

No doubt universality unaccompanied by such disadvantages as the equatorial *coudé* possesses is very much to be desired, but I do not yet see how it is to be obtained. With respect to the solitary original objection that M. Loewy has raised, viz. that the light reflected by the mirror varies with the different angles of inclination, and therefore renders the instrument unfit for photometric researches, I confess this objection did not occur to me before, and I am inclined to think M. Loewy is right, and that my instrument will not be well adapted for photometric researches, but I ask: Is the equatorial *coudé* any better? On consideration it will be evident to your scientific readers that the light after the first reflection is elliptically polarised, and if so the quantity reflected by the second mirror is variable at the various angles of declination; consequently photometric observations made with the equatorial *coudé* cannot be relied upon.

In attempting to prove his case M. Loewy gives in his first letter a considerable number of numerical details, and no doubt most of your readers have taken these figures as correct. I will ask them, however, to verify for themselves a few of them, and the result will, I think, show how very loosely M. Loewy has put these data together. For instance, he mentions the weight of a 40-inch mirror, whose thickness is just one-sixth of the diameter, to be 380 kilos., and he calculates (see further down) that a mirror of 38 inches diameter and proportional thickness would weigh 280 kilos.—100 kilos. less. Now, if the thickness be proportional, the weight should be as the cube of the diameter. If your readers will try this themselves, they will find that M. Loewy has in this case exaggerated the difference to the amount of about 100 per cent.

I find I omitted to notice just one point in Mr. Loewy's first letter. He says:—"If Mr. Grubb had looked at the drawing which I published in the *Journal de Physique* of last year, he would have seen that it is almost identical with that which he has communicated to the Royal Dublin Society, so far as the general arrangements for sheltering the observer and instrument are concerned."

Permit me to inform M. Loewy that this would hardly have been a novelty to me last year, inasmuch as I had such arrangements not only on paper but in actual work for some years back, and a description of the same was published in the Royal Dublin Society's *Proceedings*, April 1879.

Your readers will see from the foregoing that M. Loewy's whole letter is based on a series of misconceptions of statements in my paper in the *Transactions* of the Royal Dublin Society.

Some of the mistakes that M. Loewy has fallen into were perhaps due to the fact that the plate issued with the Royal Dublin Society's *Transactions* was merely a diagram without details, introduced to illustrate the principle of the mounting. He assumes that details not figured in the diagram are not to be provided, in spite of the fact that in the text of my paper I discussed several of them.

M. Loewy occupies nearly half a column of *NATURE* in speaking of the labour involved in working this instrument, because no tube is shown in the diagram connecting the equatorial part with the ocular; all this trouble would have been saved if he had read my paper a little more carefully, for then he would have found that not only did I say, "In most cases it would be desirable to have a connecting tube," but I even discuss the best form of tube for the purpose. There are some special cases in which a tube would not be actually necessary.

It appears to me that M. Loewy is very unnecessarily disturbed in his mind by the advent of my instrument. No doubt the equatorial *coudé* and my siderostatic telescope have each their own sphere of work, and there may be room for both. An observatory having at its back a generous individual who (as was stated at a late meeting of the Royal Astronomical Society), has already expended a quarter of a million on astronomical observatories and is willing to spend more, can afford a large instrument perhaps on M. Loewy's plan; but as all observatories are not equally fortunate, there may occasionally be one found which will be glad to get equally great optical power at one-third the cost.

I barely alluded in my last letter to this question of cost. On this point it may be desirable to supplement what I have said in my former letter, bearing in mind that the cost of the instrument will, as I have above stated, depend somewhat on whether or not the objective is achromatised on the ordinary principle or that of the dialyte.

In order to put the matter of cost in the clearest light, let us consider the four forms which we have at present to select from, viz. the ordinary equatorial, M. Loewy's equatorial *coudé*, my

siderostatic telescope with objective achromatised in the ordinary way, and the same instrument with objective achromatised on the dialyte principle.

Let us consider first what apertures we can obtain in the several forms for a given sum; assuming M. Loewy's figures for the equatorial *coudé*. For 1760*l.* can be obtained—

- (a) Equatorial *coudé* of 12-inch aperture.
- (b) Ordinary equatorial of 12-inch aperture, including its dome and observatory.
- (c) Siderostatic telescope with objective achromatised in the ordinary way of 18 inches aperture.
- (d) Siderostatic telescope with objective achromatised on the dialyte principle of 24 inches aperture.

It would be for the astronomer to say whether the double aperture of the objective would not more than counterbalance the disadvantages of want of absolute universality.

Let us, secondly, consider for what prices the same aperture could be obtained in the various forms:—

- (a) Equatorial *coudé* 12" aperture £1760
- (b) Ordinary equatorial of 12" aperture, including dome and observatory 1760
- (c) Siderostatic telescope of 12" aperture with objective achromatised in the ordinary way ... 1000
- (d) Siderostatic telescope of 12" aperture, with objective achromatised on the dialyte principle ... 500

The difference between cost of equatorial *coudé* and siderostatic dialyte (about 1200*l.* for this size) will probably be considered by the purchaser rather too large a sum to pay for the possibility of examining the 6 per cent. of the northern hemisphere which is beyond the reach of my siderostatic telescope, particularly when it is borne in mind that that portion is the least important part of the heavens.

M. Loewy does not say whether the 1760*l.* includes cost of observing hut. If not, the comparison is still more striking, for, although the equatorial *coudé* requires a special building, my siderostatic telescope does not.

HOWARD GRUBB

Dublin, May 27

The Earthquake

CHANCE brought me to Colchester about a week after the earthquake, and since then I have been amusing myself mapping the effects of it, and hope to read a paper on the subject at the meeting of the Royal Geological Society, Ireland, next month. In the meantime I would like to draw attention to a few of the general facts that seem not to be recorded.

The area of structural damage lies at and southward of Colchester, principally to the west of the Colne estuary, and in it there are five smaller areas in which are found the greatest damage. These areas occur in the following order:—Wivenhoe, Peldon, Abberton and Langenhoe, Colchester, and West Mersea; each of these have two or more well-marked margins; where these margins can be easily studied, there are found to be lines of breaks, and alongside one, or in places two of them, the greatest destruction occurred, while at the other side of such lines the damage is a bagatelle in comparison.

Thus at Wivenhoe, where there was the greatest damage done, the shock came from the north-east; but when it reached the break of the Colne River valley, it seems to have recoiled as if from a percussion blow. Westward of the estuary of the Colne the damage at Rowhedge was slight when compared with that at Wivenhoe, while at Hornwood it was still slighter, although the last is only divided from Wivenhoe and Rowhedge by the valleys of the Colne and Roman Rivers.

At Peldon, where the shock appears to have been nearly as bad as at Wivenhoe, the damaged area is very well defined, being bounded northward and southward by stream valleys. The shock seems to have travelled southward and to have recoiled from the southern boundary, causing excessive damage alongside it. Here also the shock appears to have had a rotary motion, which possibly may be due to the recoil against the southern boundary.

In the Abberton and Langenhoe area the shocks seem also to have had a rotary motion, the main direction seems to have been from the south-east; here the greatest damage occurs at the western boundary.

At Colchester the shock was going north, while at West Mersea it went south. In both of these places the boundaries of the areas are in part obscure. In the first, however, we can trace the tract of maximum damage from Head Gate along the south Roman wall and eastward to Colne valley, east of which very

little damage was done. Thus everywhere except at West Mersea there are one or more lines, at one side of which there was excessive damage not to be found at the other side.

In the area of excessive damage, according to Mr. Dalton's map, the geological formations are *Alluvium*, *Glacial Drift*, and *London Clay*. On the first we find damage done to houses near Eastbridge, Colchester, and at Wivenhoe, although elsewhere they escaped. In the north portion of Wivenhoe and the north portions of Colchester, structures on the Glacial Drift were injured, but elsewhere the damage nearly invariably is confined to tracts and small exposures of the London Clay. This is very conspicuous in places—at Colchester there is a narrow outcrop of London Clay which widens eastward near the Colne, and on this narrow tract the greatest damage was done; similarly at Wivenhoe the excessive damage is along the outcrop of the London Clay. At Fingrinhoe and Frenchman's Lane the damage margins an outlying tract of Glacial Drift, while very good examples can be seen between Colchester and Ardleigh, the structures on narrow tongues of the clay being injured, while those on the intervening tracts of gravel have escaped, except in one instance.

Victoria Road, Colchester

J. HENRY KINAHAN

ONE of the most curious effects of the earthquake in the Peldon district is the evidence of a decided *twist* or apparent rotation of the shock evident in many cases upon standing buildings. Is is very apparent in the cracks throughout Dr. Green's house, which take a complete screw round some of the rooms and the staircase. It is also evident in the twist of the tapering mill chimney shaft where the upper 20 feet (still standing) is screwed round at the fracture upon the lower part about one inch. The same is apparent in a chimney at the "Peldon Rose" Inn, the screwing in this instance being about two inches. As such twists as are evident could not exist within the areas of separate single buildings, it appears to me that they must have been the resultants of the effects of two separate shocks, the first about north to south, and the second immediately following about east to west. That there were two shocks appears to be the general impression of the inhabitants of whom I made inquiry. Another matter of interest is the very peculiar fracture of the eastern side of Dr. Green's house. This fracture leaves the lower northern corner of the wall, and passes diagonally across the house to the upper southern corner. The crack is open about one inch through solid modern brickwork. In this case the line of fracture does not follow a line of weakness in the wall, but cuts directly through the thick chimney breasts, and equally across a window opening, as though there was present no difference in resistance. The angle of fracture is about 47° to the horizon, and it appears to me that this must have been the direction of the first or greater shock in this district, which was therefore more one of upheaval than of horizontal motion. This is also confirmed upon inquiry, as I find many persons in the district felt distinctly the motion of upheaval, but no one who was standing at the time is known to have been thrown down.

W. F. STANLEY

DARWIN relates that the earthquake of February 20, 1835, which overthrew Concepcion, although it was severely felt in Chiloe, yet on the neighbouring Cordillera (near Mellipulli) it was not felt at all. "Some men who had been employed in the mountains splitting fir planks, when they returned in the evening to Calbuco and were told of the shock, said that 'about the time mentioned they recollected that they had not been able to strike fair with the axe, and that they had spoilt a board or two by cutting too deep.' This probably is not so fanciful as it appears; at least it shows that if there was any motion it was of an exceedingly gentle kind" (*Trans. Geol. Soc.*, vol. v. p. 605).

A parallel case occurred during the late earthquake in Essex. Some men hoeing wheat at Frating, about seven miles north-east of the focus of the shock, did not perceive the shock, but felt as if they could not get their hoes to the ground.

May 30

O. FISHER

Jupiter

THIS planet is now so unfavourably placed that very few further opportunities will occur of observing the chief features during the present apparition. It is, however, important that the red spot and equatorial white spot should be followed as long

as practicable, and I give a list of the times when they will be situated on or near the central meridian:—

Red spot			White spot		
h.			h.		
June 5	...	8.8	June 5	...	9.1
7	...	10.4	7	...	10.3
10	...	7.9	12	...	8.3
12	...	9.5	14	...	9.5
17	...	8.7	21	...	8.8
22	...	7.8	28	...	8.1

The two spots will come to the same longitude on June 7, but at the time of their transit Jupiter will be too low to admit of satisfactory observation.

Erratum.—The dark satellite transit which I observed on May 18 (*NATURE*, May 22, p. 77) referred to the *fourth* satellite and not to the first as described. The three dark spots seen were really the shadows of the first and second satellite and the fourth satellite itself. The first satellite was also projected on the disk of Jupiter at the time of the observation, but it was not seen under the form of a dark spot. The error in the original description arose from a mistake in the identification of the satellites and their shadows, four of which were on the planet at the same time.

W. F. DENNING

Bristol, June 1

Animal Intelligence

THE instances of intelligence which I am about to relate, to the credit of a cockatoo, were described to me by the owner, a lady, in whose presence they were displayed, as well as in that of several other witnesses, one of whom (her husband) was also present on two occasions when I heard the accounts.

The bird is fond of white lump-sugar, and ordinarily drops it into his saucer of tea or other drink to soften it. On one occasion when he was thought to be thirsty, a glass of water was offered him, which appears to have been of the goblet kind, about 6 inches high, with a foot and stem, and holding, it would seem, something more than a large wine-glass and less than a small tumbler. Shortly after, the bird received a piece of sugar, and, as usual, dropped it into the water. But now, alas! the depth of liquid was too great for him to recover the saturated lump; and unfortunately, not having myself witnessed the occurrence, I am unable to describe the indications of mental effort which doubtless preceded the attempt to solve the problem of extracting the lump of sugar before it should disappear. I was told that the like difficulty recurred next day, and, whether on account of the practical failure of the first attempt, or in consequence of a fresh inspiration at the moment, a different and *entirely successful* plan was then adopted. It is no doubt to be regretted that the experiment was not followed up, but the reason will shortly be apparent. Now, as to the first attempt. There was no endeavour to upset the glass; it was too high for the claw to be used, and too deep for the beak to be plunged in. To *drink* all the water would indeed have been, as remarked by the narrator, "an heroic remedy." What "*Koko*" did do was to *bale* the water out with his scoop-like lower mandible. Here again I find myself unable to describe the action more exactly, but it must have been in the highest degree interesting to watch the operation, with its increasing difficulty, and constantly diminishing prize at the bottom. Finally we may suppose that the sugar having disappeared the last portions were at least partly enjoyed. Still the result was to some extent evidently a disappointment; for on the next occasion "*Koko*," without the least hesitation, put in practice a device which we may fairly suppose he had thought out meanwhile. He began forthwith to drop in lumps of sugar one after another until the last was level with the surface, when he recovered that one and left the rest to their natural fate, while he peacefully enjoyed the fruits of his invention.

I have unfortunately too slight an acquaintance with the ways of these birds to know certainly whether this is above the average of their intelligent acts and as such worthy of space in your columns. For the same reason I hesitate to give, at second hand, other indications which, however interesting to me, might prove less so to others. I will only add that it is so distressing to see so nice a creature almost naked, through its inveterate propensity to pluck out every feather within reach, that I should be glad to hear of any possible remedy.

J. HERSHEY

23, Suffolk Street, Pall Mall East, S.W.

P.S.—At the suggestion of a gentleman whose name is well