colleagues, who are at present absent in the field, but we are convinced that if they had the opportunity they would join with us in appending their signatures to this letter.

T. H. D. La Touche, H. H. Hayden (Superintendents, Geological Survey of India).

P. N. Datta, E. Vredenburg, L. L. Fermor, G. E. Pilgrim, G. H. Tipper, H. Walker, K. A. K. Hallows, G. de P. Cotter, J. J. A. Page, H. C. Jones, A. M. Heron, M. Stuart, N. D. Daru (Assistant Superintendents, Geological Survey of India).

W. A. K. Christie (Chemist, Geological Survey of India).

Geological Survey of India, Calcutta.

An Optical Phenomenon.

IN reference to the query of "V. P." in NATURE of June 3 (p. 398), under the above title, I describe a simple experiment which will, in all probability, lead to an easy explanation.

Allow sunlight to fall upon a vessel filled with water to a depth of a few inches. If the bottom be white, so much the better. A bath-tub is excellent. Now draw a finger through the water so as to produce a wake, in which are to be seen the familiar "dimples" characteristic of vortex motion. Then, on the bottom will be observed, corresponding to each dimple, a black shadow with a brilliant edge, just the same sort of appearance, in fact, as that described by your correspondent. The same, by the way, may be observed in shallow brooks.

The explanation in this case is not difficult. A very small central portion forms a concave lens, the enfeebled illumination of which on the bottom is negligible. The portion surrounding this and extending as far as the plane water-surface acts somewhat after the manner of a convex lens, concentrating the light passing through it into a more or less sharply defined ring, a "focal ring," so to speak, as contrasted with a "focal point." The diameter of this ring would approximate that of the whole dimple. By far the greater part of the light falling upon the area of the dimple is collected here, and, consequently, the field within appears black aided by contrast. It is easy to see that an essential is the relative smallness of the concave part of the dimple, as is borne out by failure to obtain the phenomenon on a large scale by stirring water in a beaker.

Now, following up this experiment and considering window-panes, one would expect to find there flaws of a dimpled nature, or else of a corresponding heterogeneity of refractive index. The former I have found to be the case, especially surrounding air-bubbles, as is easily to be detected by the touch in many cases. The formation of these flaws could be accounted for by the contraction of the air during cooling in process of manufacture. Moreover, in this instance, the bubble itself, forming the concave lens, need not always be small, since it is usually of a focal length far shorter than that of the surrounding portions of the pane.

Flaws of this type are rarer than those of an opposite or protruding type, which, of course, produce patterns with a white centre.

L. G. HOXTON.

University of Virginia, July 26.

A Quest on of Percentages

IN reply to the letter on the "Calculation of Percentages" in NATURE of August 5, may I venture the opinion that the only common-sense method of finding the percentage of marks gained by a student in a series of examinations is to add together all the marks obtained by the student, and find what percentage this total is of the maximum possible?

By this method the more difficult papers, which have a greater number of marks allotted to them, retain an important proportion in the result, whereas the elementary papers, which are worth only a few marks, have only a small influence on the final percentage.

If one were to calculate the percentage for each paper, and then average these percentages, this would manifestly be the same as giving the same number (i.e. 100) of marks for each paper. This would necessitate equal difficulty in each paper set.

LEWIS WHALLEY.

39 Clarendon Street, Keighley, Yorks, August 13.

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IN NATURE of August 5 Mr. Cunningham appeals to mathematical readers for information on the question of averaging three results, viz. :—

either giving $37/50 + 50/50 + 71/100$,

$(37 + 50 + 71)/200 = 79/100$

or

$(2 \times 37 + 2 \times 50 + 71)/300 = 81\frac{1}{3}/100$.

Though I am not a mathematician, but a chemist, I trust I can give the required answer.

The way of averaging depends on the weight of the single results. By the latter way of calculating, the third result affects the average with twice the weight of the former way. Equal weights for each result require equal denominators. Taking for a very simple instance the problem of averaging between 20/100 and 40/100, which is obviously 30/100, the first way of averaging, as proposed by Mr. Cunningham, would permit a calculation like this (20/100 being = 2/10 = 1/5, &c.) :—

$2/10 + 40/100 = 42/110$ or $1/5 + 40/100 = 41/105$,

or (40/100 being = 400/1000 = 4000/10,000)

$1/5 + 400/1000 = 401/1005$ or $1/5 + 4000/10,000 = 4001/10,005$.

These results, I believe, will explain better than many words the essential point of this question.

Breslau, Parkstr. 13.

R. ABEGG.

Kohlrausch's "Physical Measurements."

REPLYING to the letter of Mr. Nelson in NATURE of August 12, the value given for the k in question in the ninth German edition of "Kohlrausch's Lehrbuch der praktischen Physik" (1901) is 0.457. But it must be borne in mind that this value is deduced on the assumption that the specific gravity of the brass weights is 8.4, and seeing that the specific gravity of various samples of "brass" varies not inconsiderably, it is immaterial whether one uses 0.457 or 0.458 for the correction factor. The rounded value, 0.46, is near enough for most purposes, and that is the one given in the tables of Landolt-Birnstein. For accurate work the specific gravity of the weights must be determined in any case, and the value of k calculated for these particular weights.

G. RUDOLF.

"Ivor," Cranley Gardens, Muswell Hill,
London, N., August 12.

A Kinematical Illusion.

THE following experiment is easily tried, and throws, I think, some light on a certain type of illusions.

A small cogwheel from an old American clock is the only apparatus required. Holding the axle in the finger and thumb of the right hand, give it a twirling motion, say counter-clockwise. Let the teeth of the wheel click gently against a small card, or the finger-nail of the left hand. On looking at the wheel the spokes appear to revolve counter-clockwise (as they do) and the teeth to revolve in the reverse direction.

C. S. JACKSON.

25 Nightingale Place, Woolwich.

RÖNTGEN RAYS IN THE DIAGNOSIS OF DISEASE.

GREAT development has taken place in the last few years in the application of Röntgen rays to the diagnosis of disease. At first it was only possible to show the shadows cast by bones and by dense foreign bodies, usually metallic bodies. With improvement in apparatus and in method, the art of radiography has advanced in such a way that it is now possible to show, not only the outlines of the bones, but minute details of their structure, and, more than this, a considerable amount of detail can now be shown in the soft parts of the limbs. While at first surgeons alone found X-ray diagnosis useful, as in the diagnosis of fractures, dislocations, and foreign bodies, the physicians have gradually been able to