

LETTERS TO THE EDITOR

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[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

Natural Science for Schools

I WAS glad to see that "Science Master" had pointed out some of the difficulties in the way of applying the principles laid down in Prof. Armstrong's valuable paper in your number for November 6 (p. 19). The difficulties to which he has adverted relate mainly to those gratuitously thrown in the way of sound and useful practical teaching in grammar-schools by boards of examiners. Another difficulty I ventured to point out in the brief discussion upon Prof. Armstrong's paper at the Educational Conference of the International Health Exhibition, but it did not receive the attention which I think it deserved—partly, perhaps, owing to press of business, and partly, perhaps, also to the fact of the naturally somewhat strong representation of South Kensington interests at a conference held within the shadow of the Brompton Boilers. Prof. Armstrong appeared specially to recommend his mode of teaching "in science classes, such as those held under the auspices of the Science and Art Department," and towards the end of his paper he seems to recognise only one difficulty in the way of introducing it generally, viz. it "undoubtedly involves more trouble to the teacher than that ordinarily followed," and he appears to hint that the present method is mainly due to the incapacity of the teacher, as he says, "I do not believe that it is because the Department consider it" (the system) "a satisfactory one; but they know full well that it would be unwise to legislate far in advance of the intelligence and powers of the majority of the teachers." There are many teachers who are only too anxious to teach, not chemistry merely, but physics and other branches of science upon a sensible system, and who would willingly take considerable trouble to attain that end, but the difficulty is that, were they to do so, they would not get paid for their work. The insane system of *payment by results* is responsible for the greater part of the bad and indifferent teaching of science in this country, and the real trouble is, not that something better is in advance of the intelligence and powers of the majority of teachers, but that it is in advance of the intelligence and powers of the majority of examiners. The Department accept as their primary axiom that no teaching is to be paid for except that which can be exactly tested and appraised by certain examiners; and so no teaching, whatever its educational value, is counted worth anything by them except that which is susceptible of being weighed and measured. I took the liberty at the discussion of asking Prof. Armstrong whether he had ever taught a class on his methods, and if that class was presented to the Department for examination, and if so what was paid for it, and I made bold to express my own opinion that the result would be either *nil* or despicably small. My question received no answer, but I got plentifully snubbed—firstly, that a science teacher should even think of such a subject as remuneration, and secondly, I was informed that practical teaching always paid best. But as it appeared that my critics had misapprehended the point at issue, and were not speaking of the kind of teaching advocated by Prof. Armstrong at all, but thought that *practical* teaching meant allowing the class to see certain experiments performed by the teacher himself—a mode of teaching which I am quite agreed with the reader of the paper in considering quite *unpractical*—I did not feel satisfied that my question was answered, and with your permission will again propound it. It is not a sufficient answer to say that the most practical teachers earn the best results—I am a science teacher of quite sufficiently long experience to know that—*provided it is strictly on the lines laid down by the Department*. What I doubt is whether *sensible* practical teaching would produce any pecuniary results.

Certainly, in what is called (*lucus a non lucendo*) practical chemistry it would not: there nothing but test-tubing can be weighed and measured; and whereas in former years a knowledge of the modes of preparing and experimenting with certain of the more common elements and compounds counted for something in the elementary stage, it has lately, by successive alterations in that direction in successive issues of the Directory, become more exclusively test-tubing.

In physics I presume the intelligent teacher would be glad to teach his class in light, heat, and sound, to make some of the more important measurements, to verify the laws of reflection and refraction, to measure the refractive index of glass, to calculate the foci of various lenses, to determine the latent heat of water and steam, and the specific heat of one or two substances and a few other similar things, not many of which could be introduced in a course of thirty lessons of one hour each; in electricity and magnetism, to establish the laws of intensity, to construct an electroscope, a galvanometer, and a Wheatstone's bridge, to measure the resistance of a few lengths of wire, to determine the E.M.F. of a "cell," &c., in which case the same limits would soon be reached. But would such a course pay? I venture to say not, and the Department have not even given to practical physics the scant encouragement which they afford to so-called practical chemistry. I say *scant encouragement*, because, by a series of red-tape regulations, which are strictly adhered to, they do their best to render the study of practical chemistry needlessly expensive to the committees and unremunerative to the teachers.

I shall probably be told—firstly that the teacher of a science class has no need to limit himself to thirty hours for a course; and secondly, that he should not make remuneration his first consideration. On the first point I reply that he is practically limited in most cases by the length of time during which it is possible to get students to attend: the month of September is as early as it is practicable to commence a course, and the examinations are early in May, so that one lesson a week, allowing for necessary holidays, cannot much exceed thirty lessons. To give two lessons per week would be to occupy the time of two classes for the remuneration—generally poor enough—of one; this, of course, virtually brings us to the second point, as to which I would say that, as in other professions men do not work for inadequate remuneration, I do not see why the science teacher should be expected to be more philanthropic; that neither the clergyman, the lawyer, nor the physician professes to regard money as his chief consideration, yet that the remuneration of each of these professions is far before that of the science teacher, at all events of him who works for the Science and Art Department; and lastly, that that particular line of criticism does not usually come from those who are themselves working from philanthropic motives, but from those who are pretty well paid for their labours, and who would despise the modest reward of the "*payment by results*" teacher.

I hope I shall not be misunderstood as disagreeing with Prof. Armstrong's views; it is, on the contrary, because of my full agreement with them and that I am anxious that those science teachers who are sufficiently advanced in intelligence (and I am persuaded that they are not so rare as Prof. Armstrong seems to think) to adopt a truly educational mode of teaching, should have no needless obstacles thrown in their way, that I venture to address you and to repeat before a larger audience those arguments which I made use of before the smaller auditory at the Health Exhibition.

I for one should be only too glad to see the scope of the science teaching under the Science and Art Department widened, and to know that encouragement was given to the intelligent and advanced teacher to get out of the grooves in which it appears to be the present policy of that Department to retain him.

WALTER A. WATTS

Farnworth Grammar School, November 20

Do Flying-Fish Fly?

I CANNOT pretend to the great experience of Mr. R. W. S. Mitchell in observations on aerial movements of the flying-fish when for a brief space he leaves his native element; but during one voyage from the Isthmus of Panama to England *via* the West Indies I lost no opportunity (of many) of watching these beautiful creatures, sometimes very close indeed to our steamer. The opinion I formed at the time and still retain was that there was constant very rapid motion of the great lateral fins whilst out of the water, so rapid, indeed, that the strokes of the fins could not be counted. From what Mr. Mitchell says, he evidently counted the strokes of the wings (pectoral fins), not by seeing the movements of these, but by the "impressions made on the oily surface of the water," impressions apparently similar to those made by a cormorant or other diver when taking wing from the sea.

The movements of the side fins whilst the fish was in the sea or touching the surface, would be much slower than would be the