results unless plenty of ash constituents are present, phosphates as well as potash; paragraph 20, that phosphates are a highly desirable addition in the manuring of barley; and paragraphs 24 and 27, that both phosphates and potash should be used on potatoes and on grass-land when sulphate of ammonia is used to supply nitrogen.

The Committee is to be congratulated on having secured and published a very useful and very justly written essay.


With this book we have another addition to the great number of text-books on the Elements of Geometry. Its chief features seem to be that the editors endeavour to instil into the students the notion that it is the correct reasoning and proof of the propositions which should be mastered, and not so much an exact repetition of the words of the text-book or teacher.

Abbreviations are freely used early in the first book, and these should be adopted generally by beginners, as the reasoning of a proof can be more easily scanned. The editors have in several cases departed from Euclid's solutions and adopted in their stead more modern and simple methods. Included in the text are many examples, both original and selected, from mathematical journals and examination papers. In this form the Elements should be found useful in many schools.


An attempt is here made to employ the methods of Lewis Carroll in the teaching of botany. In the first chapter the foxglove explains: "This is Leap Year with us (the flowers), and so we have a thirty-first of June," and because the thirty-first of June does not occur every year, it is a day of special favour to humans, who are allowed "to hear with both eyes and ears." Sylvia talks with plant after plant, and is instructed by them in the fascinating mysteries of cross-pollination and many other interesting questions of plant-life. The jam is sometimes scarcely thick enough to hide the powder; but we have little doubt that the volume will find many appreciative readers.


Mr. Yorke's object is to provide an introduction to this branch of physics for those students who already possess some acquaintance with general elementary science. His treatment is non-mathematical, and no precise instructions are given for experimental work. It is a little difficult to understand the reason for the interpolation of chapter vi., headed "Electricity," between the subjects of magnetism and the study of electric currents, most especially as the subject of electrostatics is resumed in chapter xii. The explanations are clear and simple, and the book should give an intelligent reader sound preliminary conceptions of an important subject.


The collection of short essays on various aspects of nature-study collected here should do a great deal towards enlisting the sympathy of school teachers in developing a love in their pupils for outdoor observations of animal and plant-life. Mr. Lowerison gives, in an informative way, a series of useful hints as to how to set about observing nature, and what books to consult to fill in an explanation of observations which are not at first easily understood. Mr. Nutt's chapter describes the scope of folklore and the aims of students of this department of knowledge.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. No notice is taken of anonymous communications.]


I CANNOT refrain from addressing to you a few words in support of Prof. Herdman's remarks on the outcome of the Stockholm Conference. With marine biology so eminently represented at the meetings, there was ground for an expectation that the claim for primary attention in any report would be established for explorations for work at sea. The representatives of chemical and physical work appear to have known their minds and to have obtained the just recognition of their claims.

Hitherto in biological investigation work has been too exclusively devoted to the food fishes themselves—too little to the food of these fishes—for too little to their biological environment. It will be to many eager students, both of fishery affairs and marine biology, a matter of dismay if nothing more definite results from this Conference. There are, and have been, too many committees, secretaries, and bureaux engaged on this subject. As Prof. Herdman says, we want work at sea. To be precise, we want, to begin with, two well-equipped trawlers and the right men in them. If the Stockholm Conference had recommended even one, it would have been a sign of grace. But the trawlers are not made; they are not scientific instruments—not merely the luxuries afforded by governments in times of prosperity—but sound financial investments in fishery affairs. The Norwegian Government has, I understand, ordered one, admirably devised for marine investigation.

GEORGE MURRAY.

November 25.

Bust of Sir George Stokes.

You were kind enough to say last June that Mr. Hammond-Thornycroft would undertake the production of bronze copies of the presentation bust of Sir George Stokes, about one-third of the size of the original, at a cost of seven guineas each, in case twenty-five were ordered, and that names would be received by Sir William Crookes and myself.

If anybody wants such a copy I hope that he will write to me at once.

JOHN PERRY.

Royal College of Science, London, South Kensington, S.W., November 22.

A Geometric Determination of the Median Value of a System of Normal Variants, from two of its Centiles.

A SHORT account appeared in Nature, October 12, p. 584, of a paper read by me at the British Association, entitled the "Median Estimate," which will appear in the forthcoming Journal of the Association. Its object was to solve a problem of the following kind—40 per cent. of the members at a meeting vote that a proposed grant should be less than 100/-; 80 per cent. vote that it should exceed 500/. What is the Median Estimate, supposing the normal law of frequency to hold good? That is to say, What is the sum that one-half of the members would think too little, and the other half too much, and which therefore presents the best compromise between many discordant opinions? I showed that the calculation was exceedingly simple if certain tabular values are used that will be spoken of later. But, on after reflection, it seems to me that further simplification is both desirable and feasible. The problem is representative of a large class of much importance to anthropologists in the field, few of whom appear to be quick at arithmetic or acquainted even with the elements of algebra. They often desire to ascertain the physical characteristics of races who are too timorous or so numerous as to be measured individually, but who could easily be dealt with by my method. Suppose it to be a question of strength, as measured by lifting power, and that it has been ascertained that a per cent. of them fail to lift a certain bag of known weight, and another per cent. of them fail to lift another heavier bag. From these two data, the median strength can be determined by the simple method spoken of above, and not only it but also the distribution of strengths among the people. Having indicated

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the utility and importance of the general problem, I will proceed to work out the particular case of the voters by the latter simplified method. In Fig. 2 let the base line a represent 100, and let each successive horizontal line above it represent an increment of 100. A dot b is placed on c, at the division 40°, and another dot d is placed on e, at the division 80°, at the level of the fourth line above g. Therefore a and b are plotted at their respective places. Join the two dots with a straight line. The place where this line cuts the ordinate at 40°, shows the Median value. The principle on which this exceedingly simple process rests must be explained by beginning with Fig. 1, where an ordinary curve of distribution is drawn, about the axis H, with a quartile equal to 1. The curve of distribution is made up of points obtained by plotting the values of a, b, and c, while the ordinate graduations lie along the opposite edge of the strip serve for the ordinates A and B. For frequent service, a ruled blank form, like Fig. 2, is quicker in use, and it need not, I think, be larger than half a sheet of foolscap paper, or eight inches wide. This would suffice to show clearly each alternate centile, as about the middle of the form, where the centiles lie closest together, the alternate centiles would be more than one-tenth of an inch apart.

An attempt is made at the bottom of Fig. 1 to exhibit the amount of error that would be produced by a simple interpolation between A and B. It is better to make the comparison numerically.

Let a and b be the percentage of those who vote, &c., for less than A and B respectively, and let a and b be the tabular numbers including their sign, corresponding to a and b, on the scale reckoned from 0° to 100° (from not 0° to ±50°). Let m be the unknown median and q the unknown quartile of that curve of normal frequency which passes through the plotted positions of A and B, then

\[ m + qa = A \]
\[ m + qB = B. \]

Whence, by eliminating q, we have

\[ m = A - a \left( \frac{B - A}{B - a} \right) = a \left( \frac{B - A}{B - a} \right), \]

The "medians calculated" in the table below are thus derived. The simple interpolations require no explanation. Graduations on the scale 0° to ±45° are in brackets.

<table>
<thead>
<tr>
<th>Values of b</th>
<th>(+20°)</th>
<th>(+25°)</th>
<th>(+40°)</th>
<th>(+50°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mₜ</td>
<td>70°</td>
<td>80°</td>
<td>90°</td>
<td>95°</td>
</tr>
<tr>
<td>Medians calculated</td>
<td>348</td>
<td>300</td>
<td>259</td>
<td>236</td>
</tr>
<tr>
<td>Simple interpolation</td>
<td>340</td>
<td>300</td>
<td>271</td>
<td>200</td>
</tr>
<tr>
<td>Medians calculated</td>
<td>231</td>
<td>193</td>
<td>167</td>
<td>154</td>
</tr>
<tr>
<td>Simple interpolation</td>
<td>233</td>
<td>200</td>
<td>180</td>
<td>173</td>
</tr>
</tbody>
</table>

The interpolated results are, of course, correct when A and B are symmetrically placed, as they are at 20° (±30°), and 80° (±30°). They are most incorrect when either A or B is near to the limits of the curve, and when both are on the same side of its middle point.

When applying the method practically, especially upon some unfamiliar characteristic whose law of frequency is doubtful, the determination of M should be considered as a first approximation, and the process be repeated with two new values A and B, the one a little less, and the other a little greater than M. The new result M₁ could be accepted as final.
For perfection of simplicity some method, whether it be
graphic or tabular, for converting observed numbers into per-
centiles, might be printed at the back of the blank form.

FRANCIS GALTON.

On the Cause of Dark Lightning and the Clayden
Effect.

I have been criticised in a letter which appeared recently in
Nature for not alluding in my letter on dark lightning to the
peculiar photographic reversal known as the Clayden effect. I
must confess that at the time of writing my letter I was unaware
of this effect, a description of which has only appeared, so far
as I know, in one of the photographic journals. Mr. Clayden
has certainly explained dark lightning, and it only remains to
explain his explanation. As I think that this effect is not
generally known, I believe that it may be worth while to de-
vote a few words to the statement of the case before describing
the experimental work by which I have determined the factors
which play a part in this very curious photographic phenomenon.
Mr. Clayden showed that if a plate which had received an
impression of a lightning flash or electric spark was subsequently
slightly fogged, either by exposing it to diffused light or by
leaving the lens of the camera open, the flash on development
came out darker than the background. If, however, the plate
was fogged before the image of the flash was impressed, it came
out brighter than the background, as in the ordinary pictures
of lightning. I refer to the appearance in the positive print
in each case. This is quite different from ordinary reversal
due to the action of a very intense light, for the order in which
the lights are applied is a factor, and the phenomenon lies
wholly in the region of under-exposure. I repeated Mr. Clay-
den's experiment, and obtained dark flashes without any
difficulty.

The effect cannot, however, be obtained by impressing an
image of the filament of an incandescent lamp on a plate, and
subsequently fogging the plate. Clearly there is something
about the light of the electric spark which is essential to the
production of the reversal. It is not intensity, however, for I
found that it was impossible to obtain reversed images of bright
sparks with the lens wide open.

Fig. 1 shows a series of spark images, some normal, some
partly reversed, and others wholly reversed. The sparks are
those of a large inductorium with a good-sized Leyden jar in
circuit. The sparks were all of equal intensity, but after each
discharge the iris diaphragm of the lens was closed a little.
It will be seen that the borders of the bright sparks are re-
versed. In some the image is reversed, with the exception of
a narrow thread down the core. The images were impressed
in succession on the plate by moving it in the camera. A plate
holder was dispensed with, an opening being made in the
ground-glass back by removing a strip a few centimetres wide.
The plate was held against this opening, and a large number of
exposures made in a few moments. Of course, the room
was in total darkness. After exposure, the plate was exposed
to the light of a candle for a second or two, and then developed.

In this series of pictures it will be seen that the edges of the
images of the sparks are reversed, the intensity on the border of the image being less than at the core. As the inten-
sity of the spark becomes less and less, the bright central core
dwindles down to a mere thread, and eventually disappears,
the spark's image being feeble enough to reverse over its entire
area. This explains why the dark lightning flashes are usually

ramifications of the main flash. The ramifications are less
brilliant discharges and reverse, while the main one is too bright
to cause the effect.

The first thing that occurs to one is that it may be some
peculiar radiation, which the spark emits, which is warming in
the light coming from other bodies. If a small photographic plate
is partly screened by a piece of black paper and illuminated by
the light of a small spark at a distance of two or three feet, and
a similar plate, screened in the same manner, is illuminated for
a moment by candle light of sufficient intensity to produce the
same amount of blackening on development, he shall have the
means of showing that the spark light differs in its action on the
plate from that of the candle. If these two plates, before
development, be half-screened in a direction at right angles to
the former one, and exposed to the light of the candle for a
second or two, the part of the plate which has been illumina-
ted by spark light plus candle light does not become as
black on developing as the part which has received candle
light alone, whereas the part which has been twice exposed
to candle light is blacker than that which has been only ex-
posed once. This shows that the light of the spark does not
act in the same way as the light of the candle. Wherin