not be included in the equation of energy; if it is, there is no longer conservation of energy. This makes me think that the authors' arguments about velocity of escape are invalid.

Cleveland Lodge, J. H. JEANS.
Dorking.

[1] NATURE, **143**, 116 (1939).
[2] Hubble, "The Realm of the Nebulæ", 189.
[3] *Loc. cit.*, 178.
[4] "Astronomy and Cosmogony" (second edit.), 348.

Glaciological Results of the Jungfraujoch Research Party

LAST spring a note was published in NATURE on the aims of our expedition to the Jungfraujoch to study glaciological problems. The working out of our results has now progressed so far that we are able to give a brief account of them.

The main part of the work was concerned with the study of the transition of snow into ice in glaciers, but the results obtained also threw considerable light on the mechanism of glacier flow.

The general scope of the work and results may be outlined as follows:

(1) *Transition of snow into glacier ice.* Specimens of firn and ice were removed from the walls of deep crevasses and artificial shafts in the interior of the glacier. Depths one hundred feet below the surface were explored. The samples were examined in a laboratory which had been excavated in stationary ice at the Jungfraujoch. The temperature of the laboratory remained at about − 4° C. throughout the summer. The change in density with depth was determined at various points between the source and firn line of the Great Aletsch Glacier. From these results it was possible to draw a profile of the density distribution in the glacier and to define a transitional plane between firn and glacier ice. Usually the density increase on passing from early firn to glacier ice was found to be a gradual one. However, a transition point between the two could be distinguished at a density of about 0·84, since here the hitherto porous firn becomes impermeable to water by the freezing out of descending melt water and by a slow process of settling. Measurements indicate that the latter process is an important factor in increasing the density.

(2) *Névé temperature.* By means of thermocouples buried at depths down to 30 m., it was found that the winter cold wave penetrated to about 15 m. depth. Below this depth it was concluded that the whole glacier was at the pressure melting temperature. The heating of the firn in summer is attributed to a downward percolation of melt water from the surface and it was found that the rate of temperature rise depended on the firn structure and its permeability to water.

(3) *Crystallographic studies.* Using the standard methods of optical crystallography, the size, shape and orientation of the crystals and the distribution of the air spaces were studied in thin sections cut from specimens which had been taken from the interior of the glacier. A statistical survey of the orientation of a large number of crystals in these sections gave evidence of the presence or absence of any preferred orientation. Although firn near the surface showed orientation due to growth in a unidirectional cold wave, this orientation was observed to disappear gradually at greater depths by the independent movement of firn grains during glacier flow and settling. Preferred orientation of crystals by plastic deformation due to shear was found in several places on glacier tongues.

(4) *Stratification bands.* Two types of bands are distinguishable in the *névé*, (*a*) dirt bands, which form on the surface and represent the boundary between the accumulation of successive years, and (*b*) ice bands, which are also of sedimentary origin; the crystal orientation of these is similar to that of pond ice. Other types of bands are to be seen in glacier tongues; of these the most important are the 'blue bands' which are of tectonic origin. Bands of sedimentary origin are also found in the glacier tongues.

(5) *Glacier flow.* Fundamental differences were observed between the mechanism of flow in the *névé* region and in the ice of the tongue. Measurements of the differential movement in firn together with the crystallographic evidence showed conclusively that flow takes place by the haphazard motion of crystals or small crystal aggregates. Below the firn line, where the interlocking of crystals prevents their relative motion, the glacier flows by plastic deformation and also by laminar movement along thrust planes. Plastic deformation involves the slip of crystals along their basal glide planes and is accompanied by the growth and reorientation of crystals due to a molecular transfer across their grain boundaries.

Full accounts of the work will be published in the near future.

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Distribution of Radioactive Sodium after Injection into the Rabbit

RADIOACTIVE sodium has been administered to rabbits in the form of sodium chloride and the subsequent distribution of the Na^{24} investigated by measuring the activity of samples of ashed blood and tissues with a Geiger counter. The radioactive sodium (Na^{24}: 14·8 hours period) was obtained by irradiating magnesium or sodium hydroxide with neutrons from a radon-beryllium source of about 500 mc. The total activity so produced corresponded to 2000–4000 impulses per minute on the counter used for recording.

After intravenous injection of the radioactive salt, the Na^{24} in the blood was found to reach a constant level in about 15–20 minutes (see accompanying graph). A similar constant level was reached in about the same time after intraperitoneal injection. Equilibrium was obtained more slowly following injection of the salt into the colon. Assuming that the sodium is evenly distributed in a fluid medium[1], it is possible to estimate from the ultimate constant level of the Na^{24} in the blood the volume in which it is dissolved. Thus, for example, in one animal (weight 3000 gm.) 22·5 minutes after intraperitoneal injection of Na^{24}, 5 c.c. of blood contained an amount of radioactive sodium corresponding to 15 impulses per minute. The total radioactive sodium in the body at this time, allowing for the overflow into the urine, would have given 2500 impulses per minute. Hence the volume of fluid in which this Na^{24} was dissolved must have been about 830 c.c., that is, 36 per cent of the body weight in water. Similar results