JUDGING from the Report of the Exeter Science School in connection with the Government Department of Science and Art, it seems altogether in a very satisfactory condition. There are classes for Physical Geography, Mathematics, Acoustics, Light and Heat, Chemistry, Animal and Vegetable Physiology, Geology, Mineralogy, Metallurgy, Botany, Building Construction, Theoretical Mechanics, Machine Construction, and Drawing. From the number who have passed the examinations, it would appear that the classes must have been well attended, and several of the students have most creditably distinguished themselves.

The following is a list of the electric lights in England and France with the dates at which they were erected:—Dungeness, Jan. 1862; Cape La Heve, France, South Light, Dec. 1863; North Light, Nov. 1866; Cape Grisnez, France, Feb. 1869; Souter Point, England, Jan. 1871; South Foreland, 2 lights, Jan. 1872. It is interesting to see that England took the lead in this matter of the adaptation of electric illumination to lighthouse purposes, and it must also be remembered that although the first electric light was only erected in 1862, yet that in 1859 experiments were made under the supervision of the late Prof. Faraday which were very successful.

MR. WILLIAM F. DENNING, of Bristol, writes us that the sun's surface has recently been in a very disturbed condition. On observing the sun on the afternoon of the 12th instant with an old 4in. metallic-mirror reflecting telescope, he noticed a large scattered group of spots in the north-eastern quadrant of the disc. This group contained no less than twenty-seven individual spots, one of which was of considerable dimensions. It was situated on the eastern portion of the group, and was constituted of three well-defined umbræ and a large irregular penumbra, which on the east side was very dark, and on the exterior edge pierced with a train of minute dark spots. In the other quadrants Mr. Denning noticed four groups and one isolated spot surrounded by penumbra in the north-western quadrant. These groups (though insignificant in regard to the dimensions of the spots which composed them) contained twenty-one spots in all; so that, including the large cluster before referred to, there were forty-eight dark spots seen altogether. Several groups of faculæ were also perceptible in the vicinity of the margin of the disc.

THE first number of the Journal of the Society of Telegraph Engineers contains, besides a list of members, and the rules and regulations, a record of the proceedings of the Society since its formation, including reports of the papers read, and the discussions which followed. The members already number about 280, and among them are the names of some of the most eminent scientific men of the time, the President being Charles W. Siemens, and the Vice-Presidents Lord Lindsay and Frank I. Scudamore, C.B. The society "is established for the general advancement of Electrical and Telegraphic Science, and more praticularly for facilitating the exchange of information and ideas among its members," and consists of members, associates, Besides the President's students, and honorary members. address, in which he justly maintains that such a special society "is necessary for the more rapid development of a new and important branch of applied science," the report contains a paper by Mr. R. S. Culley on Automatic Telegraphs, and a sketch of the Progress of Sea Telegraphy by Captain Colomb, R.N. The latter half of the volume consists of "Abstracts and Extracts," bearing on the department with which the society is concerned.

A NOVEL kind of magazine has made its unpretending appearance—Loose Leaves, a magazine conducted at the Church Stretton Private Asylum. It is written almost entirely by members of the asylum, and we have seen many madder publications proceeding from those who consider themselves sane. As an effort to occupy the minds of the unfortunate inmates of such establishments, the attempt is commendable, and worthy of all success and imitation.

HISTORICAL ECLIPSES

MR. J. R. HIND, writing from Mr. Bishop's Observatory, Twickenham, to the *Times*, supplies the following interesting sketch of the Eclipses recorded in History:—

"It is well understood that the historical eclipses, especially those of the sun, have an important bearing upon our knowledge of the elements of the moon's motion, as affording the means of testing the accuracy of those elements when carried back to very remote times. I send you a brief account of some results I have deduced in a systematic examination of these eclipses, making only such a selection therefrom as may possibly possess interest for the general reader. I shall omit any reference to the purely astronomical conclusions to which I have been led, which would be out of place in your columns, and, indeed, would extend this communication beyond reasonable limits. It may, however, be desirable to state that I have employed the last value of the secular acceleration of the moon's mean motion given by Prof. Hansen, of Gotha, the author of the latest lunar tables, and have combined other important elements as determined by him with the results of M. Leverrier's tables of the sun. From recent investigations it appears by no means improbable that we may have to rely wholly upon the ancient eclipses in fixing the true amount of acceleration in the motion of our satellite.

"I shall follow the chronological order in the subjoined remarks upon some of the better known eclipses of history. These form a part only of the phenomena I have rigorously examined

upon the same system of calculation.

"I. The Nineveh Eclipse of B.C. 763, June 15.—The discovery of the record of this eclipse on one of the Nineveh tablets in the British Museum was announced by Sir Henry Rawlinson in the Athenaum of May 18, 1867, to which I refer for details of its bearing on the sacred and profane history of the period. In the actual state of our knowledge it is the terminus' a quo for researches on the historical eclipses, and I believe I am correct in saying its value in an astronomical point of view is greater than that attaching to the famous eclipse predicted by Thales to the Ionians, as mentioned by Herodotus. The underlining of the inscription appears to indicate a phenomenon of unusual character, or that the eclipse was total in or near Nineveh. Adopting for the position of the city the longitude and latitude deduced by the Astronomer Royal for the pyramid of Nimrud, I find the calculated southern limit of totality would pass a few miles south of Nineveh, leaving a very large partial eclipse at that city. Very trifling corrections in the lunar elements employed would suffice to bring the total eclipse over it. In this longitude the duration of totality on the central line would be 4m. 20s., the middle of the eclipse at half-past o local time.

of the eclipse at half-past 9 local time.

"2. The Eclipse of B. C. 689, January II.—The idea that the retrogression of the shadow on 'the dial of Ahaz' during the illness of Hezekiah may have been connected with a solar eclipse has given rise to much discussion, and several writers have endeavoured to point out how the occurrence might thus be explained. Of the eclipses to which attention has been directed, the above has perhaps appeared the more probable. It was an annular eclipse, and at Jerusalem the sun would present the form of a luminous ring for 7½ minutes, the middle at 10h. 18m. In Babylon it would have the same appearance for seven minutes. It seems hardly probable that the eclipse could have occurred much later in the day, though more than one author has considered the circumstance essential for the explanation of the retrograde motion of the shadow on the ancient form of sun-dial by an eclipse. I must leave the reader to judge how far the expression 'the wonder done in the land' may relate to such a phenomenon, which is, of course, a very rare one in a particular

locality.

"3. The eclipse of Thales, B.C. 585, May 28.—This eclipse, which, as Herodotus informs us, terminated the six years' war between the Medes and Lydians under Cyaxares and Alyattes, when during a battle 'day was suddenly turned into night,' has greatly exercised the chronologist and the astronomer, and although, misled by imperfect tables of the lunar motions, they have fixed upon other eclipses from time to time, it has been known for some years past that the date distinctly assigned by Pliny (the fourth year of the 48th Olympiad) is the correct one. My new calculation throws the shadow precisely over the tract of country where with the greatest probability it has been supposed the contending armies were situated, and in addition it indicates a circumstance which I believe has not resulted from any previous calculation, and which may not be without its

chronological import, viz., that the eclipse was total in Nineveh for between three and four minutes shortly before sunset. date of the final destruction of Nineveh is closely connected with

the eclipse of Thales.

"4. The Eclipse of Xerxes, B.C. 478, February 17.—Much difficulty has been experienced by chronologists with regard to an eclipse which occurred, according to Herodotus, in the early spring, when Xerxes was setting out from Sardis on his expedition against Greece. It is certain there was no such phenomenon in the year B.C. 480, to which this event is usually referred, and in examining the eclipses about this period I have found only one that can apply. There is no doubt that the sun was very largely eclipsed at Sardis on the morning of February 17, B.C. 478. direct calculation for this place shows that more than 94-100ths of the sun's diameter would be covered, the greatest phase ten minutes after 11, local time. The eclipse was annular, and Sardis appears to have been just outside the annulus. other eclipse only was visible in eastern Europe about this year, it occurred B.C. 479, October 2, and has been considered to be the one which occurred at the time Cleombrotus consulted the oracles at Sparta. Its magnitude there is found to have been about 6-10ths, the greatest eclipse at oh. 50m. If the eclipse of B.C. 478 be truly the one recorded by the historian, the date of the battle of Salamis will be required to be brought down two

years.
"5. The Eclipse of Agathocles, B.C. 310, August 15 (Diodorus, Justin).—On the morning after the fleet of Agathocles sailed from Syracuse for Africa, the historian tells us the sun was eclipsed to such a degree (tantum fit solis deliquium) that the stars everywhere appeared as at night. Though Agathocles could hardly have been more than 100 miles from Syracuse, it is uncertain in which direction he had sailed, or whether he was rounding Sicily on the north or south side, and this circumstance detracts from the scientific value of the record. My calculation throws a central line near the African coast, so that the fleet, if sailing southwards, would be near the northern limit of

totality.
"6. The Eclipse on the Passage of the Rubicon by Cæsar (Dion), B.C. 51, March 7 .-- This would appear to have been a very notable phenomenon on the Rubicon and in Northern Italy generally. The eclipse was annular, and the annular phase con-At Rome there would be a partial eclipse, about tinued 6m. 30s. three-fourths of the sun's diameter being covered. A line drawn from 9° 24' E., and 43° 26' N., to 14° 39' E., and 46° 15' N., will define the course of the central eclipse across Italy, and the ring-formed appearance of the sun would extend to about 1° 35' north and south of this line. The Rubicon would be placed about midway between the central line and the southern limit. Near Ariminum the middle of the eclipse occurred at oh. 50m. By some writers (including the Abbé du Fresnoy, in his valuable 'Tablettes Chronologiques,') the eclipse is dated B.C. 50; the above, however, is the correct year.

"A great eclipse has been referred to the year B.C. 43 or 44, soon after the death of Julius Cæsar, and it is instanced by Baron de Zach and M. Arago as the first annular eclipse upon record. Calculation shows that there could not have been an eclipse, annular or otherwise, visible in Italy in either of those years, nor, indeed, for several years before or after. The phenomenon alluded to was, no doubt, of a meteorological character, and this would appear from the passage in Suetonius, one of the authors

quoted upon the subject.

"7. The Eclipse of Herod (Josephus).—The lunar eclipse which I take to be the one recorded by the Jewish historian during Herod's last illness occurred B.C. I, January 9. occasion the moon passed nearly centrally through the earth's shadow, entering in at 11h. 23m. P.M. mean time at Jerusalem, and emerging at 2h. 57m. A.M. on the 10th; the total eclipse continued 1m. 39s. This is the date recognised by Calvisius and recently supported by Mr. Bosanquet. An eclipse in B.C. 4 on

recently supported by Mr. Bosanquet. An eclipse in B.C. 4 on the night between March 12-13, which other chronologists have supposed to be the one referred to, was partial only, and did not commence till I A.M.; little more than half the moon's diameter was immersed in the earth's shadow at greatest phase.

"8. The Eclipse of Phlegon in the 202nd Olympiad (Eusebius) A.D. 29, November 24.—Total on a line crossing the Black Sea rather west of Odessa in Sinope, thence near the site of Nineveh to the Persian Gulf. At Jerusalem a partial eclipse; about II IDAM eight-tenths of the sun's diameter would be about 11.10 A.M. eight-tenths of the sun's diameter would be covered; at Heliopolis (Baalbec) also partial—nine-tenths. At a point on the central line near Sinope the totality would con-

tinue 11 minutes. Humboldt mentions that this eclipse had been calculated by Wurm, but I have not met with his results. It is the only solar eclipse that could have been visible in Jerusalem during the period usually fixed for the ministry of Christ,

"The moon was eclipsed on the generally received date of the Crucifixion, A.D. 33, April 3. I find she had emerged from the earth's dark shadow a quarter of an hour before she rose at Jerusalem (6.36 P.M.): but the penumbra continued upon her

disc for an hour afterwards.

"9. The Eclipse of 113, May 31.—Kepler, after endeavouring to ascertain the date of a total eclipse mentioned by Plutarch as having 'recently occurred about noon,' when the darkness was like that of night, and stars were seen in all directions, states he had found none which accorded better with the description than the above. On submitting it to calculation on the modern elements, the central line appears to have passed too far north—over central Germany. I have not succeeded in discovering the date of this eclipse, though I have accurately examined several

at the close of the first and beginning of the second century.

"10. The Eclipse of 418, July 19.—Very large at Constantinople, according to Philostorgius, who relates that at the eighth hour of the day the sun was so far eclipsed that the stars appeared, and a comet which had not been previously perceived became visible during the obscurity, and was watched for more than four months afterwards. According to my calculation the central line passed somewhat to the south of Constantinople; where ninety-five hundredths of the sun's diameter would be covered. At a very short distance below that point the eclipse would be total. This is the second occasion upon which the discovery of a comet during a total, or nearly total, eclipse of the

sun is recorded in history.

"11. The Eclipse of 671, December 7, on the attempted removal of the pulpit of Mahomet from Medina. - Prof. Ockley, in his 'History of the Saracens,' mentions on the authority of several Arabian writers, a large solar eclipse which occurred about the 52nd year of the Hegira. The Caliph Moawiyah having formed the intention of removing the Prophet's pulpit from Medina to his residence at Damascus, his people proceeded to do so, 'when immediately to their great surprise and astonishment the sun was eclipsed to that degree that the stars appeared.' Baron de Zach refers the eclipse to 674, October 4, but in this he is certainly mistaken—I believe through a wrong assumption as regards the moon's latitude. The correct date would appear to be 671, December 7. The eclipse of this day was annular on the central line. At Medina the greatest phase occurred at 10h, 43m., when 85-100ths of the sun's diameter would be observed. In the deep chiese of that part of the movid work adverse of the sun's diameter. scured. In the clear skies of that part of the world such a degree of eclipse might be sufficient to bring out the brighter planets or No larger eclipse, visible at Medina, occurred about this

"12. The Eclipse of 840, May 5.—Among the causes which are said to have brought on the maladie de langueur that termianted the life of Louis le Débonnaire was 'the fright which a total eclipse of the sun had occasioned him.' It is related that the King was taken ill at Worms, and having been removed to Ingelheim, near Mayence, he died there on June 20. I find the northern limit of totality in this eclipse passed about 100 miles south of Worms, and on the central line in this longitude the total eclipse continued 5m. 25s., an unusually long interval for the latitude of Central Europe. The middle occurred at 1.15 P.M., with the sun at an altitude of 57°. The phenomenon under such circumstances must have been a very imposing one,

and well calculated in those days to inspire alarm.

"I have already described in your columns the track of the total eclipse of 1140, March 20 (William of Malmesbury) across this country, and merely refer to it now to add, that if any one of your readers is aware of its being recorded as total in London, he might be doing an astronomical service by making the fact

generally known.
"13. The Eclipse of 1133, 'August 2 (William of Malmesbury), a great solar eclipse, considered as foreboding evil to Henry I. of England. -The central line traversed Scotland from Ross to Forfar, and the eclipse was, of course, large in every part of the country. It would be total in Northumberland. In the centre was about 20 miles within the south limit.

"During the existence of the kingdom of Jerusalem there is

mention of an eclipse which would appear to have been total in the city or its immediate neighbourhood, and has been variously dated from the election of Godfrey of Bouillon in 1097. I am inclined to think it must be to the eclipse of August, 1133, that the record applies, though previous or subsequent events may have been mixed up with it by the historian. Continuing the calculation of the track of total eclipse after leaving this island, I find it would enter Palestine near Jaffa, and pass over Jerusalem and Hebron, where the sun would be hidden $4\frac{1}{4}$ minutes about 3 P.M., and from Nablous on the north to Ascalon on the south the country would be in darkness for nearly the same interval. The magnitude of the eclipse of 1187, September 4, was rather more than 9-10ths at Jerusalem, the central line passing between eight and nine degrees to the north; in the eclipse of 1191, June

23, the magnitude was about 7-10ths.

"14. The Eclipse of 1433, June 7, long remembered in Scotland as "the black hour."—It was a remarkable eclipse, the moon being nearly in perigee and the sun not far from apogee. The central line traversed the country in a south-easterly direction, from Ross to Forfar, passing near Inverness and Dundee. Maclaurin mentions that in his time a manuscript account of this eclipse was preserved in the University of Edinburgh, wherein the darkness is said to have come on about 3 P.M., and to have been very profound. By direction calculation for Edinburgh I find the total eclipse commenced at 3h. 3m., and continued 3m. 4ts. At Inverness totality continued 4m. 32s. The after course of this eclipse was north of Frankfort on the Main and Munich, over the Dardanelles, south of Aleppo, and thence

nearly parallel to the course of the Euphrates to the north-east border of Arabia. The totality was observed in the Turkish dominions according to Calvisius.

"15. The Eclipse of 1598, February 25.—Maclaurin says the memory of this eclipse was preserved among the people of Scotland, and 'that day they termed Black Saturday.' He adds:—'There is a tradition that some persons in the north lost their way in the time of this eclipse, and perished in the snow'—a statement the probability of which our experience of recent phenomena by no means tends to support. The central eclipse may be described as having passed about five miles south of Stranraer to the Bass Rock, a little south of Edinburgh, or, more precisely, over Dalkeith. Totality came on at Edinburgh at 10h. 15m., and continued 1m. 30s. The duration was the same at Douglas, Isle of Man. From the rapid motion of the moon in declination the course of the central line was a quickly-ascending one, in latitude on the earth's surface, the total eclipse passing off within the Arctic circle. Kepler must refer to another eclipse which was observed by Jessenius at Torgau, on the Elbe, though he gives the above date.

gives the above date.

"16. The Eclipse of 1652, April 8, to which reference is also made by Maclaurin as 'still famous among the populace of Scotland, and known among them by the appellation of Mirk Monday."—The central line passed over the south-east of Ireland, near Wexford and Wicklow, arrived on the shores of Scotland near Burrow Head, Wigtonshire, and running within a few miles from Edinburgh, Montrose, and Aberdeen, left the island at Peterhead. Greenock and Elgin would be situate near the north limit, and the Cheviots and Berwick upon the south limit of totality. The eclipse was observed at Carrickfergus, Ireland, by Dr. Wyberd. I find by direct calculation for this place that it was only just within the north limit of totality, which would commence at 10h. 8m. 30s., and continue 44 seconds. This short duration may partly explain a curious remark of Dr. Wyberd, that when the sun was reduced to 'a very slender crescent of light, the moon all at once threw herself within the margin of the solar disc with such agility that she seemed to revolve like an upper millstone, affording a pleasant spectacle of rotatory motion.' Wyberd's further description clearly applies to the corona.

an upper millstone, affording a pleasant spectacle of rotatory motion. Wyberd's further description clearly applies to the corona. "I believe it has been generally supposed that the last total eclipse of the sun visible in England was that of 1715, May 3, so well recorded by Halley in the 'Philosophical Transactions' of the Royal Society, and I was under this impression myself until, on calculating the elements of the eclipse of 1724 (May 22), observed at Paris, and by the French King at the Trianon, I discovered that before reaching France the belt of totality must have traversed the south-west of England, and it now appears

that the totality did not pass by us unrecorded.

"I am indebted to the Astronomer Royal for referring me to an account by Dr. Stukeley, who observed the eclipse from Salisbury Plain. The duration of totality in that locality would be rather less than three minutes. The eclipse of 1724 is therefore the last that has been total in England, and as I have shown in a previous communication, there will be no other till August 11, 1999, and that will be confined to the south-west corner of the country."

ON PHOTOGRAPHIC IRRADIATION IN OVER-EXPOSED PLATES*

THE most cursory observer of any of the recent corona photographs must have remarked the apparent eating in of the prominences over the limb of the dark Moon. A more careful examination of the photographs shows that the whole limb of the Moon is more or less eaten into, and that the indentations under the prominences are only exaggerations of a phenomenon which is present at all parts of the limb, but which varies in intensity according as the dark limb of the Moon is projected on a brighter or less luminous background.

In all over-exposed photographs of luminous objects upon a dark background, the brighter parts of the picture are found to be surrounded by a nebulous haze or border of light, which increases the diameter of the image formed by the luminous objects

at the expense of those which are less luminous.

This nebulous haze has often been spoken of as "the extension of the chemical action," but without begging the question of its cause, we propose to speak of it as photographic irradiation. It has been found to vary with the time of exposure, and the relative brightness of the object and its background.

On examining the effects of photographic irradiation in a decidedly over-exposed picture, it will be seen that the nebulous fringes round luminous objects are distinctly divided into two parts—an inner and very marked border of light, following the contour of the luminous objects, and an outer and much less definite haze, thus:—



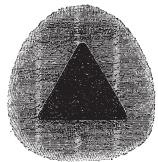


Fig. A

Fig. B

where Fig. A represents a normal photograph, and Fig. B a decidedly over-exposed plate from the same object.

The inner border of light fades gradually from the inside outwards, and it is very difficult, and indeed impossible, to tell where the true image of the luminous object ends, and its photographic irradiation begins. While, on the other hand, the boundary between the outer and inner fringes (or halos) of irradiation is more definitely marked, although it would be difficult to say with any absolute precision, at what point the inner fringe terminates.

any absolute precision, at what point the inner fringe terminates. Our first experiments were devised in order to test whether reflections from the back surface of the plate played any part in the production of the fringes; for this purpose plates of ebonite and the so-called non-actinic yellow glass were prepared.

In the over-exposed photographs taken on ebonite, it was found that the outer haze had entirely disappeared; while in the photographs taken on plates of yellow glass the outer haze is still distinctly to be traced, though it is much fainter than on an ordinary white glass plate with the same exposure

ordinary white glass plate with the same exposure.

By placing a piece of wetted black paper at the back of an unground plate the outer haze may be greatly reduced, while it was found that by grinding both the back and the front surfaces of a yellow glass-plate, and covering the back with a coating of black varnish, the outer haze may be rendered quite imperceptible, while, however, the inner border of irradiation still remains as before.

From these experiments we may conclude that the outer haze is produced by reflections from the back of the plate; and the action of the wetted black paper in reducing the outer irradiation may be explained by the consideration that the change of refractive index in passing from the glass to the film of water behind, is much less than in passing from glass into air. There is, consequently, less reflection at the back surface of the plate; most

* By Lord Lindsay and Mr. A. Cowper Ranyard. Reprinted from the Monthly Notices of the Royal Astronomical Society, June 14, 1872.