of light. Each corpuscle when passing a vibrating atom would have kinks or saw-teeth impressed on its surface along its whole length. Aitken's results led me to infer that these saw-teeth would remain fixed in position, and would not travel along the vortex-filament. While travelling through space the toothed corpuscle may encounter an atom of the same frequency of vibration as the original radiator. In that case the saw-teeth must set the atom into vibration. Thus is radiation and absorption explained.

That paper may perhaps now, fifty years later, be useful as a suggestion to present-day workers. That paper to the British Association concluded with these words: "The question naturally arises, Can this action be the keystone to a new theory of light? Can the phenomena of reflection, refraction, interference, diffraction, and polarisation be explained by this kind of action? In answer to these questions it can at present only be said that the germs of a complete theory of light do exist in this speculation."

I did not publish anything more on the subject. To-day, however, I will say what was meant by the last sentence. *Plane Polarisation* occurs when the corpuscles have saw-teeth only on opposite sides, and not all round them. Refraction is more difficult to explain. *Interference* and *Diffraction* follow, exactly as in the wave-theory, if corpuscles flying in all directions rob other corpuscles of their saw-teeth and carry them on. The saw-teeth form wave-fronts as in the wave-theory; and these can only be propagated in a direction perpendicular to the wave-front. Diffraction and interference can then be calculated by mathematical formulæ, which are precisely the same as we use in explaining the same phenomena by the wave-theory.

Perhaps these considerations may be of use to-day. My reasons for saying this are that they seem to form a physical basis for quanta, for Einstein's (1905) photoelectric theory, and for the heat of stars, and also for Eddington's law of the mass-luminosity of stars.