$$G=\frac{4}{3}\sqrt{2\pi}.R^3\sqrt{\rho_1}\frac{p'-p''}{L},$$

where R is the radius of the tube, L its length, and p' and p'' the pressures at the ends. By a series of experiments with a tube, the length of which was 2·00 cm., the radius 0·00333 cm., the proportions between the measured values and those calculated from this formula were found to be, for hydrogen, 1·04; oxygen, 1·01; carbonic acid, 1·01.

The formula will, however, only apply correctly when the radius of the tube is small compared with the mean free path. With increasing pressure $\frac{p'+p''}{2}$ (decreasing mean free path), the gas flow of a given value for $p'-p''$ decreases to a minimum, and afterwards increases in order to approach the value which it should have according to Poiseuille's well-known law. That this must be the case may easily be inferred from the kinetic gas theory in connection with the above-mentioned theory as to the interaction between gas molecules and a wall.

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The Germ-layer Theory.

THE germ-layer theory as stated on p. 428 of NATURE (June 10) by Mr. Stanley Gardiner appears in a rather extreme form. Probably all will agree that, not only the germ-layer theory, but every theory of development, presupposes a certain definiteness in structure of germ cells. But if that much is granted, it is not necessary to suppose that the differentiation of protoplasm has proceeded at so early a stage to such an extent as to preclude absolutely the possibility of protoplasm, which has been so far misplaced by experiment as to find itself in a new environment, responding to the influences of the new environment and so developing along a path it would not have followed had the experiment not been performed.

It seems difficult to comprehend what reason can be assigned for regarding those organs of the early phase of the life-cycle which we call germinal layers as being less capable of showing homology than the organs of later phases which we speak of as adult.

Surely the biological principles—whatever they may be—must apply equally throughout all periods of the life-cycle.

The argument from regeneration is hardly conclusive, because one essential of regeneration and budding seems to be the regression of differentiated protoplasm into undifferentiated protoplasm (or, at any rate, the origin in some way or other of an undifferentiated cell mass), that is to say, a regression to a state equivalent to a segmenting egg, namely, a state really prior to that of germ-layer formation.

Finally, it must be remembered that visible differences and resemblances are much less obvious in these early phases of the life-cycle than later, and that the difficulty of observation, owing to the minute size of the objects, is so great that errors of observation, which delay correct interpretations, are far more frequent than is the case with work upon the grosser phases of the life-cycle.

It cannot be conceded that the "anomalies in the formation of the layers in vertebrates" which are "patent to every student" are all capable of substantiation.

Grantchester, June 15. RIC. ASSHETON.

The Pollination of the Primrose.

IT appears that in a previous note on this subject (NATURE, June 17, p. 457) clearness may have been sacrificed to brevity. It is not meant that humming-bird and bee hawk-moths can be regarded as usual or frequent agents in the pollination of the primrose. They are mentioned in proof that some moths do, now and then, visit the flowers, and may presumably aid in their cross-pollination. There can be little doubt, however, that the humble-bee is herein the chief agent, and in this district, I should say, more particularly *Bombus hortorum*.

W. E. HART.

Kilderry, Londonderry, June 19.

FROST AND ICE CRYSTALS.[1]

DURING the past quarter of a century Mr. Wilson J. Bentley has devoted himself with a patient industry deserving of all praise to securing permanent records of the multitudinous forms assumed by water in its crystallised condition. The work has been executed at his home, a farmhouse, situated sixteen miles east-north-east of Burlington, Vermont, near the Canadian border, at an altitude of 1500 feet above sea-level, where the low temperatures experienced every winter are very favourable for the study of these forms. Seven years ago we directed attention (NATURE, 1902, vol. lxv., pp. 264–6) to his beautiful series of photomicrographs of snow crystals; a selection of them was reproduced in the *U.S. Monthly Weather Review*, and was accompanied by a paper in which Mr. Bentley described the methods used for obtaining the photographs, and the facts that could be established from a study of the almost bewildering variety of the forms represented. At the same time, but mainly during the subsequent years, Mr. Bentley has been further engaged in preparing a companion and complementary series of frost and ice crystals, *i.e.* the forms assumed by water that has crystallised immediately upon the surface of the earth. A large number of different types were reproduced in successive numbers of the *Monthly Weather Review* from August to December, 1907, and Mr. Bentley again contributes a description of the apparatus used, and full details with regard to the circumstances under which the several pictures were obtained.

Nearly the whole of the present series represents crystals that were formed during the winters of 1904–5, 1905–6, and 1906–7. For several reasons fewer difficulties were experienced in obtaining photographs of these crystals than was the case in the investigation of snow crystals; they could invariably be photographed in the positions in which they were found, and since owing to the greater duration of growth, their size usually much larger, smaller magnifications were required, and, indeed, in pictures of groups of crystals actual reductions were called for. The apparatus used was consequently simpler in character. For the majority of the photographs, in which the magnification did not exceed eight diameters, an ordinary portrait-lens was used in a camera which was fitted with a home-made extension arrangement, and the crystals were illuminated obliquely. For higher magnifications a microscope-objective, of $\frac{3}{4}$- or $\frac{1}{2}$-inch focal length, was employed, and the illumination was direct. The second method, which was required for the minute flakes deposited on windows, entailed more trouble in manipulation, because, while the camera was indoors, the diaphragm for cutting off all but direct light was on the other side of the window, and had, of course, to be adjusted for each position of the camera.

The series is divided into three principal groups—hoar-frost, window-crystallisation, and ice—a few sections dealing with hail being appended, and for convenience each group is split up into divisions and subdivisions, according to the shape or the grouping of the crystals. The hoar-frost group is divided into two main divisions—tabular and columnar—but the distinction is apparently one of degree only, and cannot be pressed. We have selected as an illustration of this group a beautiful example of the "open branch or tree-like" structure (Fig. 1). It will be noticed that the stems broaden out into well-developed plates at their terminations. The study of the crystals deposited on windows obviously admits of greater ease of observation, and, since the conditions of the atmo-

[1] "Studies of Frost and Ice Crystals." By Wilson J. Bentley. Pp. 22; with 273 figures on 31 plates. (Reprinted from the *Monthly Weather Review*, 1907.)