(2) When convinced of beholding so-called luminous clouds, to what points shall attention be especially directed, and what simple measurements of place, time, form, &c., shall be carried out in order to aid most usefully in the inquiry?

In answering this question we will first consider those methods of research in which the observer can obtain no instrumental aid, except only a watch, which should be a sufficiently good timekeeper to estimate the time of observation to one minute, when compared with the correct time within eight to twelve hours after the observation.

Such simple observations are the more useful, since it frequently happens that in the well fitted up and prepared stations, observation of the phenomena is prevented by bad weather, or else that the phenomena stretch over too large an extent of the earth's surface to be included in an organized series of observations. The farther the stations are apart, the more valuable are the most simple methods. For instance, in order to get corresponding photographic observations from two stations, 35 kilometres apart, such as Berlin and Nauen, the most rigid exactness, both as to time and place, must be observed.

If, however, observations are taken in East Prussia and in the Rhine province respectively, a from twenty to thirty times larger margin of difference as to time and place can be allowed than in the foregoing case, without in any way lessening the value of the result.

So, if without preparation and instruments to hand an observer believes he beholds luminous clouds, he must not imagine that he can render no service to science by examining them closely, for very possibly the most simple method may, taken in conjunction with other similar observations, prove to be of the greatest service.

It is desirable, too, to look out for luminous clouds at all seasons of the year, though, so far, they have only been seen in summer. In the northern hemisphere they have only been seen from the end of May to the beginning of August, with greatest frequency and brightness in the month of July.

During these weeks, usually two stars are seen simultaneously with the luminous clouds, a star of the first magnitude, Capella, and a star of the same constellation, of the second magnitude, β Aurigæ.

The brighter of the two stars, which is characteristic of summer nights, in the northern horizon, sets towards the end of June soon after eleven, and towards the middle of July before ten, on account of the northerly direction of the meridian, and, in North Germany, at a distance from the horizon of 10 to 12 diameters of the full moon. At almost as great a distance from this bright star, and at a not very different distance from the horizon, the second magnitude star follows towards the west.

By estimating the distances and directions of these two stars, an excellent means is afforded of determining the outlines of a group of luminous clouds. It is only necessary to determine how great the distance of a certain part of the outline of the cloud group is from one or the other star, and in what direction this line lies with regard to one or the other star, or how far the line in question is above or below the prolongation of the connecting line of the two stars. A simple drawing of the course of the outlines and their situation with regard to the two stars is useful, even when it cannot be completed on the spot but must be finished from memory. The time at which the drawing was made should be noted within one half-minute.

If the group of clouds should be so far from the above-mentioned two stars as to make the determinations inexact, it is advisable to determine the outlines of the clouds for a certain time in the following way. Take up a position from which the outlines of houses, trees, &c., can be seen close to the position of the clouds, and fix thus the relative position of these earthly objects to the position of the clouds by a simple drawing, describing the spot from which the observation is made in such a manner that the place occupied by the head of the observer can be found again. The lines drawn from the position of the observer to the outlines of the earthly objects, and the resulting localization of the outline of the clouds in the heavens can then be determined at once by means of simple instruments for measuring angles, or on succeeding nights by the aid of a good star chart.

It is necessary to verify the exact point of time of these observations by comparison of the watch used with the time at a telegraph office, and correction of any errors should be made to the fraction of a minute.

In communicating these observations, the exact place at which they have been made must be accurately described.

Should a complete observation be impossible, owing to the time during which the luminous clouds are visible being too short for careful measurements and drawings or to any other cause, the observer should nevertheless communicate briefly to the Society of Friends of Astronomy and Cosmic Physics that he has seen what he believes from the foregoing considerations to be luminous clouds from a certain place, in a certain direction in the heavens, and within a certain quarter-hour.

The peculiar movements hitherto observed of the clouds in question lead to the suggestion that perhaps a period consisting of several days exists, within which one and the same group of clouds is visible at the same hour from the same place, other conditions of the heavens being favourable. Every communication as to these phenomena will be valuable in the decision of this important point, which it has hitherto been impossible to settle, owing to the uncertainty of the weather and the fewness of the observers.

Those co-operating in our branch of research who are in possession of astronomical, photographic, or other physical apparatus, will of course be able to give more exact details as to place, movement, and constitution of the luminous clouds.

Suggestions for these observations cannot be given so briefly and simply; but for the sake of full and complete agreement between different observers, especially as to the point of time selected for taking photographs and measurements, members of the Society of Friends of Astronomy and Cosmic Physics are invited to communicate with O. Jesse, Steglitz bei Berlin, Albrechtsstrasse 30. This course would also be advisable in the close optical examination of the clouds with regard to the peculiar changes in strength of light and the degree and kind of self-luminosity which they perhaps send out together with the reflected sunlight.

In the night from June 25–26 of this year the summer reappearance of the luminous clouds was observed very brightly from Berlin and the neighbourhood.

More detailed particulars on the whole subject of inquiry are contained in a small paper by W. Foerster, which has been sent to all the members of the Society of Friends of Astronomy and Cosmic Physics.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Mr. G. C. Inge, Magdalen College, has been appointed to the Studentship offered to the University by the Managing Committee of the British School of Athens, from the Newton Testimonial Fund.

The death is announced of Dr. Evan Evans, Master of Pembroke College, who filled the office of Vice-Chancellor of the University from 1878–82.

Convocation has granted £25 towards the cost of the antiquarian researches at Chester, which are throwing great light upon the obscure period of the military occupation of Britain in the time of Agricola. Prof. Mommsen has appreciated the value of these researches.

At a meeting of the Junior Scientific Club, Mr. A. Colefax, Christ Church, read a paper on the investigation of the change taking place in acidified solutions of sodium thiosulphate. The subject of hypnotism was treated by Mr. E. L. Collis, of Keble; and P. C. Mitchell had an exhibit, and offered some remarks concerning primitive man in the Torquay caves.

The University has published the official Calendar for 1892. The arrangement and information contained differ little from former years. We learn that the number of undergraduate members of the University has increased from 3110 to 3212. The number of matriculations in 1890 were 771, as compared with 787 in the preceding year. The number of B.A. and M.A. degrees is very nearly the same as in 1889.

SCIENTIFIC SERIALS.

American Journal of Science, November 1891.—The solution of vulcanized india-rubber, by Carl Barus. Experiments have been made by the author on the solubility of india-rubber in different solvents at different temperatures. Elastic sheet india-rubber, such as is used for rubber bands and tubing, is not fully soluble in CS_2 at 100° or 160°, but is quite soluble at 185°, and extremely soluble at 210°. It is also easily dissolved by liquids of the paraffin series at 200°. Various other substances have been used as solvents, and many remarkable results obtained. The importance of the paper may be gathered from the fact that in it is described "a method by which vulcanized india-rubber of any quality or character whatever, as well as the undecomposed or reclaimable part of rubber-waste, may be dissolved or liquefied in a reasonably short time, the solutions possessing any desirable degree of viscosity or diluteness, from which india-rubber may be regained on evaporation of the solvents."—Report of the examination by means of the microscope of specimens of infusorial earths of the Pacific coast of the United States, by Dr. Arthur M. Edwards. Seven new fluviatile fossiliferous deposits from Oregon, California, and Washington are described.—The Tonganoxie meteorite, by E. H. S. Bailey. An analysis of the meteorite gave the percentage composition: Fe 91·18, Ni 7·93, Co 0·39, P 0·10, and a trace of copper. The weight is $23\frac{1}{4}$ lbs., specific gravity 7·45, shape an irregular triangular pyramid $9\frac{1}{2}$ inches long by $6\frac{1}{2}$ inches wide by $4\frac{1}{2}$ inches deep. A fine figure showing numerous pittings on the surface of the meteorite accompanies the paper.—Proposed form of mercurial barometer, by W. J. Waggener.—Colour photography by Lippmann's process, by Charles B. Thwing. The results obtained seem to indicate—(1) that mixed colours may be reproduced with a fair degree of accuracy; (2) that an exposure sufficiently long to give a clear image of the red is quite certain to obliterate the blue by over-exposure; and (3) that an over-exposure may completely reverse the colours, causing the original colours to appear on the reverse, and the complementary colours on the film side of the plate.—New analyses of uraninite, by W. F. Hillebrand. From the analyses it appears that the species may be broadly divided into two groups, one characterized by the presence of rare earths and the almost invariable presence of nitrogen, the other containing little or no nitrogen and no rare earths. Varieties of the former group occur in more or less well defined crystals, whilst members of the latter group are usually devoid of crystalline form.—The Tertiary silicified woods of Eastern Arkansas, by R. Ellsworth Call. The investigation has led to the following conclusions:—(1) The silicified woods of Eastern Arkansas are all of Tertiary age. (2) They are derived from the beds of Eocene clays that underlie the sands and gravels in which they commonly occur. (3) They are silicified lignite; the process of silicification has occurred either while they were still in clays, or most often after they were removed and buried in the sands or gravels. (4) They possess as yet no taxonomic value in determining the relative ages of the members of the Tertiary series.—Occurrence of sulphur, orpiment, axd realgar in the Yellowstone National Park, by Walter H. Weed and Louis V. Pirsson.—Mineralogical notes, by L. V. Pirsson. Some specimens of cerussite, hæmatite, and cassiterite, gypsum, and pennine are described.—Peridot dykes in the Portage sandstones, near Ithaca, N.Y., by J. F. Kemp.—A new locality of meteoric iron, with a preliminary notice of the discovery of diamonds in the iron, by A. E. Foote. The existence of black and white diamonds in the meteorite appears to be established by indifference to chemical agents and hardness. Carbon in the form of an iron carbide also occurs with the diamonds. The meteorite was found in Cañon Diablo, Arizona. Three figures accompany the paper.—The South Trap Range of the Keweenawan series, by M. E. Wadsworth.—Geological facts noted on Grand River, Labrador, by Austin Cary.

SOCIETIES AND ACADEMIES.

LONDON.

Mathematical Society, November 12.—Prof. Greenhill, F.R.S., President, in the chair.—The President announced the recent decease of Mr. H. M. Jeffery, F.R.S., who was elected January 14, 1875.—The following gentlemen were elected to serve on the Council for the ensuing session: Prof. Greenhill, F.R.S., President; Dr. J. Larmor, Major P. A. MacMahon, F.R.S., and J. J. Walker, F.R.S., Vice-Presidents; A. B. Kempe, F.R.S., Treasurer; M. Jenkins and R. Tucker, Hon. Secs.; other members, Messrs. A. B. Basset, F.R.S., E. B. Elliott, F.R.,S. J. Hammond, C. Leudesdorf, A. E. H. Love, S. Roberts, F.R.S., Drs. A. R. Forsyth, F.R.S., J. W. L. Glaisher, F.R.S., and M. J. M. Hill.—The following communications were made:—On selective and metallic reflection, by A. B. Basset, F.R.S. It is well known that most transparent substances, which produce anomalous dispersion, exercise a strong selective absorption, and at the same time strongly reflect rays of the same periods as those whieh they absorb. Thus in fuchsine the order of the colours going up the spectrum is blue, indigo, violet; then there is an absorption band, followed by red, orange, yellow. The experimental laws relating to substances of this class may be summarized as follows: (1) the rays which are most strongly absorbed, when light is transmitted through the substance, are most strongly reflected; (2) when the incident light is plane polarized in any azimuth, the reflected light is elliptically polarized; (3) when sunlight is reflected, the colour of the reflected light, when viewed through a Nicol's prism whose principal section is parallel to the plane of incidence, is different from what it is when viewed by the naked eye. The phenomena of absorption, anomalous dispersion, and the like, have formed the subject of numerous theoretical investigations by German mathematicians. It is not the object of the present paper to propose any new theory upon the subject, but to discuss and extend the theory of von Helmholtz. The theory of von Helmholtz is an elastic-solid theory, which is based upon certain assumptions respecting the mutual reaction of ether and matter. The potential energy of the system may be conceived to consist of three distinct portions, viz. W_1, W_2, W_3, of which W_1 is the ordinary expression for the potential energy of an isotropic elastic solid; W_2 is a homogeneous quadratic function of the displacements of the matter; and W_3 is a similar function of the relative displacements of ether and matter, and is supposed to arise from the mutual reaction of ether and matter. Having obtained the expression for the energy of the system, the equations of motion can be at once written down; and it will be found, on integrating them, that the index of refraction, μ, of light of period τ, is given by the equation—

$$\mu^2 = \frac{\rho}{\rho_0} - \frac{\alpha^2\tau^2}{4\pi^2\rho_0}\left\{1 + \frac{\alpha^2k^2\tau^2}{4\pi^2\rho_1(k^2 - \tau^2) - \alpha^2k^2\tau^2}\right\} \quad . \quad . \quad (1)$$

In this equation ρ is the density of the ether when loaded with matter, ρ_0 is the density of the ether *in vacuo*, and ρ_1 is the density of the matter; k is the free period of the matter vibrations, and α is a constant depending on the mutual reaction of ether and matter. If we suppose that the value τ_1 of τ, which makes the denominator vanish, corresponds to the double sodium line D of the spectrum, whilst a value τ_2, which makes $\mu = 0$, corresponds to the hydrogen line F, μ^2 will be negative when τ lies between D and F, and (1) accordingly represents a transparent medium (such as fuchsine) which has a single absorption band in that portion of the spectrum. Moreover, the dispersion is anomalous, since the value of μ when τ is a little greater than τ_1, is much greater than its value when τ is a little less than τ_2. To explain selective reflection, I have provisionally adopted Sir W. Thomson's hypothesis, that the ether is to be treated as an elastic medium, whose resistance to compression is a negative quantity, whose numerical value is slightly less than $\frac{4}{3}$rds of its rigidity. Under these circumstances, the amplitudes of the reflected light will be given by Fresnel's sine and tangent formulæ, according as the incident light is polarized in or perpendicularly to the plane of incidence. When μ^2 is a negative quantity, these formulæ become complex quantities of the form $\epsilon^{-2\iota\pi f/\lambda}$ and $\epsilon^{2\iota\pi f_1/\lambda}$, and this indicates that reflection is total, and is accompanied by a change of phase; moreover, since the changes of phase, f, f_1, are different, according as the incident light is polarized in or perpendicularly to the plane of incidence, it follows that if the former is polarized in any azimuth the reflected light will be elliptically polarized. From these results it appears that the colour of the reflected light is of a greenish yellow when viewed by the naked eye; but when it is viewed through a Nicol, whose principal section lies in the plane of incidence, a considerable portion of the yellow rays are refused transmission by the Nicol, and the light under these circumstances is of a much richer green. Cauchy's formulæ for metallic reflection may be obtained from Fresnel's sine and tangent formulæ, by assuming that μ ($= \sin i / \sin r$) is a complex quantity of the form $R\epsilon^{\iota\alpha}$; but the experiments of Jamin, and the calculations of Eisenlohr, show that the real part of μ^2 must be *negative*, which requires that α should lie between 45° and 90°. In fact, for silver, Eisenlohr finds that $\alpha = 83°$. Lord Rayleigh, on the other hand, has shown that, if we attempt to explain metallic reflection by introducing a viscous term into the ordinary equations of motion of an elastic solid, physical considerations require that the real part of μ^2 should be *positive*; he has also shown that a similar objection lies against attempting to explain metallic reflection on the electro-magnetic theory,