NOTES AND NEWS

Correspondence

A photoelastic method of two-dimensional separation of stresses along a line of symmetry by using the isochromatic fringes only

The paper by Dr. S. P. Christodoulides, published on pp. 190–4 of the May 1956 issue of this *Journal*, was quite interesting. However, the author's conclusion "that the radius of curvature is the same for any of the curves: the orthogonal to the isoclinics, the isochromatics, and one of the principal stress trajectories at any point on a line of symmetry" is incorrect. One can think of several simple cases which show that this statement is not valid. Consider, for example, a circular disk under diametral loads. The radii of curvature of the stress trajectories and the isochromatics are not equal along either axis of symmetry of the disk. (See Figs. 124 and 125, Jessop and Harris.*) A second illustration is offered by the simply supported beam under a central concentrated load, where the radii of curvature of the isochromatics and stress trajectories are clearly different along the vertical axis of symmetry. (Figs. 143 and 144, Jessop and Harris.*)

The author's error seems to be in the interpretation of equations (18) and (20). For the case in which the isochromatics are taken as the s-curves and for a line of symmetry, he shows in equation (20) that

$$\frac{\partial P}{\partial n} + (P - Q)\frac{\partial \alpha}{\partial s} = 0$$

From Fig. 3,

$$\alpha = \theta - \phi \tag{1}$$

so that

$$\frac{\partial \alpha}{\partial s} = \frac{\partial \theta}{\partial s} - \frac{\partial \phi}{\partial s} \tag{2}$$

On the line of symmetry, $\alpha = \theta$ from our equation (1), but $\partial\alpha/\partial s$ is given by equation (2). The curvature of the stress trajectories orthogonal to the axis of symmetry is $\partial\alpha/\partial s$ and its values do not depend on the particular choice of the orthogonal s-curves, whereas $\partial\theta/\partial s$ and $\partial\phi/\partial s$ depend on the choice of the s-curves. When the isochromatics are taken as the s-curves, $\partial\theta/\partial s$ is the curvature of the isochromatics. The author's statement "that $\partial s/\partial\alpha = \partial s/\partial\theta =$ the radius of curvature of the isochromatics" is incorrect since $\partial\phi/\partial s$ is not zero in our equation (2). The value of $\partial\phi/\partial s$ is zero only when the stress trajectories orthogonal to the axis of symmetry are chosen as the s-curves. Thus, for the line of symmetry, equation (20) is the Lamé–Maxwell equation in which $\partial\alpha/\partial s$ is the curvature of the orthogonal stress trajectories, not the curvature of the isochromatics.

In a similar manner, it can be shown that the radii of curvature of the principal stress trajectories and the orthogonal curves to the isoclinics are different for points on a line of symmetry.

As a consequence of the error in the interpretation of equations (18) and (20) the method of stress determination based on measuring the radii of curvature of the isochromatics as proposed by the author is not valid. The computations for the numerical example on p. 193 are therefore in error. In addition, there are some errors resulting from a confusion of sign convention. It is known both from theory and experiment that for a tension bar containing a central hole both principal stresses on the transverse axis of symmetry are tensile. Therefore, the stresses shown in Fig. 9 cannot possibly be correct.

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P. D. Flynn,
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* Jessop, H. T., and Harris, F. C. *Photoelasticity* (London: Cleaver-Hume Press Ltd., 1949).

Dr. P. D. Flynn and Dr. R. Guernsey, Jr., are quite correct in their criticisms. As they have pointed out, an error occurred in the interpretation of equations (18) and (20) where the rate of change of the angle ϕ was by mistake taken equal to zero on the line of symmetry. This error was the result of faulty reasoning from the conditions of symmetry existing on the axis, from which symmetry in ϕ (i.e. $\theta - \alpha$), was assumed instead of $|\phi|$.

The quantities $\partial\phi/\partial n$ or $\partial\phi/\partial s$ can be small, but cannot be ignored in the step by step integration, and the error actually invalidates the method of separation of stresses suggested.

I thank Dr. Flynn and Dr. Guernsey for pointing out this mistake.

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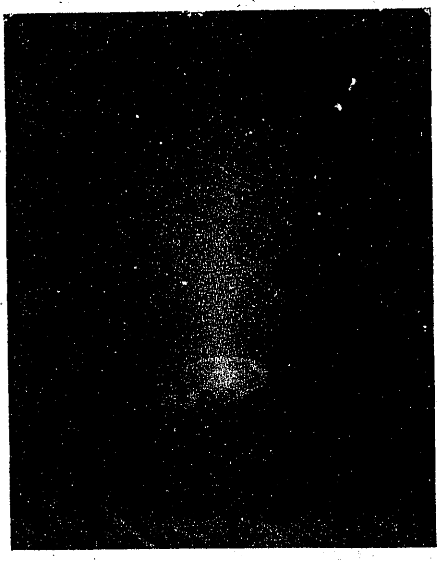
Ring conduction in the early stages of sparks

In a recent letter[1] it was shown that a study of the marks left by brief sparks on an anode covered by a thin contaminating film of a substance like barium stearate could give information about the variation with time of the current



Kerr-cell shutter photograph (exposure about 2 μs) of an 80 A spark to a plane tin anode, 40 μs after initiation of the spark. The photograph was taken looking down obliquely at the anode. The diameter of the luminous ring is about 0·04 cm distribution at the anode. Using this technique it was found that, about 1 μs after the initiation of the spark, all or most of the current leaves the anode in a ring and that this state of affairs persists for perhaps 10 or 20 μs, after which a more uniform current distribution probably prevails.

On looking over some old records we came across four photographs of sparks taken during the course of an earlier investigation[2] some four years ago. The figure shows one of these photographs, all of which are similar. It confirms in a striking way the existence of an active ring at the anode, already deduced from the study of anode marks. At the time when the photograph was taken the significance of the anode surface condition was not realized and this particular anode must have had, by chance, the right degree of contamination to show the ring clearly.

The photograph shows a central luminous channel suggesting that much of the current may have moved back to the centre, as previously suggested.[1] It is not possible to say whether the ring is still passing current or not; it may be still incandescent after earlier use.

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REFERENCES

(1) Somerville and Grainger. *Brit. J. Appl. Phys.*, **7**, p. 109 (1956).

(2) Somerville, Blevin and Fletcher. *Proc. Phys. Soc.* [*London*] *B*, **65**, p. 963 (1952).

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New books

Abstracts of the literature on semiconducting and luminescent materials and their applications. Compiled by Battelle Memorial Institute. (New York: J. Wiley and Sons Inc.; London: Chapman and Hall Ltd., 1956.) Pp. viii + 200. Price 40*s*.

The comments made by Prof. Garlick on the 1953 issue of these abstracts (*Brit. J. Appl. Phys.*, **6**, p. 453, 1955) apply with little change to the 1954 volume. The time lag seems to be shorter, but the latest papers are well over a year old. The use of abstract journals as sources for some of the material must have aggravated this delay.

Though printed from typescript in a not very durable loose-leaf form, these abstracts look opulent with their good paper, wide margins, and lines of full page width. In the more essential feature of completeness of cover the position is not entirely satisfactory. This is particularly the case for the patent literature, not perhaps the scientist's favourite reading, but which is often a source of new information. In 765 abstracts about 33 patents are mentioned, and of these only one is British, the rest are mostly American or Japanese, and several are hardly worth inclusion. There is also some untidiness in the classification. Thus electroluminescence references occur under the main heading "Sulphides," and also under a sub-section of "Fluorescence and phosphorescence"; but it would be difficult to suggest a completely logical arrangement. On the whole this is a valuable compilation of good abstracts for the worker who tries to remain aware of recent literature, not a little of which is in inaccessible journals.

S. T. Henderson

Theory of sound, Vols. 1 and 2. By Lord Rayleigh. (New York: Dover Publications Inc., 1956.) Pp. xlii + 480 (Vol. 1); xvi + 504 (Vol. 2). Price $3.90 per set (paper bound).

Dover Publications of New York have in recent years adopted the admirable policy of making available a series of reprints of classics of the mathematical and physical sciences. These have included works such as Agricola's *De re metallica*, Descartes's *Geometry*, Galileo's *Dialogues*, Clerk Maxwell's *Scientific papers*, Newton's *Opticks* and Helmholtz's *Sensations of tone*. The volumes are well produced, often having been photostated from the originals, and are available in cloth or in a cheaper paper bound edition. Now comes the famous *Theory of sound* in two volumes by Lord Rayleigh, the original edition of which appeared in 1877–8 (Macmillan and Co. Ltd.). A revised and enlarged edition was issued in 1894 (Vol. 1), and 1896 (Vol. 2). Since then there have been English reprintings in 1926 and 1929 and an American reprinting in 1945, the latter being greatly enriched with an historical introduction of 32 pages, comprising a brief biography of Lord Rayleigh, a survey of the history of acoustics, and an excellent bibliography, contributed by Robert Bruce Lindsay, Hazard Professor of Physics in Brown University. The present reissue is the same as that of 1945, together with the historical introduction.

Until the advent of popular radio and reproduction of sound some thirty years ago, from which originated modern acoustical engineering, the science of acoustics was the cinderella of physics.

Despite attempts to draw illustrations of acoustical phenomena from the art of music—not very successfully it must be admitted since they commanded little respect from musicians—the majority of the textbooks of pre-radio days were arid in the extreme. An extensive discussion of the mechanics of vibration, some reference to measurements of the velocity of sound by very crude methods, an unimaginative, purely numerical, treatment of the tuning of keyboard instruments ignoring almost entirely the artistic needs of the musician, a dubious theory of the action of organ pipes which was negatived every day in the work of practical organ builders, and a questionable discussion of the mode of action of other musical instruments, constituted the core of the subject.

One would have looked in vain for the terms *transients* and *formants*; there would be no reference to the sensitivity characteristics of the ear that are so important in both speech and music, while very few authors referred at all to the acoustical properties of auditoriums though Sabine had done his (now) classical work twenty years previously.

The importance of acoustics in the modern world through developments in the fields of telephony, the radio transmission and recording of sounds, the "measurement" of sound, and the design of concert halls, has emphasized the connexions of the subject with psychology on the one hand and electricity on the other. Great advances in sensory