Large questions now present themselves as to transformations which a distribution of turbulent motion would experience in an infinite liquid left to itself with any distribution given to it initially. If the initial distribution be homogeneous through all large volumes of space, except a certain large finite space, S, through which there is initially either no motion or turbulent motion, homogeneous or not, but not homogeneous with the motion through the surrounding space, will the fluid which at any time is within S acquire more and more nearly as time advances the same homogeneous distribution of motion as that of the surrounding space, till ultimately the motion is homogeneous throughout? Probably, I think I may say certainly, yes—at all events for a large class of cases.

But can it be that this equalization comes to pass through smaller and smaller spaces as time advances? In other words, will any given distribution, homogeneous on a large enough scale, become more and more *fine-grained* as time advances? Probably *yes* for some initial distributions; probably *no* for others. Probably *yes*, for vortex-motion given continuously through all of one large portion of the fluid while all the rest is irrotational. Probably *no* for the initial motion given in the shape of equal and similar Helmholtz rings, of proportions suitable for stability, and each of overall diameter considerably smaller than the average distance from nearest neighbour. Probably also *no*, though the rings be of very different volumes and vorticities. But probably *yes* if the diameters of the rings or of many of them, be not small in comparison with distances from neighbours, or if the individual rings, each an endless slender filament, be entangled or nearly entangled among one another.

Again a question: If the initial distribution be *homogeneous and æolotropic*, will it become more and more isotropic as time advances, and *ultimately quite isotropic?* Probably *yes* for any random initial distribution, whether of continuous rotationally-moving fluid or of separate finite vortex-rings. Possibly *no* for some symmetrical initial distribution of vortex-rings, conceivably stable; though it does not seem probable that there is any such stability.

If the initial distribution be homogeneous and isotropic (and therefore utterly *random* in respect to direction) will it remain so? Certainly *yes*.

We shall now suppose the initial motion to consist of a laminar motion $[f(y), 0, 0]$ superimposed on a homogeneous and isotropic distribution $(\mathfrak{u}_0, v_0, w_0)$; so that we have—

$$\text{when } t = 0,\ u = f(y) + \mathfrak{u}_0,\ v = v_0,\ w = w_0\,;$$

and we shall endeavour to find such a function, $f(y, t)$, that at any time, t, the velocity-components shall be—

$$f(y, t) + \mathfrak{u},\ v,\ w,$$

where $\mathfrak{u}$, v, w are quantities of each of which every large enough average is zero.

With this assumption the equations of motion yield the following—

$$\frac{df(y, t)}{dt} = -\ xzav\ \frac{d(\mathfrak{u}v)}{dy}.$$

It is to be remarked that this result involves no isotropy, no homogeneousness in respect to y; and only homogeneousness of *régime* with respect to y and z, with no translational motion.

The translational component of the motion is wholly represented by $f(y, t)$, and, so far as our establishment of the above equation is concerned, may be of any magnitude, great or small relatively to velocity-components of the turbulent motion. It is a fundamental formula in the theory of the turbulent motion of water between two planes; and I had found it in endeavouring to treat mathematically my brother Prof. James Thomson's theory of the "Flow of Water in Uniform *Régime* in Rivers and other Open Channels" (Proceedings of the Royal Society, August 15, 1878). In endeavouring to advance a step towards the law of distribution of the laminar motion at different depths, I was surprised to discover the law of propagation as of distortional waves in an elastic solid, which constitutes the conclusion of my present communication—

$$\frac{d}{dt}\ xzav\ (\mathfrak{u}v = -\ \tfrac{2}{9}R^2\frac{df(y, t)}{dy}.$$

Eliminating the first member from this equation, by the former, we find—

$$\frac{d^2f}{dt^2} = \tfrac{2}{9}R^2\frac{d^2f}{dt^2}.$$

Thus we have the very remarkable result that laminar disturbance is propagated according to the well-known mode of waves of distortion in a homogeneous elastic solid; and that the velocity of propagation is $\frac{\sqrt{2}}{3}$ R, or about 47 of the average velocity of the turbulent motion of the fluid. This might seem to go far towards giving probability to the vortex-theory of the luminiferous ether.

But a difficulty remains unsolved: a possible rearrangement of vortices within each wave, giving rise to dissipation of the wave-energy.

The mathematical investigation appears in full in the October number of the *Philosophical Magazine*, with some slight farther considerations regarding this virtual viscosity, and the question of what, if any, distribution of vortices can either have no tendency to the vitiating rearrangement, or can, with the requisite fine-grainedness, be slow enough in the vitiating rearrangement to allow the propagation of waves of light to go on through a hundred million million miles of space, or a million times the earth's distance from the sun.

The Committee of the Section reported that at a meeting of the Committee it had been resolved, on the motion of Prof. Gustav Wiedemann, of Leipzig, seconded by Sir William Thomson:—"That this Committee of the Mathematical and Physical Science Section of the British Association hereby convey to Dr. Joule their sense of the great loss sustained by the Section in consequence of his inability to take part in this meeting of the British Association in his native city, and express their sincere regret at the cause of this loss, and their hearty sympathy with him in his illness. The Committee take this opportunity of recording their appreciation of the splendid work of this most painstaking and conscientious seeker after truth, who, with his discoveries, has led the way in the greatest advance in knowledge made in this age, and, by his life, has conferred on mankind a precious example for their admiration and imitation."

SCIENTIFIC SERIALS.

American Journal of Science, August.—History of the changes in the Mount Loa craters (continued), by James D. Dana. In this paper the history of Kilauea is continued from January 1840 to the end of 1886, during which period sufficient facts were accumulated for a widened and apparently final explanation of the method of filling the pit. The eruptions of 1849, 1855, 1868, and 1886 are fully described, and the whole subject is illustrated with maps of the burning mountain at various dates during the period under consideration.—On some phenomena of binocular vision (continued), by Joseph Le Conte. In this paper, the twelfth of the series, the author deals with certain peculiarities of the phantom images formed by binocular combination of regular figures. The phenomena here described, none of which have hitherto been satisfactorily accounted for, are all explained by the law of corresponding points, justly regarded as the most fundamental law of binocular vision.—Chemical integration, by T. Sterry Hunt. In this paper the author deals more fully with several points connected with chemical metamorphosis, which were more briefly noticed in his recently published work, entitled "A New Basis for Chemistry."—Studies in the mica group, by F. W. Clarke. In this paper the author deals with specimens of muscovite from Alexander County, North Carolina; of lepidomelane from Baltimore and Litchfield, Maine; of iron biotite from Auburn, Maine; and of iron mica from near Pike's Peak.

SOCIETIES AND ACADEMIES.

LONDON.

Institution of Mechanical Engineers, September 30.—Mr. E. H. Carbutt, President, in the chair.—A supplementary paper by Major Thomas English, R.E., on the initial condensation in a steam cylinder, was read and discussed in connexion with the paper by the same author on the distribution of heat in a stationary steam-engine, read at the spring meeting on May 17, an abstract of which has already appeared in NATURE (vol. xxxvi. p. 115). The supplementary experiments were carried out in a portable engine of ordinary type, the cylinder of which was jacketed on the cylindrical portion but not at the ends. The steam was admitted directly from the boiler into the steam chest, and the quantity required for each experiment being small compared with the capacity of the boiler, no question of priming or condensation before admission can arise. The con-