

treated those of the second quality, while the clippings and inferior fruit are received into baskets at the feet of the trimmers and reserved for home consumption. A quantity of small wooden trays are now brought forward, just the size of a common raisin box and about an inch deep. In these papers are neatly laid so as to lap over and cover the raisins evenly deposited in the trays, which are then subjected to heavy pressure in a rude press. After pressing the raisins are dropped into the boxes for market.

THE SUN.

BY S. P. LANGLEY, ALLEGHENY OBSERVATORY, PA.*
A "TOTAL" ECLIPSE.

Every one has seen an eclipse of the sun of some sort, but a "partial" eclipse as seen through a piece of smoked glass, though no doubt a curious and interesting, can hardly be called an imposing phenomenon. From some such experience, perhaps, many form an idea of what a "total" eclipse may be like, but in reality there is hardly any resemblance. Not only is a solar total eclipse, by general agreement, the grandest and most imposing spectacle nature offers, but it is to most the rarest of all; the chances being against any average human life's bringing the opportunity to see one from any given place on the earth's surface.

Besides this it is a most important opportunity for seeing certain things about the sun which are never visible even to the most powerful telescope at any other time. We say "about," and not "on," advisedly, for the things in question belong to a region extending out from the sun into space, where every feature is usually obliterated by the greater brilliancy of sunlight. It is only when this is withdrawn, and we are in the shadow of the moon, that the "corona" appears, though it is always existing there; as the stars are by day in the heavens unseen till the shadow of the earth makes night. When such an event as a total eclipse occurs, observers therefore travel if necessary across the globe to see it, though the spectacle lasts usually less than five minutes; and one such is to appear in the Territories of the United States on the 29th day of the present month.

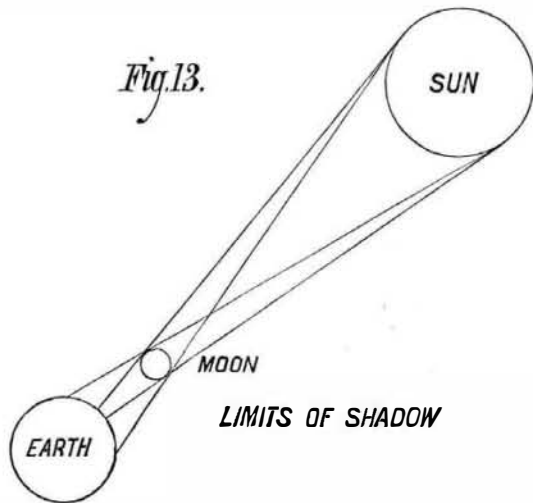
It will be seen from the annexed figure (Fig. 13) that when the moon comes between the sun and earth, two shadow cones are formed; one (the larger) within which the observer will have his view of part of the sun cut off by the intervening body (and see a "partial" eclipse), the other cone marking the limits within which the whole sun is rendered invisible, and the eclipse is total.

The first cone grows larger and larger as we go away from the moon in the direction opposite the sun, the second smaller and smaller. If the moon were a little further off than it is, the apex of this second cone might be reached without its touching the earth at all, and as her distance is variable this in fact sometimes happens. The moon is always so far away (and so small compared with the sun) that the section of the inner cone where it strikes the earth is at all times small, or, in other words, the part of the earth whence a total eclipse can be seen is never more than a very small portion of the whole. The section of the inner cone where it strikes the earth is (where the sun is vertical), generally speaking, a circle of less than 200 miles in diameter, and as this section is carried along by the moon's motion and the earth's together, it sweeps over the surface of our globe in such a narrow belt as is shown in Fig. 14, which is taken from the *American Nautical Almanac*, with a very slight modification that the heavy black line across the continent marks both the track along which totality lies and the width of the very narrow region through which alone it is visible.

When from an elevated station we watch the progress of a total eclipse, the sun's disk is seen to be slowly invaded by the advancing moon, and as the solar brightness is gradually reduced to a thin crescent, daylight fades with increasing rapidity, and a quite peculiar and unnatural light, hard to describe but which no one forgets who has once seen it, spreads over the landscape. Then, and suddenly, we come to a new sense of the reality (if I may so speak) of the heavenly bodies, for the moon, which we have been accustomed to see as a disk of distant light on the far background of the starry skies, takes on the appearance of the enormous solid sphere which it is, and a faint glow within its circumference (due, perhaps, to reflection from the corona) makes its rotundity so perceptible that we feel, perhaps for the first time, the perpetual miracle which holds this great cannon-ball-like thing from falling. But almost at the same moment we become aware that its immense shadow is rushing toward us, blotting out the landscape, and advancing like a material darkness with an effect actually terrifying.

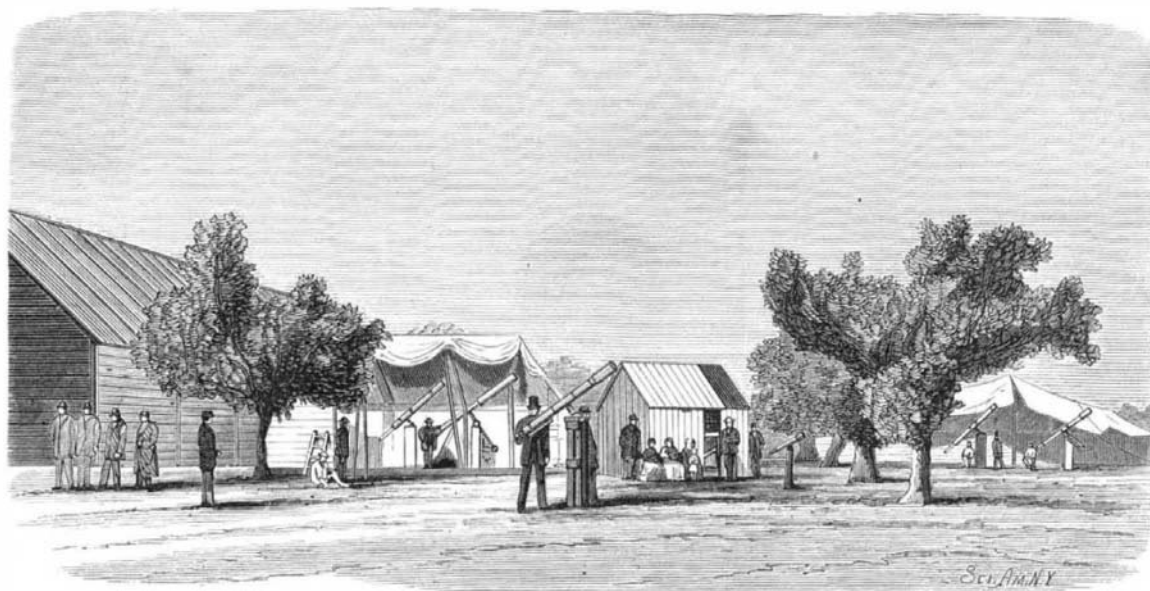
Lest I seem to exaggerate, let me quote the words of another, a trustworthy and careful witness. Principal Forbes,

watching the eclipse of July, 1842, in Europe, says of this: "I perceived in the southwest a black shadow like that of a storm about to break, which obscured the Alps; it was the lunar shadow coming toward us. Those who have seen a locomotive approach at the rate of 40 miles an hour can judge of the stupefaction caused by the approach of this black column with all but lightning speed. I confess it was the most terrifying sight I ever saw. As always happens in the case of sudden, silent, unexpected movements, the



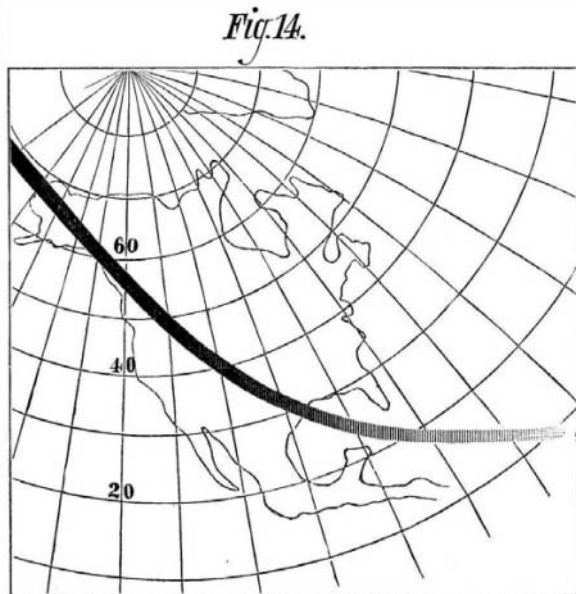
spectator confounds real and relative motions—I felt almost giddy for a moment, as though the massive building under me bowed on the side of the coming eclipse."

Another witness, Captain Biddulph, says:—"The light cloud I saw distinctly put out like a candle. The rapidity of the motion of the shadow, and its intenseness, produced a feeling that something material was sweeping over the earth at a speed perfectly frightful. I involuntarily listened for the rushing noise of a mighty wind."



"ECLIPSE ENCAMPMENT."

The shadow having involved us, we look up to the place the sun occupied a moment ago, and find in its stead a black circle, around the edge of which are irregular flames, or what seem like flames, chiefly of a rose red, rising in fantastic shapes to heights which in some cases have exceeded 80,000 miles (Fig. 15, p. 50). These are not always present in equal quantity. In the eclipse of this month they will probably be few, but they are always a beautiful spectacle. The



REGION OF TOTAL ECLIPSE JULY 29, 1878.

illustration annexed (Fig. 15) is taken in part from a paper in the notices of the Royal Astronomical Society, describing the English observations of an eclipse in India, and gives a fair idea of the sizes of these "flames" compared with that of the sun. The variety and in some cases beauty

of the "flames" themselves, when studied separately by the spectroscope, are very great, and even as small as the scale of the drawing is, they exhibit great diversity of outline. None are here seen entirely detached from the sun, and floating cloudlike above its surface, but such are sometimes visible. At the time of the eclipse at which this drawing was taken, the "flames" were the objects of principal curiosity, and it was even uncertain till then whether they were attached to the sun or moon. But the dark body of the moon was distinctly seen to advance over them, and their fluctuating character was exhibited by drawings taken a short distance of time apart. Thus the great prominence at A is shown on an enlarged scale at A' with its curious twisted structure as it appeared to the English observers at Guntoor, while at B is another enlarged view of the same prominence as it appeared at Mantawallock which the eclipse reached later. It is very plain that its form has altered in the interval. The curious spiral, striated structure of A has also been observed by Professor Abbe of the United States Signal Service in portions of the corona itself, or in what appears to be such. The whole structure of these red "flames" allies them with the delicate cloud forms described here as seen in spots, and it will likewise be noticed that they are shown on the figure as not being seen about the solar poles, a region from which the spots are also absent. Beyond them, stretching out into space for distances sometimes equal to the sun's entire diameter, are brushes of pale light, whose extremities some describe as perceptibly curved and scintillating, or at least fluctuating. (These were to me the most striking thing in the eclipse of 1869.) It is not entirely certain how far these brushes are a real solar appendage, for something like them can undoubtedly be produced by the rays of the sun broken by the ragged mountainous edge of the moon, and seen reflected from the distant parts of our own atmosphere, in such a way that by an effect of perspective they seem to be entirely without it (Fig. 16). Nearer to the body of the invisible sun the light grows brighter and more continuous, till close to the black moon it becomes much brighter than full moonlight would

be, and gives so much light that in the complete absence of the sun only the brighter stars are visible. The darkness is then by no means absolute, and it is further lessened by light reflected from regions in the extreme horizon, which are without the limits of totality.

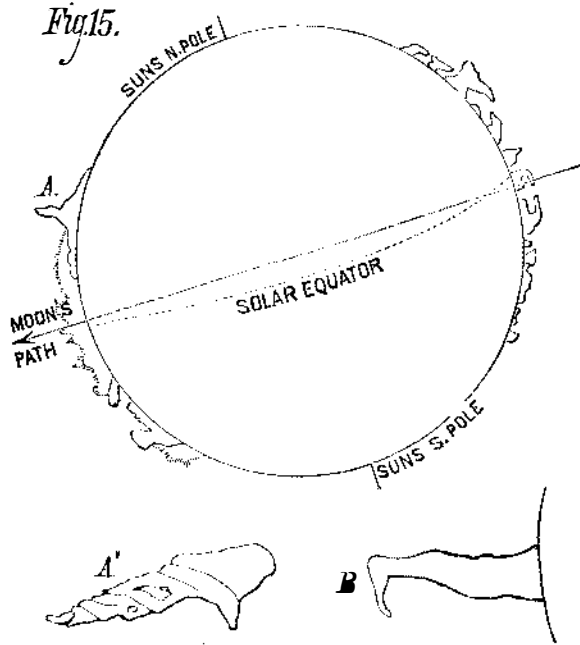
The red flames are a part of what is called the chromosphere of the sun. The rest of the appearances described belong to the corona, the crown or glory about the eclipsed orb, as they seem, looking, in fact, much like the aureole represented by painters about the heads of saints. Fig. 16, p. 50 represents the inner corona and red flames as drawn by Professor J. H. Eastman, U.S.N. Fig. 17 is from a sketch by Tacchini, and shows the more extended corona rays as seen

at the eclipse of December, 1870. The total phase lasts at the longest six or seven minutes, but rarely as much as that. In the case of the eclipse of 1870, observed at the station of Xeres de la Frontera, by the U. S. Coast Survey eclipse expedition, the whole duration was two minutes and ten seconds, and for the opportunity afforded by this brief interval the ocean had been crossed by a whole body of observers. Two principal parties were dispatched for the purpose by our Government, and the operations of that at Xeres, under the direction of Professor Winlock, may be taken as an example of the care and preparation used on such an occasion.

The party in this case consisted of fourteen, eleven of whom were from this country, and the station (in a vineyard near the town of Xeres) presented, from the number of the tents, the appearance of a military encampment (Fig. B). Every variety of instrument that science uses at such a time was in requisition: huge telescopes, solidly mounted and driven by clockwork, carried photographic apparatus; others spectroscopes; close by was a heliostat and horizontal telescope 40 feet in length, also for photography. Other telescopes were directed so as to form cameras, for sketching the corona; still others bore polariscopic apparatus for determining the character of its light. Elaborate provision for measuring its brightness was made, and in charge of a little division of the party in a neighboring orange grove, while a coast survey transit station had been improvised, with mounted transit, chronograph, chronometers for determining the time, and telegraphic connections established for the purpose with the Spanish Observatory of St. Fernando, near the city of Cadiz. Each of the observers had drilled himself for weeks beforehand in every part of every observation to be made by him, and there was such subdivision of labor that each had one thing only to do. As the critical moment approaches, lamps are lighted. Clouds are sweeping over the sky, and it has been raining a few minutes before, but now a break in the clouds appears about the sun, showing the light dwindled to

* For Part I, see SCIENTIFIC AMERICAN of July 20.

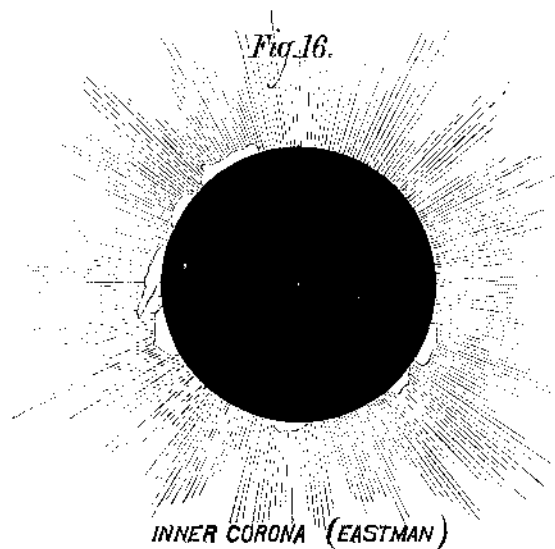
that of the thinnest crescent moon. A moment more and darkness seems to come suddenly down; the groups of spectators around the confines, kept back by sentinels, grow indistinct; an utter silence settles with the falling night, and for two minutes is unbroken; and while this silence lasts it may be safe to say that every observer has every faculty of mind or body that will serve his work bent on it with such a tension as one must have experienced to understand. Even while it seems to each as if he had only begun to do what he



wishes to accomplish, something seems to whirr past overhead, and turning the eyes we see the retreating shadow flying over a distant chain of mountains, which bounds the eastern horizon, while the sun's rays come out as suddenly and as dazzlingly as those of an electric lamp. It is over, and what those brief minutes have yielded is being written down by each one, while every impression is fresh in mind, before he leaves his post. This done, voices break out again; there are comparisons, congratulations, and regrets; but nothing can be done now but to leave the work as it stands, with the feeling, we may hope each has, that he at any rate did his best, whether that turned out much or little.

What knowledge have such labors brought us? Not nearly all we could wish, it must be confessed, for the corona is still in great part a mystery. The spectroscope shows that its light consists largely of a line in the green part of the spectrum, very nearly coinciding with an iron line ("1474, Kirchoff"). It was for a time inferred that it might be largely composed of iron vapor, but this supposition, never a very probable one, has been disproved by Professor Young, who with one of the recent very powerful "grating" spectroscopes has shown that the coronal line is not identical with the iron one, as supposed, and that the collocation probably means nothing. It is very difficult to see how the corona can be vapor of any sort, for the reason, among others, that comets have been known to pass through it without any visible effect on these excessively light bodies.

The most recent investigations seem to point to the conclusion that the corona is composed of an infinitude of minute discrete particles, somewhat like a dust cloud, but intensely hot from the neighborhood of the sun. This leaves us, however, with the difficulty of determining why these particles do not fall upon the sun's body. Now we must



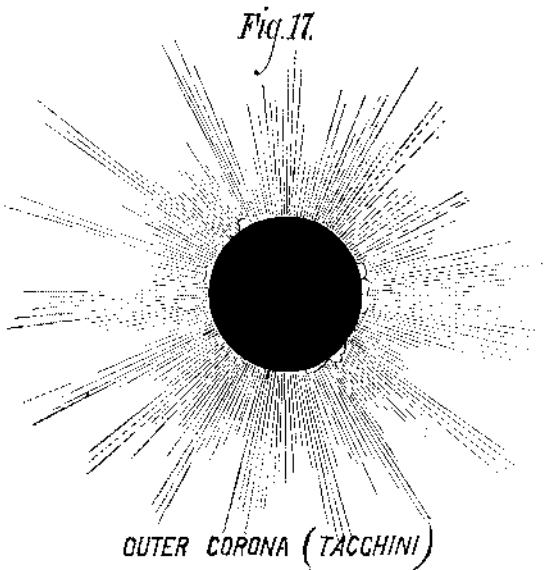
either suppose them to be moving about it, like other bodies obeying the law of gravitation (and there are several difficulties in the way of this), or suppose them to be kept away from the sun by a repulsive force. Fanciful as this last supposition may seem to be at first sight, it is not to be dismissed as impossible in the present state of our knowledge, which is leading us to look on the existence of such forces co-existently with gravitation (such as we familiarly know it) as even probable. It is to be hoped that our coming eclipse may do much toward settling such questions.

The "red flames" which have been spoken of are an object of far minor importance at an eclipse than formerly, because, according to the well known discovery of Messrs. Janssen and Lockyer, they can be made now visible at any time without an eclipse by the spectroscope. They constitute, however, a beautiful addition to the eclipse phenomena, and one point at least may be noted during the totality which the spectroscope alone could not tell us of—that they are not all of the rose red mentioned, but that occasionally some of a more nearly orange hue have been seen, thus marking the presence at great heights above the sun of other substances than hydrogen, to which the principal color is due.

It may perhaps be of interest, in view of the immediate approach of the eclipse, to give the approximate times of its occurrence in some of the principal cities where this will be read. By help of the computations of our Nautical Almanac Office we find:

Place.	Local time of beginning.	Of ending.
New York	4h. 47m.	6h. 33m.
Philadelphia	4h. 43m.	6h. 31m.
Baltimore	4h. 38m.	6h. 26m.
Cincinnati	3h. 58m.	6h. 02m.
Chicago	3h. 42m.	5h. 41m.
Pittsburg	4h. 20m.	6h. 12m.
New Orleans	3h. 51m.	5h. 52m.
San Francisco	0h. 52m.	3h. 17m.

It is possible that this article may fall into the hands of some one residing where the eclipse is total, and who may wish to be able to make some observation of service. None is likely to be so useful as a drawing made on the spot—not "corrected" or "improved" by subsequent retouching—and accompanied by any remarks as to the features of the corona seen by the naked eye or with the telescope. These may be sent to the Naval Observatory, Washington. A large number of parties will visit the eclipse track, and many of them have started with the beginning of the month to be early in the field and to make every preparation on the ground. Among these are several European astronomers of high reputation, and it seems at present as if no previous eclipse is likely to have received the attention to be bestowed on this.



We must not forget how completely all are at the mercy of the weather at such a time, and how large the risk is which all take that their labor and time will be rendered valueless by an hour of cloudy sky; and remembering this, we will wish for all clear weather and full success.

The Bishop of Manchester on British Trade Depression.

In a lengthy letter to the *Courier*, of Manchester, the Bishop of that diocese has "freed his soul" of his opinions upon the strike in Lancashire and the general depression of trade. He profoundly deprecates the contest being waged by masters and men, and while disclaiming the character of an arbitrator, or even of a mediator, counsels the strikers to accede to their employers' demands, which he seems to regard as justified by the circumstances into which they find themselves thrust. He argues that no display of strength can prevent a future further reduction, if such reduction be necessary as the only way in which trade can be carried on at a profit, and then he proceeds to deduce from the experiences in the iron and coal trades arguments in support of his counsels. He says: "In the interests of labor as well as of capital, I would invite the attention of both parties to certain phenomena which have come within my own knowledge or observation, and which I regard as typical. The iron trade of South Wales has disappeared, and, Lord Aberdare told me, in his judgment, is not likely to revive. The look of the country is described to me by those who have seen it as being as desolate as if it had been overrun by a foreign foe. I was told two days ago by a man, himself once a miner, and now the coachman of a Wiltshire friend of mine, who has friends in the smitten district, that the people are emigrating in all directions, and, as he expressed it, are being sent off by shiploads. 'What is the cause of this?'

'Oh,' he said, 'the strike; though I don't know what they struck for, for they were earning, many of them, £2 10s. a week, and twenty years ago, when I worked in the pits from five o'clock in the morning to seven o'clock at night, it was only with a "scrabble" that I could make my

bound or five and twenty shillings.' At any rate, whether my informant's view of the case is correct or not, here is a district, once the home of a thriving and remunerative industry, now reduced to the condition of a wilderness. A month ago I traveled up to London with the managing director of one of the largest engineering works in Manchester, himself well known as a man of the highest intelligence and capacity for business. 'What are you doing?' I asked. 'Not much,' he answered; 'we have reduced our number of hands, and I don't know how much longer we may have anything to do for those who remain. We have just had to refuse an order that would have been worth £45,000.' 'Why?' I asked with surprise. 'A foreign railway company invited us to tender for twenty locomotives. We offered to build them for £2,200 each; the company would only give £2,000. There was not much profit to be got out of the transaction, but to keep the men employed we were willing to have undertaken it, if we could save ourselves from loss. So we called the heads of departments together, who are all working by piece work, and asked them if they would help us to accept the order by reducing in fair proportion the wages that were being paid to them, so as to leave some small margin of profit to the shareholders. They to a man refused, and we had to decline to enter into a contract which would have been worth £45,000.' I am not able to estimate how much

of this sum represents the loss in wages to the men, whom it would probably have kept in constant employment for half a year. It may now have gone into the pockets of some foreign competitor whose existence Mr. John C. Fielden and the great body of the operatives seem utterly to forget or ignore. I was informed recently, upon authority that seemed to me sufficient, that Blockow, Vaughan & Co. are sending the pig iron which they have made into Belgium to be manufactured into girders, rails, etc., and to be re-imported into this country for use, simply because the work can be done quite as well and more cheaply there than here. Mr. R. W. Dale, in his 'Impressions of America,' published in the *Nineteenth Century* for April (p. 769), asserts distinctly that 'in Birmingham itself merchants are importing from the United States such articles as axes, hayforks, and agricultural implements of nearly every description, sash pulleys, and "small castings" of many kinds, although it is estimated that freight and other expenses are 17 or 18 per cent to the cost of the goods,' while 'the Lowell manufacturers, who are aghast at the prospect of free trade, are actually sending cotton cloth to Manchester, and in American retail stores cotton goods are marked at a lower price than that at which goods of the same quality could be sold in Liverpool or London.' He expresses a 'doubt whether, if the protective duties were swept away to-morrow, our own manufacturing industry would receive at once the general stimulus which some sanguine persons might anticipate. Leeds and Bradford might become more active, but that the Lancashire and Birmingham manufacturers would recover their old place in the American market seems extremely improbable.' These instances and forebodings could easily be multiplied, if it were necessary; but I think that what I have said is enough to show that the operatives' theory of the present depression of trade is not a complete account of the case; which, of course, if to any extent it is due to foreign competition, anything that embraces the cost of production at home—as working short time must do—throws the advantage still more into the hands of our competitors abroad. Indeed, it is the one fact of this foreign competition so seriously imperiling our position as a manufacturing nation in the markets abroad, and even, if Mr. Dale's 'impressions' are true, in the market at home, that presses itself home to my mind as the great motive that ought to stimulate both parties to the present strife to a speedy reconciliation of their differences." Proceeding, he treats trade unionism at considerable length. He does not condemn the principle, which he agrees has probably worked good in those who have adopted it; but he blames such of its adherents as use it in promotion of movements which have neither common sense nor experience to back them up, and characterizes as absurd the idea widely obtaining, that were unionists to make the concessions asked, a death blow would be struck at their cherished institution. "Trade unions must take care," he says, "that in their eagerness to get the golden eggs they do not kill the bird that lays them."

A New Insect Pest.

Psyche, the organ of the Cambridge Entomological Club, notes the recent introduction into the United States of a weevil which devours the foliage of many beautiful plants, and suggests to florists who have been troubled by it that it will be for their advantage to search, at this time of the year, in the flower pots and in all waste soil about their hot houses for the larvæ and pupæ of these pests. The larvæ, which feed upon rootlets, are now pupating, and the destruction of every individual prevents the laying of a large number of eggs during the coming season.

Death of a Giant.

William Campbell, the Scottish giant, died lately at Newcastle-on-Tyne, at the age of twenty-six. Campbell had been exhibiting in London at the Egyptian Hall, and returned to

feet 3 inches, and weighed 728 pounds, measured 96 inches round the shoulders, 76 round the breast, 47 round the thigh, and 35 round the calf of the leg. He was the biggest man in the United Kingdom, and, so far as report goes, in the world.