vibration of the diaphragm occurs capable of producing sonorous effects. It has occurred to me that Mr. Preece's failure to detect with a delicate microphone the sonorous vibrations that were so easily observed in our experiments might be explained upon the supposition that he had employed the ordinary form of Hughes' microphone shown in Fig. 1, and that the vibrating area was confined to the central portion of the disk. Under such circumstances it might easily happen that both the supports (A B) of the microphone might touch portions of the diaphragm which were practically at rest. It would of course be interesting to ascertain whether any such localisation of the vibration as that supposed really occurred, and I have great pleasure in showing to you to-night the apparatus by means of which this point has been investigated (see Fig. 2).

The instrument is a modification of the form of microphone devised in 1827 by the late Sir Charles Wheatstone, and it consists essentially of a stiff wire (A), one end of which is rigidly attached to the centre of a metallic diaphragm (B). In Wheatstone's original arrangement the diaphragm was placed directly against the ear, and the free extremity of the wire was rested against some sounding body, like a watch. In the present arrangement the diaphragm is clamped at the circumference like a telephone-diaphragm, and the sounds are conveyed to the ear through a rubber hearing-tube (C). The wire passes through the perforated handle (D), and is exposed only at the extremity. When the point (A) was rested against the centre of a diaphragm upon which was focussed an intermittent beam of sunlight, a clear musical tone was perceived by applying the ear to the hearing-tube (C). The surface of the diaphragm was then explored with the point of the microphone, and sounds were obtained in all parts of the illuminated area and in the corresponding area on the other side of the diaphragm. Outside of this area, on both sides of the diaphragm, the sounds became weaker and weaker, until at a certain distance from the centre they could no longer be perceived.

At the points where one would naturally place the supports of a Hughes microphone (see Fig. 1) no sound was observed. We were also unable to detect any audible effects when the point of the microphone was rested against the support to which the diaphragm was attached. The negative results obtained in Europe by Mr. Preece may therefore be reconciled with the positive results obtained in America by Mr. Painter and myself. A still more curious demonstration of localisation of vibration occurred in the case of a large metallic mass. An intermittent beam of sunlight was focussed upon a brass weight (1 kilogram.) and the surface of the weight was then explored with the microphone shown in Fig. 2. A feeble but distinct sound was heard upon touching the surface within the illuminated area and for a short distance outside, but not in other parts.

In this experiment, as in the case of the thin diaphragm, absolute contact between the point of the microphone and the surface explored was necessary in order to obtain audible effects. Now I do not mean to deny that sound-waves may be originated in the manner suggested by Mr. Preece, but I think that our experiments have demonstrated that the kind of action described by Lord Rayleigh actually occurs, and that it is sufficient to account for the audible effects observed.

EXPERIMENTAL DETERMINATION OF THE VELOCITY OF WHITE AND COLOURED LIGHT[1]

THE method employed in this research to measure the velocity of light resembled the method of M. Fizeau, subsequently employed by M. Cornu. A revolving toothed wheel is employed in the same way to alter the intensity of the light reflected from a distance. In the present method, however, there are two distant reflectors instead of only one. They are separated by a distance of a quarter of a mile. The observing telescope and the two reflectors are almost in the same line. The observer sees two stars of light, which go through their phases with different periods as the toothed wheel is revolved at increasing speeds. One star is increasing, while the other is diminishing, in intensity, with increase of speed of the toothed wheel. The speed required to produce equality of the light is determined by means of a chronograph.

By choosing such a speed as gives a maximum of one star at the same speed as a minimum of the other, a pair of observations eliminates all cause of doubt arising from varying brightness in the stars, and ratio of the width of a tooth to the width of a space. The distances were observed by triangulation with the Ordnance Survey 18-inch theodolite, using as a base line a side of one of the Ordnance Survey triangles. The source of light was an electric lamp. The velocities (uncorrected for rate of clock, and reduction to a vacuum) measured are as follows :—

187,707
188,405
187,676
186,457
185,788
186,495
187,003
186,190
186,830
187,266
188,110
188,079

Mean ... ... 187,167 miles a second.

The correction to vacuum is + 54 miles a second. The correction for rate of clock to a mean solar time is + 52 miles a second.

The final results for the velocity of the light from an electric lamp *in vacuo* is 187,273 miles a second, or 301,382 kilometres a second.

Using Struve's constant of aberration 20·445″, we obtain for the solar parallax the value 8·77″, and for the mean distance of the sun 93,223,000 miles.

On February 11, 1881, the reflected stars were seen to be coloured, one reddish, the other bluish. The particular colour of a particular star depended upon the speed of rotation of the toothed wheel. That star which was increasing with increase of speed of the toothed wheel was reddish, that one that was diminishing with increase of speed was bluish. This seems to be caused by the fact that blue rays travel quicker than red rays.

A number of tests were made to judge of the accuracy of this conclusion, and they confirmed it. In the final arrangements, the electric light was acted upon by a bisulphide of carbon prism, and part of a pure spectrum was used. Differential measurements were then made to find the difference in velocity of rotation of the toothed wheel, required to produce equality of red and of blue lights. The most convenient method was to use a driving weight slightly in excess of that required to produce equality of the light, then to fix to the pulley carrying the weights one end of a piece of stout india-rubber tubing, the other end being fixed to a point above. This gradually diminished the effective driving weight. The equality of red lights was first noted, the colour of the light was changed, and the interval of time until the blue lights were equal was measured. The rate at which the india-rubber diminished the speed was afterwards measured by the aid of the chronograph, and thus the difference of speed determined. The mean of thirty-seven determinations in this and other ways gave the result that the difference in velocity between red and blue lights is about 1·8 per cent. of the whole velocity, blue travelling most rapidly.

The general conclusion seems to be supported by a comparison of the velocity of light measured by M. Cornu and Mr. Michelson, where the source of light usually employed is taken into consideration. These are the only accurate measurements of the velocity of light hitherto published. They give us the following results :—

	Usual Source of Light.	Velocity in kilos. a Second.
Michelson's research ...	The sun near horizon ...	299,940
Cornu's ,, ...	Lime light	300,400
The present ,, ...	Electric light...	301,382

Classifying the sources of light used by Cornu, we get the following approximate relative velocities :—

Source of Light.	No. of Observations.	Approximate Relative Velocity.
Petroleum	20	298,776 kilos.
Sun near horizon ...	77	300,242 ,,
Lime light...	449	300,290 ,,

All these results seem to support the view that the more refrangible the source of light, the greater is the velocity. But the evidence of the present observations, indicating an excess of

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[1] Abstract of a paper by Dr. J. Young, F.R.S., and Prof. G. Forbes, read before the Royal Society, March 19.

velocity for blue over red light, seeming to exceed 1 per cent. of the whole, must rest upon the merit of the present observations themselves.

SCIENTIFIC SERIALS

Journal of the Royal Microscopical Society, June, 1881, contains: On the diatoms of the London Clay, by W. H. Shrubsole, with a list of species and remarks by F. Kitton (Plate V. Fig. 1).—On the estimation of aperture in the microscope, by Prof. E. Abbe (woodcuts).—On a new species of Hydrosera (Wallich), by Dr. H. Stolterforth (*H. tricornata*), Plate V. Figs. 2, 3.—Summary of current researches relating to zoology and botany (principally Invertebrata and Cryptogamia), microscopy, &c., including original communications from Fellows and others.—Proceedings of the Society.

The Scottish Naturalist, July, 1881, contains under Phytology—Dr. Stirton, on the genus Usnea and a new genus allied to it.—Rev. J. Stevenson, Mycologia Scotica (continued).—J. Cameron, the Gaelic names of plants (continued).—Dr. F. B. White, preliminary list of the flowering plants and ferns of Perthshire.

SOCIETIES AND ACADEMIES

Vienna

Imperial Academy of Sciences, July 7.—L. T. Fitzinger in the chair.—Dr. T. Holetschek and T. v. Hepperger, determination of the elements and ephemeris of the comet of 1881*b*.—E. Rathay, on the spermagonia of the *Aecidio mycetes*.—F. Exner, on galvanic couples consisting only of chemical elements, and on the electromotive force of bromine and iodine.—C. Block, a sealed packet.—A. Brezina, on new and little-known meteors (third report).—A. Schlosser and Z. H. Skraup, synthetical experiments on the chinolin series.—R. Brix, on the constituents of copahu (Maracaïbo) and on commercial copaïbic and metacopaïbic acid.—H. Weidel, on dichinolins.—A. Spina, inquiry into the mechanics of intestinal and cutaneous resorption.—Th. Opeuchowsky, on the pressure of the pulmonary circulation.

July 14.—L. Fitzinger in the chair.—T. Glax and R. Klemensiewicz, contributions to the theory of inflammation (1st part).—E. Scherks, on the action of metals on α-bromopropionic ethyl ether.—H. Leitgeb, on *Completoria compleus*, Lohde, a fungus-parasite on fern-prothallia.—N. v. Lorenz, on the action of lead-metal on aqueous solutions of nitrate of lead.—A. Adamniewicz, preliminary note on the microscopical vessels of human cord.—A. W. Meisels, studies on the zoöid and oekoid of different vertebrates.—C. Etti, contributions to the knowledge of catechin.—T. Kachler, on the action of nitric acid on some fatty bodies made by ustion.—S. Exner, to the knowledge of the cortical motor area.

Paris

Academy of Sciences, July 18.—M. Wurtz in the chair.—With regard to a telegram from Gabès about a recent earthquake there, and detonations preceding the shocks, M. Boussingault remembered having heard detonations at intervals during an earthquake in South America in 1827.—Observations of comet *b* 1881 at Paris Observatory, by MM. Tisserand and Bigourdan.—Theory of the plane flexion of solids, &c. (continued), by M. Villarceau.—On the reduction of quadratic forms, by M. Jordan.—Researches on glycolic ether, and on oxides of ethylene, by M. Berthelot.—On the trajectory of cyclones, and on the announcements transmitted by telegraphic cables, by M. Faye. Commandant Bridet has lately shown that if Mauritius and Réunion (Bourbon) were connected by means of a cable, the latter might be informed eighteen or twenty four hours in advance of the arrival and direction of storms. M. Bridet is trying to get this project realised.—On the integration of a linear differential equation of the second order on which evection depends, by M. Gyldén.—Effects produced by sulphide of carbon on vines of Beaujolais, by M. Henneguy.—Ephemerides of the planet (103) Hera for the opposition of 1881, by M. Callandreau.—On the tails of comets, by M. Flammarion. He replies to M. Faye, and supports M. Berthelot's theory of electric illumination.—On the vision of stars through comets, by M. André. The enlargement of the image is probably a simple effect of diffraction indicating the presence of solid or liquid nuclei in the mass of matter.—On a function similar to modular functions, by M. Poincaré.—Distribution of energy in the normal spectrum, by Prof. Langley. He gives two curves obtained from observations with his new instrument for a diffraction spectrum after and before zenithal absorption by our atmosphere. The curve of light coincides almost exactly with that of heat. There is enormous absorption by the atmosphere in the blue.—On a method enabling us to amplify the displacements of the plane of polarisation of light, by M. H. Becquerel. When monochromatic luminous rays, polarised rectilinearly, traverse a half-wave crystalline plate, the emergent rays are polarised rectilinearly in a plane which, relatively to the axis of the plate, is symmetrical with the plane of polarisation of the incident waves. This known property is utilised for the purpose indicated.—On the velocities of propagation of the inflammation in explosive gaseous mixtures, by MM. Mallard and Le Chatelier. In one form of apparatus each end of the tube has a lateral orifice communicating through a caoutchouc tube with a small chamber closed with an elastic membrane, which, being pressed outwards at the moment of explosion, affects an inscribing style. The propagation in the larger tube in not of normal velocity, unless the part not yet inflamed remains as rest during the whole phenomenon. In a tube closed at one end the velocity is much greater if the gas be fired from the closed end. Even in the other case violent movements often occur in the unburnt mass, and there are various irregularities.—On the decomposition and enlargement of bands of the rainbow, by M. Ritter. Near the observer (to a distance of about 1·50m.) the two systems of cones, with parallel axes from the eyes, by which the rainbow is defined, are quite separate; thus if the drops are within that distance one should see two distinct arcs or rings. Illustrations of this deduction and others are given.—On the extraordinary temperature of July, 1881, by M. Renou. The temperature of 37°·8 in the Park of Saint-Maux, on July 15, is undoubtedly the highest ever experienced in Paris or the environs.—On hydrosulphurous acid, by M. Schutzenberger.—Action of sulphur on various metallic solutions by MM. Filhol and Senderens. It decomposes them (in heat), producing more or less complex reactions.—Separation and determination of alumina and oxides of iron and chromium, by M. Carnot.—Industry of magnesia, by M. Schloesing. This is preliminary to an account of new ways of extracting magnesia from the water of salt marshes, and even from sea-water.—On injury done in Greece by anthracnose and *Peronospora viticola*, by M. Gennadius.—On the origin of trunks of fossil trees perpendicular to the strata of the coal formation, by M. Fayol.—On some points relative to anthracic immunity, by M. Toussaint.—On a new malady of domestic geese observed in the Commune of Viviers-les-Montagnes (Tarn), by M. Caravin-Cachin.—Experiments on yellow-fever patients with phenic acid, phenate of ammonia, &c., by M. de Lacaille.—On the Cretaceous system of the Northern Sahara, by M. Rolland.

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