LETTERS TO THE EDITOR.

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The University of London.

SIR JOHN LUBBOCK does not seem to me to appreciate in the smallest degree the facts of the position.

His proposal is, as I and others understand it, that the result of the labours of the Statutory Commission "should be submitted to Convocation for their approval, *to be signified as at a senatorial election.*"

The words which I have placed in italics propose a new procedure which I presume would have to be provided for in the Act. This is what for the sake of brevity has been called the *referendum.*

For reasons which I have sufficiently set out in my former letter I think the institution of the *referendum* extremely undesirable under any circumstances, and peculiarly open to objection in the present instance.

But I think we are now entitled to ask Sir John explicitly what he means when he says "it is the law at present," and that his "constituents highly value this right." In so grave a matter it is difficult to believe that he is indulging in a mere logomachy, or that he means seriously that the veto exercised under existing conditions and the new *referendum* are one and the same thing.

The meaning of the whole business is, of course, very simple. Convocation, in common with the Senate and practically every body interested in the higher education in London, has expressed its approval of the Report of the late Commission as affording a basis for the reorganisation of the University. As Convocation is not to be moved from its decision expressed in the customary and constitutional way, the leaders of the minority, mainly drawn from the Faculty of Laws, have induced Sir John Lubbock to suggest a fundamental change in our procedure. The hope, of course, is that by this means a different result may be manipulated. I say "manipulated" because I entirely agree with Mr. A. W. Bennett, who in his admirable letter clearly indicates the kind of tactics we may expect. As the avowed object of the whole scheme is to set aside and nullify the action which Convocation has taken, I do not think that the language in which I described it is in any way inappropriate.

Sir John may be as polite as he likes to our intelligence. But what he has done is to constitute himself the instrument of those who would destroy the prospects of academic study in London, and of making the University of London a better mechanism for the purpose for which it exists. And this is not what we had a right to expect of Sir John Lubbock.

Kew, August 10. W. T. THISELTON-DYER.

Note on Quaternions.

ON reading Cayley's famous memoir on matrices,[1] I have noticed in passing that in McAuley's[2] notation we may write in general,

$$\left.\begin{aligned} &\phi^{-1} = \underset{\phi}{\mathrm{D}}\log m, \qquad \phi'^{-1} = \underset{\phi}{\mathrm{D}}\log m\,; \\ \text{or}\quad &\psi = \underset{\phi'}{\mathrm{D}}m, \qquad \psi' = \underset{\phi'}{\mathrm{D}}m\,; \\ \text{or}\quad &\phi\underset{\phi'}{\mathrm{D}}\log m = \phi'\underset{\phi}{\mathrm{D}}\log m = \psi^{-1}\underset{\phi'}{\mathrm{D}}m = \psi'^{-1}\underset{\phi}{\mathrm{D}}m = \mathrm{I}. \end{aligned}\right\}\ldots(\mathrm{A})$$

Where m is an invariant of ϕ, which being the original linear vector function, ψ is Hamiltonian inverse function, and I is Gibb's idemfactor; they are respectively defined by

$$m\mathrm{S}\lambda\mu\nu = \mathrm{S}\phi\lambda\phi\mu\phi\nu = \mathrm{S}\phi'\lambda\phi'\mu\phi'\nu,$$
$$\psi = m\phi^{-1}, \qquad \mathrm{I}\rho = \rho.$$

Indeed, we may prove the above relation by the variation formula,

$$\delta\mathrm{Q} = -\mathrm{Q}_1\mathrm{S}\delta\phi\zeta\underset{\phi}{\mathrm{D}_1}\zeta,$$

given by McAuley[3]; thus

$$\begin{aligned} \delta m &= -m_1\mathrm{S}\delta\phi\zeta\underset{\phi}{\mathrm{D}_1}\zeta = -\mathrm{S}\delta\phi\zeta\underset{\phi}{\mathrm{D}}m\zeta = -\mathrm{S}\delta\phi\zeta\psi'\zeta \\ &= -\mathrm{S}\delta\phi i\psi' i - \mathrm{S}\delta\phi j\psi' j - \mathrm{S}\delta\phi\kappa\psi'\kappa \\ &= -\mathrm{S}\delta\phi i\phi j\phi\kappa - \mathrm{S}\delta\phi j\phi\kappa\phi i - \mathrm{S}\delta\phi\kappa\phi i\phi j \\ &= -\delta\mathrm{S}\phi i\phi j\phi\kappa = \delta m. \end{aligned}$$

If W be any scalar function of ϕ, and if its independent variable be m (as it is so in some cases of the problems in elasticity, where m is the volume-dilatation), we might dispense with the notation $\underset{\phi}{\mathrm{D}}$, for we may write in general,

$$\underset{\phi}{\mathrm{D}}\mathrm{W} = \frac{d\mathrm{W}}{dm}\psi' \quad \ldots\ldots\ldots\ldots (\mathrm{B})$$

Also, if Q be any quaternion function of ϕ, and if its independent variable be m, we have again

$$\delta\mathrm{Q} = -\frac{d\mathrm{Q}}{dm}\mathrm{S}\delta\phi\zeta\psi'\zeta \quad \ldots\ldots\ldots (\mathrm{C})$$

For, beginning with McAuley's form, we have

$$\begin{aligned} \delta\mathrm{Q} &= -\mathrm{Q}_1\mathrm{S}\delta\phi\zeta\underset{\phi}{\mathrm{D}_1}\zeta = -\frac{d\mathrm{Q}}{dm}\mathrm{S}\delta\phi\zeta\psi'\zeta \\ &= -\frac{d\mathrm{Q}}{dm}[\mathrm{S}\delta\phi i\psi' i + \mathrm{S}\delta\phi j\psi' j + \mathrm{S}\delta\phi\kappa\psi'\kappa] \\ &= \frac{d\mathrm{Q}}{dm}\delta m = \delta\mathrm{Q}. \end{aligned}$$

SHUNKICHI KIMURA.

Japanese Legation, The Hague, July 16.

1 P. 22.
2 "Utility of Quaternions, &c."
3 I cannot refer to the page, as I have not the book in hand.

To Find the Focal Length of a Convex Mirror.

THE following method is so much simpler than those ordinarily used, that it may be of interest to your readers.

Use as object an opaque screen with a hole and pin-point, and painted white, or covered with white paper.

Set up on the bench in line, say, with the left edge of the hole, the convex mirror and an auxiliary biconvex lens of short focal length (six inches or so), and adjust the lens so that the image of the hole and pin-point is formed side by side with the object. The centre of the mirror is now at the point at which the image would be formed by the lens alone; this position may either be calculated or found (after noting the position of the mirror and then removing it) by means of a screen. Thus the radius is easily measured.

If the focal length of the mirror be greater than f that of the lens, the simplest way of adjusting is to put the lens as close as possible to the mirror, put the object at principal focus of lens, and move the object back until the image is formed as above.

If, however, the focal length be less, we can be sure of finding the position by putting the mirror at a distance of $4f$ from the object, and the lens at $2f$, and moving the lens back until the desired position is reached.

The following is a simple way of making a direct measure of the focal length of a concave lens:—

Use an object like the one mentioned above, an auxiliary convex lens (say six inches focal length) to produce a convergent beam, and an auxiliary plane mirror, placed beyond the concave lens.

Adjust until the image is formed side by side with the object as before, then the rays must be emerging parallel to one another from the concave lens, and hence the convergent beam from the convex lens will (when the concave lens and mirror are removed) form an image at the principal focus of the concave lens. A direct measure can thus be made of the focal length.

I may add that both methods are very simple in practice.

Grammar School, Macclesfield. EDWIN BUDDEN.

Oceanic Islands.

IT is to be hoped that in the programme of the present Government a place will be found for an item humble and unimportant in the politician's eyes, but to the biologist of the utmost urgency—the sending out of a scientific expedition or expeditions to study the fauna and flora of oceanic islands before they are exterminated by continental importations. Let it be granted that men of science are busy with problems of even greater interest than those which such expeditions might help to solve. But among all the ambitious aims of science, it would be hard to find one to which delay would be more ruinous than to this—the