The pigment is freely soluble in hot water, though quite insoluble in cold water, and in most organic solvents. Its aqueous solution is strongly acid to litmus; and, though it appears to be quite innocuous to frogs when injected under the skin, it may well be ungrateful to the ranine palate. At the same time it must be noted in this regard that its solubility in the secretions of the frog's mouth is but very slight.

The substance is, as I have shown, undoubtedly a derivative of uric acid, yielding the latter body as one of its products of hydrolysis. It gives the murexide reaction direct. It forms quite definite salts with metals, its compounds with the alkalies being soluble bodies.

Having regard to the wide-spread presence of the body in the scales of diurnal Lepidoptera, I have ventured to call it *lepidotic acid*. In its physical properties it closely resembles mycomelic acid, a yellow derivative of uric acid; and, in my original paper, I ventured to suggest a formula for the body. I hope shortly to publish a more complete account of the subject, and to assign a formula to lepidotic acid based upon fuller evidence. Meanwhile, in common with many others of your readers, I am looking forward to the appearance of Mr. Beddard's book. The literature of the subject of animal coloration is not easily accessible, and a text-book thereon will be a valuable acquisition. We have, it is true, the interesting work of Mr. Poulton; but the subject is there treated from what is, perhaps, a somewhat limited standpoint.

F. GOWLAND HOPKINS.

Sir Wm. Gull Research Laboratory,
Guy's Hospital, December 16.

The Chromosphere Line λ 6676·9.

IN response to Father Cortie's implied question as to the identification of this line as belonging to the spectrum of iron, I would refer him to Appendix G of Roscoe's lectures on "Spectrum Analysis" (third edition). It is an extract from a joint paper by Ångström and Thalen, giving a list of several hundred (then) new identifications; among them appears K 654·3, ascribed to iron.

The original memoir was presented to the Stockholm Academy of Sciences in February 1865, and an English translation of it appeared the next year. I am unable to assign any reason why many of the identifications given in this memoir fail to appear in the map published three years later; but they do, and K 654·3 is among the missing.

C. A. YOUNG.

Princeton, N.J., U.S., December 15.

Grafts and Heredity.

I HAD not thought of grafts when I wrote my paper, and I have to thank Mr. Beeby for reminding me of an excellent illustration of my views; though I cannot gather from his letter whether he considers the "individuality" for which he contends to be represented by matter or force. Adopting his phrase I would apply it to both. The material form, *e.g.*, of the leaf of the scion, is due to molecular motion, set up by a group of forces acting in a way peculiar to the life of the scion; which *forces*, together with the resulting *form*, constitute its individuality—somewhat as a man is known by his mental and moral characters as well as by his face.

Now, no two individual plants could be fed more alike than a stock and its grafted scion; since they both receive identically the same food through the roots of the former. All I contend for is, therefore, that it would seem to be more probable that the organic molecules constructed out of this food are all alike, only differently arranged in the leaf of the scion and in that of the stock respectively. These arrangements must be due to molecular forces; while it is difficult to conceive in one's mind how any special kinds of matter can be concerned in the construction of the special forms of leaves; to say nothing of the total want of evidence of the existence of germ- or other plasm.

There is, however, a deeper question still which Mr. Croll asked:—"What *determines* molecular motion?"[1] He observed that although physical forces are not only interchangeable but can pass into those which, for want of a better expression, we may call vital energies; yet, as he says, nothing we know of in the properties of physical forces can throw the smallest degree of light upon the above question. There is always, he adds, the "object" which runs through the whole of organized nature; which cannot be accounted for by means of the known properties of physical forces. In concluding his paper he says:—"If one plant or animal differs from another, or the parent from the child [and, we may add, the scion from the stock], it is because in the building up process the determinations of molecular motion were different in the two cases; and the true and fundamental ground of the difference must be sought for in the cause of the determination of molecular motion. Here, in this region, the doctrine of natural selection and the struggle for existence can afford no more light on the matter than the fortuitous concourse of atoms and the atomical philosophy of the ancients." This observation seems to agree with the following remark of Sir J. D. Hooker on the origin of secretory glands of *Nepenthes*:—"The subsequent differentiation of the secretory organs of the pitcher into aqueous, saccharine, and acid would follow *pari passu* with the evolution of the pitcher itself, according to those mysterious laws which result in the correlation of organs and functions throughout the kingdoms of Nature; which, in my apprehension, transcend in wonder and interest those of evolution and the origin of species."[1]

The nearest approach to an answer to Mr. Croll's question is, as it seems to me (though it be but cutting the Gordian knot after all), that there exists *a responsive and adaptive power inherent in living protoplasm* which is called into action by external forces; so that by a change of environment—especially if the old and the new one be strongly contrasted—a plant, as a rule, at once begins to alter its structure so as to re-establish equilibrium with its new surroundings; and further, if these be maintained long enough, the altered structures become fixed and hereditary, while more or less of readaptation can commence again at any time.

We can no more discover the ultimate cause of this power which *determines* or *directs* molecular motion in living beings, than we can that of crystallization or gravity, reflex action or instinct. Innumerable facts, however, justify the full recognition of its existence.

To apply this to grafts. It is obvious that, whatever determines the molecular motion in forming the leaf of the scion, it is different from that which determines the molecular motion in forming the leaf of the stock, since the resulting forms of the leaves are different; and it is just this ultimate *determining power*, which is unknown and apparently unknowable, which characterizes the individuality of the scion on the one hand, and of the stock on the other. Form is but the outward and visible expression of this power. It is this, too, which underlies the responsiveness of protoplasm, and determines a new form in adaptation to, or in equilibrium with, a changed environment.

GEORGE HENSLOW.

Mental Arithmetic.

THE very simple method of multiplying large numbers, published in NATURE (p. 78) by Mr. Clive Cuthbertson, is mentioned by Pappus, Book II. (ed. Hultsch), 2–29, as an invention of Apollonius. The same method was known to the Hindoos under the name Vajrâbhyâsa (Algebra with Arithmetic and Mensuration from the Sanskrit Brahmegupta and Bhascara, translated by H. Th. Colebrooke, London, 1817).

The method may be enlarged to multiplying three and even more numbers all at once in the following manner:—

$$
\begin{aligned}
(100a_1 + 10b_1 + c_1)(100a_2 + 10b_2 + c_2)(100a_3 + 10b_3 + c_3) = \\
& c_1c_2c_3 \\
& + 10(b_1c_2c_3 + b_2c_3c_1 + b_3c_1c_2) \\
& + 10^2(a_1c_2c_3 + a_2c_3c_1 + a_3c_1c_2 \\
& \quad + b_1b_2c_3 + b_2b_3c_1 + b_3b_1c_2) \\
& + 10^3(a_1[b_2c_3 + b_3c_2] + a_2[b_3c_1 + b_1c_3] \\
& \quad + a_3[b_1c_2 + b_2c_1] + b_1b_2b_3) \\
& + 10^4(a_1a_2c_3 + a_2a_3c_1 + a_3a_1c_2 \\
& \quad + a_1b_2b_3 + a_2b_3b_1 + a_3b_1b_2) \\
& + 10^5(a_1a_2b_3 + a_2a_3b_1 + a_3a_1b_2) \\
& + 10^6a_1a_2a_3.
\end{aligned}
$$

[1] "What Determines Molecular Motion?—The Fundamental Problem of Nature" (*Phil. Mag.*, July 1872).

[1] Address to the Department of Zoology and Botany of the British Association, Belfast, 1874.