

there is no question of saving life, and which is repeated a thousand times for the private benefit of its performers, is omitted!

6. In Dr. Ferrier's research, anaesthetics were so "carefully and liberally given," that five animals out of the twenty-nine sacrificed "died before they were touched or operated on in any way" (3178).

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#### The Use of the Words "Weight" and "Mass"

IN a letter with the above heading published in NATURE, vol. xiii. p. 325, Mr. Bottomley has recommended that the ambiguity of the word weight shall be avoided by using the phrase "the gravity of a pound" when we mean the downward force due to the earth's attraction upon a pound weight.

The ambiguity against which Mr. Bottomley wishes to guard is a very real one. Not to speak of common usage, which allows three meanings of the word weight to be loosely intermingled, we have two of these meanings adopted into scientific nomenclature. The universal practice in chemistry is to employ the word weight to signify mass, and anyone may satisfy himself that this use of the word could not be dispensed with in that science by making the attempt to substitute other forms of expression for the convenient words weight, heavy, light, heavier, lighter, as used by chemists. On the other hand, physicists have generally employed the term to signify a force, and the best writers on mechanics are careful to avoid using it to express mass.

But I fear Mr. Bottomley's remedy, if adopted, would introduce quite as serious, perhaps a more serious, ambiguity. Gravity is an acceleration. When we say that gravity is less in a balloon or in a mine than at the surface of the earth, or greater at Glasgow than at Manchester, we are speaking of alterations of  $g$ —the acceleration due to the earth's attraction; and it would create confusion to employ this word to designate forces also.

But a practice which I adopted in lecturing on mechanics in Queen's College, Galway, many years ago seems to meet the difficulty, and may perhaps recommend itself to other teachers. It is to use the word *gravitation* in the proposed sense.

If this were done, *gravitation* at Glasgow would mean an acceleration; the *gravitation* of a kilogramme there would be a force; and *weight* would continue a word of doubtful import, to be judged of by the context, sometimes used for a force, sometimes for a mass, and sometimes for those pieces of metal which are employed as measures in weighing (as in the phrases "a set of weights," "a gramme weight"). In further support of my suggestion, it may be observed that the proposed use of the substantive *gravitation* follows legitimately in the English language from the established meaning of its correlative, the verb *gravitate*.

I would wish to take this opportunity of also recommending a prefix which I have found of the utmost service both to students by assisting them to acquire clear conceptions with ease, and to myself. We use the prefix *hyper* placed before the name of any metrical weight, as hyper-decigramme, hyper-gramme, hyper-hektogramme, hyper-kilogramme, hyper-tonne, to indicate those forces of the absolute metrical series which are slightly larger in amount (about 2 per cent. more) than the gravitation at the earth's surface of the decigramme, gramme, hektogramme, &c., respectively.

When a student has to use weights as forces, as he must in the laboratory, he should be trained from the beginning to think of them in their relation to the neighbouring absolute forces. For instance, if he uses a hektogramme to exert a pressure, he should

be encouraged to think of it rather as  $\frac{2}{10}$ ths of a hyper-hektogramme (which is a force) than as a hektogramme (which is more properly a mass). This will also keep prominently before his mind that the amount of the pressure depends on the station at which the experiment is made.

G. JOHNSTONE STONEY

Queen's University, Ireland, March 9

MR. BOTTOMLEY remarks in his letter on weight and mass that appeared in NATURE, vol. xiii. p. 325, that "During the present session we have aided ourselves in Glasgow with four very important helps to the teaching of the kinetic system of force-measurement. . . . The third help is the construction by Prof. Thomson, for the first time so far as I know, of spring balances for indicating poundals and kilodynes."

Will you permit me to point out that about three years ago Prof. Ball, when introducing the C. G. S. system of units into the course of mechanics at this college, had a series of dynamometers in absolute measure specially constructed by Messrs. Salter, of West Bromwich. These dynamometers were exhibited at the Bradford meeting of the British Association, and will also be seen at the forthcoming Loan Exhibition at the South Kensington.

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#### Metachromism

MR. FLINDERS PETRIE in his interesting letter (vol. xiii. p. 348) criticises the abstract of my paper which appeared in NATURE some weeks ago. Before considering his communication, I would remark that my argument against Schönbein's theory accounting for metachromism is based upon the colour relation which he mentions. I gave a small table of anhydrous binary compounds which conform to the rule, and that table includes the chlorides of chromium which Mr. Petrie has pushed out into the cold. The relation is thus referred to:—"Those compounds in a series which show the highest amount of the basylous element have the most refrangible colours." So far as I am aware, it is there announced for the first time.

For the sake of clearness we will first examine Mr. Petrie's proposition:—"Increase of the electro-negative element produces a colour-change towards the red end of the spectrum, and *vice versa*."

Increase of the electro-negative element is accompanied by less refrangible colours, but to say that this increase produces the change is going farther than the observations warrant, is, in short, opposed to fact. For example, if we take the series of oxides of chromium which he gives—Cr<sub>2</sub>O<sub>3</sub> green, CrO<sub>3</sub> yellow green, CrO<sub>3</sub> red, I fail to see that increase of the electro-negative element, *i.e.*, colourless oxygen produces a change towards the red end, or, on the contrary, that decrease in the positive element does the same. The facts seem rather to show that colour in any body is dependent upon the proximity of its molecules, since we find bodies which, with like chemical composition but different densities, have different hues.

The metachromatic scale given on page 298 is not intended to be absolute, and may, in fact, need a little modification with the accession of more knowledge. But certainly Mr. Petrie's remarks do not affect it, because (1), the colour gradation he refers to is attended by chemical differences, whereas in metachromatic phenomena we have purely physical alterations; (2) white does not come between yellow and blue, either in the "natural" or in the metachromatic arrangement. For if by "natural arrangement" he means that of the pure spectrum, then green is what intervenes between blue and yellow, and white has its nearest counterpart in the ultra-violet grey. Quite recently this part of the spectrum has been termed "silvery grey" by M. Sauer. Independently of this, however, I was led to place white in the ultra-violet part of the metachromatic scale by certain mineralogical facts which I shall not trouble your readers with detailing here.

The assertion, then, that white comes between yellow and blue, would seem to rest upon the colour relation found to obtain between the oxides of the alkali metals, which really is not worth much, because of the little we know about the sub-oxides; and because even the chief series he gives, that of sodium, is an exception to the rule, Na<sub>2</sub>O<sub>2</sub> being pure white (Watt's "Dictionary," vol. v., p. 340), and not orange, as Mr. Petrie states; and, finally, because we cannot fairly compare the order of colour we see in the binary compounds with what we get in metachromatic phenomena, although to a great extent there is a colour parallelism which is remarkable.

WM. ACKROYD

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March 4

#### The U.S. Survey Publications

IN NATURE, vol. xiii. p. 314, I observed a note upon the rumour that the publication of Prof. Hayden's Geological Reports was likely to be stopped by the U.S. Government.

Having brought the paragraph under the notice of the Museum Committee of the Town Council, I am requested by them to communicate with you, and to say that several of these Reports have been received by the Leicester Museum, and are regarded as of great value; and that the Museum Committee will be glad