single bright colour, scarlet for instance, a kind of shadow appears to come over any part of the surface to which I direct the eye.

With respect to my absolute power of perception of colour, I believe that though I cannot be said to be colour-blind, my eyes are less sensitive to colour than the average of those who have equally good general sight. For instance, scarlet and green do not appear to present to me the same degree of contrast that they do to most persons with whom I have made the comparison. Close at hand the contrast is sufficiently vivid, but a scarlet uniform seen at some distance in a green field would not attract my attention by contrast of colour, though I could make out the difference under a favourable light when my attention had been called to it; so also the scarlet berries of the mountain ash would at a little distance attract my notice rather by their form than by their colour, especially if seen against the sky or a bright object. Again, I can never pronounce with certainty as to the colour of distant bright lights; the colours of the lights, for instance, used for railway signals, though distinctly enough perceived by me when close at hand, puzzle me much when seen at a distance, while I am quite incapable of assigning with certainty a colour to a star or a meteor.

I should add that my ordinary power of vision is good; though here my right eye has a slight, but unmistakable, advantage as to distinctness over my left. Hence, in looking at a brilliantly-coloured picture I have found that I could appreciate the drawing best with my right eye, the colour with my left, while in using both eyes each appears to remedy the defect of the other.

I think that the facts which I have here stated cannot fail to be of interest to those who are inclined to theorise on the nature of colour-blindness; but apart from all theory it would be satisfactory if the statement of my case should induce others to examine their own perceptions of colour with each eye separately, and in the event of their observing anything confirmatory of, or contrasting with, my observations, to send an account of them to NATURE. I think it quite possible that such cases may not be very uncommon, since the defect is one which may easily escape the notice of the subject of it.

Harrow, August 1

ROBERT B. HAYWARD

The Source of Solar Energy

MR. GREG still misses my meaning. I do believe that meteors supply a portion of the solar energy, and I also believe that they fall in enormous quantities into the sun; what I do not believe is that the whole solar energy is derived from meteors, or that any meteors fall in a solid state upon the sun (whose surface is also certainly not solid, even if any part of his mass be).

Mr. Greg's reasoning only proves what I have already pointed out, that none of the meteor systems our earth encounters can supply a meteoric downfall on the sun. This is, however, so obvious as to need no enforcing.

The reasoning by which I show that enormous quantities of meteors must fall upon the sun is wholly untouched by Mr. Greg's arguments, and is, so far as I can see, simply incontrovertible.

Surely Mr. Greg is not in earnest in saying that there would be a loss of solar energy if a large mass of iron fell on the sun before it was quite melted (any conceivable mass would, by the way, be vaporised), *because the sun would have to melt the portion which remained solid*. That solar energy would be consumed in the process is true enough; but if Mr. Greg supposes that the total solar energy would be diminished, he altogether misapprehends the whole subject he is dealing with. If the action of the solar energy in changing the condition of matter forming (as the imagined meteorite would) part of the sun's substance had to be counted as loss of energy, the sun would be extinguished in a very short time indeed. Such processes involve exchange, not loss.

If the earth could be placed on the sun's surface, the action of the sun in melting and vaporising the earth, and producing the dissociation of all compound bodies in the earth's substance, would involve an enormous expenditure of energy, yet the solar energy, considered as a whole, would be recruited, even apart from the fact that the earth would serve as fuel. The absolute temperature of the sun would, I grant, be diminished in this imaginary case, though quite inappreciably, but his total heat would be increased by whatever heat exists in the earth's substance.

Apart from this, however, if the minimum velocity with which a meteor or other body can reach the sun, is such as would—if wholly applied to heating the body—completely melt it, then the size of the body makes no difference whatever in the result. The meteor might not be melted if enormously large, but in that case the balance of heat would be communicated to the sun. In reality, of course, the heat corresponding to meteoric motion near the sun is very far greater than is here implied.

But I really must apologise for bringing before your readers considerations depending on the most elementary laws of the conservation of energy.

RICHARD A. PROCTOR

Müller's Physics and Meteorology

FROM Prof. Jack's Review of Müller's "Physics and Meteorology," in your issue of August 4, I infer that he is not aware that an earlier edition of that valuable book was translated into English more than twenty years ago, and formed one of the volumes of Baillière's *Scientific Library*.

M.A. Cant.

Aug. 7

Colour of Water

MR. E. R. LANKESTER, in his letter in NATURE on 21st July, does not mention what is certainly one of the most remarkable known instances of a decided colour in water, I mean the Blue Lake near the road from Frutigen to Kandersteg in Switzerland. It is very small, not a stone's throw across. I think it is fed by springs. Its blue tint is so decided as to give the idea of some colouring stuff mixed with the water—not that it can be really so.

The Lakes of Neufchâtel and Bienne are of the same light-green tint as those of Lucerne, Brienz, and Thun, although the latter are fed by glacier streams and the former are fed by the streams of the Jura, where there are no glaciers. This appears to prove that the solid matter which glacier streams contain in suspension can have nothing to do with causing the green tint of most of the Swiss lakes.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim, Aug. 5

Water Analysis

YOUR article entitled "Water Analysis" consists of a review of a book, a commentary on a paper, and the reviewer's opinions of the character of Mr. Chapman and myself.

I shall not trouble you with any rectification of the statements contained either in the review or in the commentary on the paper; inasmuch as both the book and the original memoirs are accessible to the readers of NATURE, and the entire subject has already been very fully discussed.

In giving his opinion on the character of the authors of the book, the reviewer "deplored that two young chemists, with such undoubted abilities as Messrs Wanklyn and Chapman possess, should have rendered themselves notorious by attacking older workers in scientific investigation."

Perhaps you will allow me to say, that in rendering ourselves notorious in this manner, we have committed no crime, and that I cannot see why it should be deplored.

I believe that a great deal of the work which these older workers have done is unsound, and have endeavoured to sweep away some of that which I believe to be unsound. In this sweeping I have been to some extent successful, successful to an uncomfortable and alarming extent, I suppose your reviewer would say. But, if the rottenness of much that passes current in science is appalling, it is surely matter for congratulation that there are young men who will undertake a crusade against it, even at the risk of incurring the disapprobation of the older men, and of suffering every wrong that the possession of place and power enables these older men to inflict.

London, Aug. 14

J. ALFRED WANKLYN

[Mr. Wanklyn omits the sentence following his quotation:—"It is, no doubt, very laudable in a young and ardent investigator, when he points out that high authorities may err, and frequently have erred, but the manner in which these gentlemen have carried out their corrections has made their matter more distasteful."—Ed.]

Suckers from the Apple Tree

MOST of the orchards in the west of Herefordshire have had their herbage injured during the present season by the extraordinary profusion of suckers thrown up by the apple-trees. In

many places it looks like a miniature plantation, and is a serious detriment to the pasture. In an equal degree the elms have exhibited the same tendency to throw up an infinite number of shoots, and I am curious to know whether I am right in considering it to be due to the great heat of the surface of the soil.

C. J. ROBINSON

A Natural Fernery

NEAR where I am writing, in this parish (East Woodhay) is a deep hollow lane, with high sloping banks, which are abundantly clothed with the following ferns (nomenclature and arrangement from Dr. Hooker's new "Flora") :—*Pteris aquilina*, *Lomaria spicant* (rare), *Asplenium Adiantum-nigrum*, *A. filix-femina*, *Scolopendrium vulgare*, *Aspidium aculeatum*, *A. angulare*, *Nephrodium filix-mas* (with several pretty barren varieties), and *Polypodium vulgare*. Although the ferns are of the most common species, yet from the sloping nature of the ground, and the intermixing of a few other plants, such as *Equisetum sylvaticum*, *Lactuca muralis* (very fine), *Digitalis purpurea*, *Campanula Trachelium*, *Hypericum pulchrum*, *Funcus glaucus* and *compressus*, with a few pretty *Rose* and *Rubi*, tend to make it the most charming bit of fern scenery that I have ever fallen in with.

HENRY REEKS

The Science and Art Department

IN your impression of the 4th you have touched upon a point which has of late interested me much, viz., the science teaching of the "Science and Art Department."

At the commencement of the article you say that the work done is so little known that you have ventured its history. If you will allow me a small portion of your valuable space, I will put before your readers a few facts concerning the said "Department."

The teachers in the employ of the Department have no fixed salary; payments are made upon results to those persons who have passed in the first or second class (advanced stage) in the subject or subjects in which they give instruction, or who have passed in "Honours."

Now, a teacher's certificate is by no means difficult to obtain (advanced stage), provided Honours are not tried for, and consequently there is a large number of low-class teachers in the ranks, or those who are only grounded in elements of the subject which they are certificated to teach. For instance, a pupil on entering in 1869 for the examination and taking a second class in the advanced stage is entitled to teach and earn payments on results; such a teacher may only be grounded in the elements of the subject (say chemistry), and when he is applied to for the solution of a problem governed by physical laws he is at a loss and the pupil gets no answer to his query. It is my opinion that the teachers' examinations are much too easy. I think a certificate ought not to be granted unless the candidate has shown that he is familiar with the subject he intends to teach, and also with the cognate sciences. A chemistry teacher should know, at least, light and heat, magnetism and electricity; but at present such knowledge is not required.

I am not speaking specially for chemistry; geometry I may instance. There are many teachers at present engaged in giving instruction who know not a jot of Euclid's elements, nor can they work out the simplest algebraical problem. Should not a teacher know the theory as well as the practice, so as to give a definite and true answer to a pupil's inquiries. Machine drawing is the same; the examination consists of mere copying, and I can safely say that there are many teachers of mechanical drawing who would not be able to answer a single question of the paper set by the Society of Arts' examiner.

Science-teaching is daily becoming more and more appreciated, in some districts, however, only but very slowly; and I think it is only right that those teachers who do take an interest in science should endeavour to keep up the standard of the teacher. I should like to see every teacher obliged to pass in Honours—then the chemist would not pass without a thorough knowledge of physics, neither would the teacher of plane and solid geometry escape so easily, nor the pseudo-machinist obtain a certificate in a subject he was not competent to teach. But we must look at science as now taught from another point of view. It is for the encouragement of science among artisans (designated in the *Science Directory* as "the industrial classes") that the payments are made to teachers,

the teachers not being able to claim any sum upon those which do not *strictly* come under that denomination.

Now, in the branch of chemistry some important rules have lately been made: candidates for the advanced stage are to be taught qualitative analysis, and each is to be supplied with a 2*l.* set of apparatus, the artisan cannot afford to supply it himself; the institution, or other place where the class meets, has only just enough funds to enable it to keep its head above water—who is then to supply it? The teacher; but often he will not see his way clear, for if he supplies it, 50 per cent. only is allowed him if the candidate obtains a first class. The pecuniary result to a teacher then is—for passing a student in the first class 1*l.*, and in the second a loss of 1*l.*, so therefore it will be advantageous for a teacher to keep his pupils out of the advanced stage altogether. If the authorities continue to let the rule stand, I should think payments would be allowed on middle-class students, as they are the only ones who probably could provide them with the apparatus.

It is all very well to say that an artisan, if he take sufficient interest in the science, will provide himself with the apparatus, but it generally happens that the willing ones are those who have the least opportunity of doing what they wish.

The past session has been a trying one for all teachers, for not only have the payments been reduced, but, to make up the list of evils, the standard has been raised, and consequently fewer have passed. The current session seems to be attended by as many drawbacks, which, if not withdrawn or somewhat modified, will, in the opinion of the majority of teachers, produce injurious results.

AN "HONOURS CERTIFICATED SCIENCE TEACHER"

The Intended Engineering College

WILL you allow me a small space in *NATURE* to call attention to a subject which seems to me to require the serious consideration of everyone who is interested in the progress of science in this country?

In reply to a question put to him in the House of Commons by Mr. Plunket, on the 9th instant, Mr. Grant Duff is reported to have said that it is the intention of Government to establish an engineering college for the Indian service, to be entered by competitive examination. Mr. Grant Duff does not appear to have entered into any detail with regard to the instruction to be given in the intended college, but it is fair to assume that Government would not think it worth while to take the education of engineers for India into its own hands, except with the intention of giving them a thorough and systematic training, at least as complete as what is already supplied by existing institutions. In this case, the instruction to be given in the new college will embrace at least a three years' course of study devoted to pure and applied mathematics, mechanics, physics, chemistry, geology, and the principles of engineering, in addition to the actual practice in the drawing office and workshop. That is to say, the Government school of engineering will be, on this supposition, what the Government School of Mines has become, in the main, a school of pure science.

Now, in view of this probability, the question suggests itself—whether it is fair and just that institutions like University College and King's College in London, and Owens College in Manchester, which, without Government support or help of any kind, offer precisely the kind of training which we suppose the new college is intended to impart, should have to compete with an institution supported by Government prestige and Government money. The answer to this question affects not merely the interests of private institutions, such as those which have been mentioned, but, so far as the existence of these institutions is a benefit to the general public, it affects the interests of the whole nation; for in the case of colleges which depend for all or much of their income upon the general demand for education, their efficiency and their power to supply teaching of the highest kind, cannot but be seriously interfered with, if they are to be deprived of all share in the training of a class of pupils numerous enough to induce the Government to found a separate college for them alone. The course which Government proposes to adopt would, it seems to me, be justifiable only if the existing colleges were inefficient, and it had a clear prospect of establishing a more successful institution. As I have the honour to be connected with one of the Colleges in question, I do not intend to discuss their merits further than

* The Universities of Glasgow and Edinburgh might also be referred to although they do receive some amount of aid from the public funds.