are made, but the wheels of other carriages which pass over such depressions, drop heavily with force into them, so as to make the depressions continually deeper and larger, and to loosen the surrounding stones. In this manner the horses, after injuring the road themselves, prepare the way for further injury to the road by the wheels of carriages. To have the full benefit of the rolling action of the wheels in consolidating the road materials, the latter must be laid smooth and level before the wheels come upon them; but if the materials are previously thrown up into little hills and holes, the wheels will do mischief instead of good."

"Suppose the engine and machinery in a steam carriage to weigh two tons, and to be able to advance an additional load, equal to their own weight, along a good road, at an average speed of ten miles an hour, do you think that any additional toll should be imposed upon steam carriages beyond that paid by four horse stage coaches, or vans; assuming the four horses to weigh two tons, and to draw a load of two tons, at the rate of ten miles an hour? In such a case, I can see no reason whatever for any increase of toll; but the diminished wear of the roads, which I anticipate from the use of steam in lieu of horses, will be a reason for a reduction of tolls whenever such a diminution of wear is realized."

"Would horses drawing eighty cwt. upon a road, with a slow walking pace, in your opinion, do more injury to the road than an engine doing the same work? I have had no experience of drawing heavy weights by steam to enable me to form an opinion respecting the effect that the broad wheels, which must then be used, would have on the road, and what advancing power they would have before they began to slip on the road, without advancing the carriage forwards; nor what would be the weight of engines which could advance eighty cwt. at a slow speed. I feel some doubt of the practicability of making steam engines advance so many times their own weight, as I expect this would be, with effect, and I feel confident that, in the present state of the art, there would be no profit in doing it; but if it were accomplished, I believe that the broad wheels of the steam wagon would do no injury to the road, whereas, in heavy wagons, drawn slowly by horses, the horses do much more injury by digging and scraping with their feet than is done by the horse in coaches and vans travelling quickly; because the wagon horses having a heavy pull to make must choose places in the road where they can place their feet in depressions, in order to get hold; hence, on a good smooth road they slip and scrape up the surface."

[TO BE CONTINUED.]

Tract on Comets, and particularly on the Comet that is to intersect the earth's path in October, 1832. By M. Arago. Translated from the French, by John Farrar, Boston, 1832.

We avail ourselves of the privilege afforded by our title page, in which our devotion to general science is expressed, to give a notice with extracts from an essay on *comets* lately set forth by the French philosopher Arago. This tract comes to us in an English dress through the translation of Professor Farrar, of Cambridge, Massachusetts: it was, in the original, an essay in the almanack for 1832, published by the French Board of Longitude.* It would be thankless in us, after having the labour of translation done for us, to find fault with the manner of its execution; besides, we know experimentally

* *Mémoires du Bureau des Longitudes*, 1832.

the difficulty of avoiding gallicisms in a translation from the French; we may, notwithstanding, venture the remark that the French astronomer would have appeared better, before the American public, if a few of his national peculiarities had been softened down to suit the more frigid temperament of his new readers.

The comet which was the "exciting cause" of this essay by M. Arago, is one which unassisted eyes are promised a sight of in the months of October and November of this year; not, as a widely spread two-penny tract would have us believe, growing in size until it rivals the full moon in shining, and with a tail overspreading half the heavens, but with even more modest pretensions to notice than when it last visited us in 1826. The humble little publication to which I have just referred, after exciting our consternation by the description of a mighty monster, gravely tells that it cannot hurt, and that as harmless as the bright moon itself it will decrease as it had increased, and disappear from our astonished sight.

The veritable account which M. Arago gives of this comet is as follows.

Comet of Six Years and Three Quarters.

"We have now come in our account of comets to another periodical one, which is to reappear, like that just described, in 1832, and whose near approach, we are told, will be attended with fatal consequences to the earth and its inhabitants.

"This comet was discovered at Johannesburg on the 27th of February, 1826, by M. Biela, and ten days afterwards at Marseilles, by M. Gambart. The latter calculated the parabolic elements without delay, by means of his own observations, and immediately perceived, on consulting the table of the elements of comets, that this was not its first appearance, but that it had been already observed in 1805 and in 1772.

"The comet of 1826 is therefore periodical.

"It was accordingly necessary to change the parabolic elements into elliptical elements, in order to discover the length of the comet's orbit left undetermined by the former. Messrs. Clausen and Gambart undertook this calculation, and each found, at nearly the same time, that the new comet made a revolution round the sun in about seven years.

"This curious result was adopted without dispute; for, in 1826, astronomers were cured of their old notion that the revolution of a comet must necessarily be very long; while, from the example of the comet of 1770, it was deemed imprudent to venture to determine the time of the future reappearance of a new comet, before all the derangements and perturbations to which it was liable in its whole course, had been thoroughly studied. My colleague, M. Damoiseau, undertook this long and minute calculation, the result of which is as follows.

"The comet of six years and three quarters will cross the plane

of the ecliptic, that is, the plane in which the earth moves on the 29th of October, 1832, before midnight.

“The earth, during its annual course round the sun, never leaves the plane of the ecliptic; therefore it is only somewhere in this plane that a comet could strike it; of course, if we had any thing to fear from the comet of 1832, the danger would be on the 29th of October, before midnight.

“Now let us inquire whether the point, at which the comet will cross the plane of the ecliptic, is near the path that the earth describes; for, in order that there may be a meeting between the two bodies, this is as necessary a condition as the other.

“Upon this point it is proved, by calculation, that the passage of the comet through the plane of the ecliptic *will be a little within our orbit, and at a distance from it equal to two and a third of the earth's diameters, or 18,500 miles.* It is possible that this distance, already so small, may disappear entirely, if we suppose certain small variations in the elements, given by Damoiseau, which it is difficult to answer for.

“Let us, however, take two diameters and a third, as the real distance; we must remember that this has reference to the centre of the comet, and we must ascertain whether its size is large enough for any part of it to extend to the earth's orbit.

“When this body appeared in 1805, the observations made by the celebrated M. Olbers, of Bremen, gave for the semidiameter of the comet two diameters and two thirds of the earth. From this number, compared with the preceding, it plainly results, that on *the 29th of next October, a portion of the earth's orbit will be comprehended within the nebulous atmosphere of the comet.*

“There remains now but one more question to answer, it is this: At the time when the comet will be so very near our orbit that the nebulous or hairy *atmosphere* will cover some part of it, *where will the earth itself be?*

“I have already said that the passage of the comet very near to a certain part of the earth's orbit, will take place on the 29th of October, before midnight; well, the earth will not arrive *at that same point*, until the 30th of November in the morning, that is, *more than a month afterwards!* Now we have only to call to mind that the average rate at which the earth moves in its orbit is 1620 thousand miles per day, and a very simple calculation will show, that

“*The comet of six years and three quarters will, during its appearance in 1832, be always more than forty-eight millions of miles from the earth.*

“In order to ascertain the least distance of the comet from the earth in its future returns, the same calculations must be made. If in this year, 1832, instead of passing the plane of the ecliptic on the night of the 29th of October, it reached that point on the morning of the 30th of November, it would certainly mingle its atmosphere with ours, and perhaps it would strike us. But I hasten to assure the public that a mistake of a month, in determining the time when a comet reaches its node, is impossible. I have confined myself in this ac-

count to what relates to the body of the comet, because no trace of any tail has ever been seen to accompany it in its former visits.

"The reader is now in possession of all that can interest him with respect to the course of the comet of October, 1832. The foregoing facts do not differ from those which M. Olbers published in a note, the meaning of which has been so strangely mistaken by the public and by several journalists. Shall I be more successful in my endeavours to explain myself? I hope so; but I cannot be very confident so long as there are persons who, believing that the earth will not come in contact with the comet or receive any direct injury from it, yet think that the comet cannot cross the earth's orbit without altering its form, as if this orbit were a material substance; as if the parabolic line described by a bomb through the air, when discharged from a mortar, could be affected in its course by other bombs having formerly been projected through the same space."

We find then that this comet will never be nearer to us than forty-eight millions of miles; within only twice this distance we perform our round unharmed about the great central fire, in obedience to the attraction of which the comet, as well as ourselves, moves.

As the calculation of our security from ill effects by collision with the comet rests upon the time at which it will intersect the earth's orbit, M. Arago proceeds, by way of rendering assurance doubly sure, to examine the causes which might be said to cast a doubt upon the conclusions which he has stated. The first of these alleged sources of error is the effect of a resisting medium in the planetary spaces, which, by retarding the comet in its course might be supposed to bring it *later* to the earth's orbit than the time calculated. As we see the velocities of bodies diminished by resistance, this idea seems at first plausible, and we abandon it only after finding the imperfect nature of the reasoning by which we drew our conclusions. The effect of a resisting medium would be to decrease the force by which the comet tended from the sun; it would therefore be drawn nearer the sun, and, hence, be made to describe a smaller orbit, and with an increased velocity. The effect then of such a resistance would be to cause the comet to arrive sooner, instead of later, at the earth's orbit, and in this case to increase the distance between it and the earth. Comets become interesting in a scientific point of view as enabling us to detect the existence of this very attenuated medium which fills space, and the experiments of modern astronomy are employed in studying the question. Already Encke's comet has shown in its frequent returns (every three and one-tenth years) a small acceleration of about two days, which Encke considers attributable to this cause.

It is not our purpose to follow M. Arago in the various questions which he examines; our readers who feel disposed to look over these will find wherewith to amuse and to interest, plainly set down; they will see that astronomers as well as poets give the rein to imagination, and will find, with them, how limited a view our intellect can take of the vast phenomena of nature.

It may not be amiss to state that M. Arago examines the following among other questions, and proves clearly by facts that a negative answer must be returned to each and every one.

Do comets affect the seasons? Was the fog of 1831 produced by the influence of a comet? Has Siberia changed its climate from a similar influence? Is it necessary to resort to the influence of a comet to explain the severe climate of North America?

We will not quit the subject without a word upon the (so called) lost comet of 1770. It affords a fine instance of the grasp of human intellect, and is well calculated to inspire us with confidence in the results of the calculations of astronomers. It shows us, also, how inconsiderable must be the masses of these bodies which once inspired such terror in our race.

Between the months of June and October, 1770, a comet was visible, the orbit of which was found, by calculation, to be an ellipse, in which the comet made an entire revolution in five and a half years. The fact that this comet, though of so short a period, had not been recorded as visible previous to this time, and that it was not visible in 1776 (five and a half years after its first appearance,) threw a doubt upon the calculations of Lexell, and induced the Institute of France to propose a prize for a complete investigation of its orbit, to include the perturbations to which it might have been liable. Burckhardt, by the aid of certain analytical formulæ of La Place, was enabled to solve the mystery which hung about this comet. The orbit found by Lexell was confirmed as the true one, and in tracing back the course of the comet in this orbit, prior to its appearance in 1770, Burckhardt ascertained that in 1767 it had been within the sphere of attraction of the planet Jupiter, the attraction of which planet, at the nearest approach of the comet to it had been three times that of the sun. By means of the analytical processes to which we have before alluded, Burckhardt was enabled to determine that had the comet been, prior to 1767, moving in a large orbit, of which the least distance from the sun was greater than that of Jupiter from the same body, and in which its period was fifty years, the attractive force of the planet would have been sufficient to draw it into its new orbit, the least distance of which from the sun was less than the radius of the earth's orbit. The comet was not seen prior to 1770 on account of its great distance from the earth, which distance, when at the smallest, exceeded that of the planet Jupiter. Next by following the comet in its orbit, in 1776, when it should have reappeared, Burckhardt found that the sun was interposed between the earth and the comet, so as to render the latter invisible. The non-appearance in 1776 was thus accounted for. But why has the return of this comet not been noticed? An answer was also given to this question. The time of revolution of the planet Jupiter in its orbit is about twelve years; hence in 1779 the comet came a second time within the influence of the attraction of the planet, but in different relative situations from those which had occurred twelve years before; the attraction of the planet was exerted sensibly for nearly five months, and the orbit was again changed. The least distance of this new orbit

from the sun is not nearer than the planet Ceres, and the time of revolution about twenty years. Unless this comet should again be subjected to perturbations bringing it nearer to our part of the planetary system, it cannot again be visible from the earth.

The inconsiderable mass of the body just spoken of, is proved by the fact that while the attraction of the planet Jupiter caused such entire changes in the orbit of the comet, the latter did not perceptibly affect the motions of the planet, and not even those of its satellites. We are prepared from these observations to expect the result which the calculations of La Place gave, in relation to the effect of this comet on the earth's motion, namely, that passing as near to the earth as fifteen hundredths of the earth's distance from the sun, and having its own period of revolution affected two days by the earth's attraction, the reciprocal effect upon the earth's motion was insensible.

B.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY, 1832.

With Remarks and Exemplifications, by the Editor.

1. For a *Mill for Grinding Grain, Paints, &c.*; William G. Johnson, city of Philadelphia, May 3.

This mill is to be constructed in the usual manner, excepting the apparatus for pressing the stones together, which apparatus, we are informed by the patentee, consists of a horizontal lever, a regulating screw, compound levers and weights, and a moveable and fixed collar.

In form and action this apparatus bears a near resemblance to the governor of a wind mill, or steam engine, but it is not made to revolve, being acted upon in another way. When the stone is raised, it presses against a lever, connected with the governor, and this throws out the two balls, or weights, causing them to act with greater force, upon the stone, and thus prevent its further rise. The effective pressure upon the stone is in this way increased, or diminished, as it rises from, or approaches towards, the bed stone. It is this particular arrangement which forms the subject of the claim.

2. For *Applying Wind to the Propelling of Boats, Vessels, or Land Vehicles, Mills, Lathes, and other Machinery*; Benjamin Dugdale, city of Trenton, New Jersey, May 3.

The specification of the machinery employed does not make its structure clear, says nothing of its mode of operation, and lays no claim to any part of the apparatus. The drawing, in our judgment, throws but little light upon the subject, as it has not enabled us to perceive how the patentee intends that his machinery shall operate in propelling. Its general appearance is that of the horizontal wind mill, but we see no contrivance for feathering the sails. There is a