XIII. *Observations on the Nature of the new celestial Body discovered by Dr.* Olbers, *and of the Comet which was expected to appear last January in its return from the Sun.* *By* William Herschel, *L. L. D. F. R. S.*

Read June 4, 1807.

THE late discovery of an additional body belonging to the solar system, by Dr. OLBERS, having been communicated to me the 20th of April, an event of such consequence engaged my immediate attention. In the evening of the same day I tried to discover its situation by the information I had obtained of its motion; but the brightness of the moon, which was near the full, and at no great distance from the object for which I looked, would not permit a star of even the 5th magnitude to be seen, and it was not till the 24th that a tolerable view could be obtained of that space of the heavens in which our new wanderer was pursuing its hitherto unknown path.

As soon as I found that small stars might be perceived, I made several delineations of certain telescopic constellations, the first of which was as represented in figure 1, and I fixed upon the star A, as most likely, from its expected situation and brightness, to be the one I was looking for. The stars in this figure, as well as in all the other delineations I had made, were carefully examined with several magnifying powers, that in case any one of them should hereafter appear to have

been the lately discovered object, I might not lose the opportunity of an early acquaintance with its condition. An observation of the star marked A, in particular, was made with a very distinct magnifying power of 460, and says, that it had nothing in its appearance that differed from what we see in other stars of the same size; indeed Dr. OLBERS, by mentioning in the communication which I received, that with such magnifying powers as he could use it was not to be distinguished from a fixed star, * had already prepared me to expect the newly discovered heavenly body to be a valuable addition to our increasing catalogue of asteroids.

The 25th of April I looked over my delineations of the preceding evening and found no material difference in the situation of the stars I had marked for examination; and in addition to them new asterisms were prepared, but on account of the retarded motion of the new star, which was drawing towards a period of its retrogradation, the small change of its situation was not sufficiently marked to be readily perceived the next day when these asterisms were again examined, which it is well known can only be done with night-glasses of a very low magnifying power.

A long interruption of bad weather would not permit any regular examination of the situation of small stars; and it was only when I had obtained a more precise information from the Astronomer Royal, who, by means of fixed instruments, was already in possession of the place and rate of motion of the new star, that I could direct my telescope with greater accu-

* Der neue planet zeigt sich als ein stern zwischen der 5ten und 6ten grösse und ist im fernrohr, wenigsten mit den vergrösserungen die ich anwenden kann, von einen fixstern nicht zu unterscheiden.

racy by an application of higher magnifying powers. My observations on the nature of this second new star discovered by Dr. OLBERS are as follow.

April 24. This day, as we have already seen, the new celestial object was examined with a high power; and since a magnifier of 460 would not show it to be different from the stars of an equal apparent brightness; its diameter must be extremely small, and we may reasonably expect it to be an asteroid.

May 21. With a double eye-piece magnifying only 75 times the supposed asteroid A makes a right-angled triangle with two small stars *a b*. See fig. 2.

With a very ditinct magnifier of 460 there is no appearance of any planetary disk.

May 22. The new star has moved away from *a b*, and is now situated as in fig. 3. The star A of figure 1 is no longer in the place where I observed it the 24th of April, and was therefore the asteroid. I examined it now with gradually increased magnifying powers, and the air being remarkably clear, I saw it very distinctly with 460, 577, and 636. On comparing its appearance with these powers alternately to that of equal stars, among which was the 463d of BODE'S Catalogue of the stars in the Lion of the 7th magnitude, I could not find any difference in the visible size of their disks.

By the estimations of the distances of double stars, contained in the first and second classes of the catalogues I have given of them, it will be seen that I have always considered every star as having a visible, though spurious, disk or diameter; and in a late paper I have entered at large into the method of detecting real disks from spurious ones; it may therefore be

supposed that I proceeded now with Vesta (which name I understand Dr. OLBERS has given the asteroid), as I did before in the investigation of the magnitudes of Ceres, Pallas, and Juno.

The same telescopes, the same comparative views, by which the smallness of the latter three had been proved, convinced me now that I had before me a similar fourth celestial body.

The disk of the asteroid which I saw was clear, well defined, and free from nebulosity. At the first view I was inclined to believe it a real one; and the Georgian planet being conveniently situated so that a telescope might without loss of time be turned alternately either to this or to the asteroid, I found that the disk of the latter, if it were real, would be about one-sixth of the former, when viewed with a magnifying power of 460. The spurious nature of the asteroidal disk, however, was soon manifested by an increase of the magnifying power, which would not proportionally increase its diameter as it increased that of the planet; and a real disk of the asteroid still remains unseen with a power of 636.

May 23. The new star has advanced, and its motion is direct; its situation with respect to the two small stars *a b*, is given in figure 4.

Its apparent disk with a magnifier of 460 is about 5 or 6-tenths of a second; but this is evidently a spurious appearance, because higher powers destroy the proportion it bears to a real disk when equally magnified. The air is not sufficiently pure this evening to use large telescopes.

May 24. With a magnifying power of 577 I compared the appearance of the Georgian planet to that of the asteroid, and with this power the diameter of the visible disk of the latter

was about one 9th or 10th part of the former. The apparent disk of the small star near β Leonis, which has been mentioned before, had an equal comparative magnitude, and probably the disks of the asteroid and of the star it resembles are equally spurious.

The 20 feet reflector, with many different magnifying powers, gave still the same result; and being already convinced of the impossibility, in the present situation of the asteroid, which is above two months past the opposition, to obtain a better view of its diameter, I used this instrument chiefly to ascertain whether any nebulosity or atmosphere might be seen about it. For this purpose the valuable quantity of light collected by an aperture of $18\frac{3}{4}$ inches directly received by an eye-glass of the front-view without a second reflection, proved of eminent use, and gave me the diameter of this asteroid intirely free from all nebulous or atmospheric appearances.

The result of these observations is, that we now are in possession of a formerly unknown species of celestial bodies, which by their smallness and considerable deviation from the path in which the planets move, are in no danger of disturbing, or being disturbed by them; and the great success that has already attended the pursuit of the celebrated discoverers of Ceres, Pallas, Juno, and Vesta, will induce us to hope that some further light may soon be thrown upon this new and most interesting branch of astronomy.

Observations of the expected Comet.

The comet which has been seen descending to the sun, and from the motion of which it was concluded that we should probably see it again on its return from the perihelion, was

expected to make its reappearance about the middle of last January, near the southern parts of the constellation of the whale.

January 27. Towards the evening, on my return from Bath, where I had been a few days, I gave my sister CAROLINA the place where this comet might be looked for, and between flying clouds, the same evening about 6^h 49′ she saw it just long enough to make a short sketch of its situation.

January 31. Clouds having obscured the sky till this time, I obtained a transitory view of the comet, and perceived that it was within a few degrees of the place which had been assigned to it; the unfavourable state of the atmosphere, however, would not permit the use of any instrument proper for examining it minutely.

There will be no occasion for my giving a more particular account of its place, than that it was very near the electrometer of the constellation, which in Mr. BODE's maps is called *machina electrica*; the only intention I had in looking for it, being to make a few observations upon its physical condition.

February 1. The comet had moved but very little from the place where it was last night; and as the air was pretty clear, I used a 10-feet reflector with a low power to examine it. There was no visible nucleus, nor did the light which is called the coma increase suddenly towards the centre, but was of an irregular round form, and with this low power extended to about 5, 6, or 7 minutes in diameter. When I magnified 169 times it was considerably reduced in size, which plainly indicated that a farther increase of magnifying power would be of no service for discovering a nucleus. On account of cloudy

weather I never had an opportunity of seeing the comet afterwards.

When I compare these observations with my former ones of 15 other telescopic comets, I find that out of the 16 which I have examined, 14 have been without any visible solid body in their centre, and that the other two had a very ill defined small central light, which might perhaps be called a nucleus, but did not deserve the name of a disk.

Fig. 1.

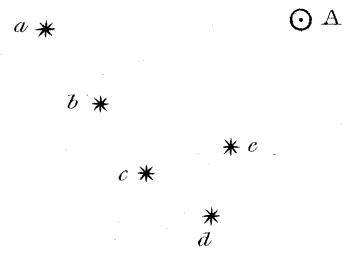

Fig. 2.

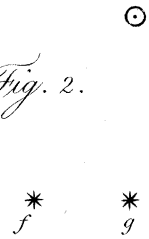

Fig. 3.

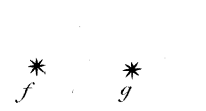

Fig. 4.