powder exploded. The cars were blown to bits, rails were broken and warped and the pieces were hurled to great distances; houses in the vicinity were wrecked; and the force of the explosion was felt throughout the city. The seismographs recorded the surface movement as a cross tracing, distinct but susceptible of measurement only with the aid of a lens.

J. E. Talmage

MASS AND ENERGY

The following is an outline of some interesting theoretical results, a full account of which will shortly appear elsewhere.

If a piece of matter be considered as an electrical system, possessing any structure or internal motions, but having on the whole a kind of average symmetry, then it may be shown that the electromagnetic mass of such a system for ordinary velocities is given by

$$\text{Mass} = \frac{4}{3}\frac{1}{V^2}E$$

where V is the velocity of light and E is the total electromagnetic energy of the system. Thus the mass of the system is determined solely by its energy content, and the idea is suggested that mass and energy may have something in common. This result has several interesting implications.

Any reaction which is caused by the action of electric forces will involve a change in the electromagnetic energy content of the system, and hence according to the above view will be accompanied by a change of mass. This change will, of course, in general be a decrease. In the case of ordinary chemical reactions calculation shows that this change would be too small to be detected, but in the case of radioactivity, where the energy lost is relatively much greater, a sensible change is to be expected. Thus on this view the atomic weight of the various products of radium can not be accurately calculated from the number of α-particles lost, for there is this further decrease in mass due to the loss of energy.

The evolutionary theory of the elements has always met an almost insuperable difficulty in the fact that there appears to be no *exact* regularity of any kind throughout the list of atomic weights.

Some years ago Rydberg came to the conclusion that it was necessary to consider the atomic weights, up to that of iron, as made up of two distinct parts $N + D$, where D is a very small difference, a slight deviation in fact from (N). Exact harmonious relations exist between the various N's and Rydberg seems to consider the D's as representing real physical deviations and not merely mathematical remainders.

From the point of view of loss of mass accompanying energy dissipation, it is evident that these small irregularities are just what is to be expected.

Finally it is to be noticed that if for all matter the ratio of mass to weight is sensibly the same, the above mentioned proportionality between mass and included energy can only imply that the gravitation of a body is always proportional to its total energy content, and this constant proportionality seems to point toward the conclusion that it is confined energy which gravitates and not mass in any other sense.

It is perhaps well to point out that the conclusion respecting gravitation involves the assumption that all the mass of matter is electromagnetic, while the conclusion respecting loss of mass and atomic weight irregularities requires only that the forces causing the energy change be electric or magnetic, *i. e.*, requires only that *part* of the total mass be of electromagnetic origin.

Daniel F. Comstock
Mass. Institute of Technology,
September 9, 1907

NOTES ON ENTOMOLOGY

Another heavy installment of Wytsman's "Genera Insectorum," has made its appearance. Fascicle 46[c] by Otto Schwarz completes the Elateridæ or click beetles; it comprises pages 225 to 370, and six colored plates. The types of the genera are not indicated, and the references are incomplete. In the case of new genera there is nothing to show