IX. *On the Method of observing the Changes that happen to the fixed Stars; with some Remarks on the Stability of the Light of our Sun. To which is added, a Catalogue of comparative Brightness, for ascertaining the Permanency of the Lustre of Stars.* By William Herschel, *LL. D. F. R. S.*

Read February 25, 1796.

THE earliest observers of the stars have taken notice of their different degrees of brilliancy, and, by way of expressing their ideas to others, have classed them into magnitudes. Brightness and size among the stars were taken as synonymous terms, and may still be used as such with sufficient truth, notwithstanding the latter, it seems, can only be looked upon as the consequence of the former. The brightest stars were called of the first magnitude; the next of the second; and those of an inferior lustre of the third, fourth, and fifth magnitudes; and so on.

Among the stars of the first two or three classes there seems to be some natural limit which confines them to a particular order. If we suppose the stars to be about the size of our sun, and at nearly an equal distance from us and from each other, those which form the first inclosure about us will appear brighter than the rest, and there can be only a small number of them. This hypothesis is nearly confirmed by observation, as may be seen by looking over a globe, and applying a pair of compasses opened to 60 degrees, which

should be the angle subtended by the stars of the first magnitude, if they were all scattered equally. For it will be found that the distances from Lyra to Arcturus; from Arcturus to Regulus; from Regulus to Sirius; from Sirius to β Navis; from Elgeuse to Canopus; from Canopus to α Centauri; from α Centauri to Achernar; from Achernar to α Crucis; from Procyon to Canopus; from Fomalhaut to Altair; and from Altair to Antares, agree sufficiently well with this hypothesis. It must also be remembered that a perfect equality in the mutual angular distribution of the stars that form the first inclosure, is a thing that is mathematically impossible, and therefore not to be looked for. This would authorize us to take in other intervals, such as from Arcturus to Antares; from Elgeuse to Regulus; from Achernar to Rigel; from Rigel to Capella; from Capella to Sirius; from Regulus to Spica; from Spica to α Crucis; and from Rigel to Castor; all which concur, in a great measure, to support the same hypothesis. But as the distribution and real magnitude of stars is not my present subject, what has been mentioned will be sufficient.

A second layer of stars will be more extensive; for the superficies of the celestial regions allotted for the situation of these successive stars exceeds the former in the ratio of 4 to 1. And on looking over the collection of stars which astronomers have pointed out as belonging to the second class, we find that their number is proportionally larger.

A similar way of considering the stars of the third order might be applied, if it did not already appear, from what has been said of the two former orders, when strictly compared with the state of the heavens, that such kind of limits can be of no real use in the classification of stars. The hypothesis

of an equality and an equal distribution of stars to which we have referred, is too far from being strictly true to be laid down as an unerring guide in this research. The stars of the first and second class, when scrupulously examined, evidently prove that if we would be accurate, we must admit them, in some degree at least, to be either of different sizes, or placed at different distances. Both varieties undoubtedly take place. This consideration alone is fully sufficient to shew, that how much truth soever there may be in the hypothesis of an equal distribution and equality of stars, when considered in a general view, it can be of no service in a case where great accuracy is required.

Since therefore it appears that in the classification of stars into magnitudes, there either is no natural standard at all, or at least none that can be satisfactory; it follows, that astronomers who have classed them thus, have referred their size or lustre to some imaginary idea of brightness. The great number of stars, indeed, which have been placed into every particular class, may assist us to form a kind of confused type in our minds, by which we may be enabled to arrange others; but how doubtful this must ever remain, we may see from the circumstance of the intermediate expressions that have been introduced.

1.2 m* for instance, denotes that a star so marked is between the first and second magnitude. 2.1 m signifies the same thing, with an intimation that the star so distinguished is nearly of the second magnitude, but partakes still something of the lustre of a star of the first order. With stars of the first, second, and third classes there may be some

* I use the letter m in a short way to express the magnitude of the stars.

necessity to introduce such subdivisions; but how very vague must be the expressions 5m, 5.6m, 6.5m, 6m! In vain have I endeavoured to find a criterion for a star of any one of these magnitudes. On looking over, for instance, the stars of the fifth order, I found that in the list of other stars which ought to be less bright because they were marked 5.6m, 6.5m, or 6m, there were many that exceeded the former in brightness, while among those that are put down 5.4m, 4.5m, or even 4m, which ought to be more bright, I found several of a lustre not equal to some of this fifth magnitude, which I was desirous to ascertain. I may therefore justly call the method that has been hitherto in use to point out the lustre of stars, a reference to an imaginary standard.

The inconvenience arising from this unknown, or at least ill ascertained type to which we are to refer, is such, that now our most careful observations labour under the greatest disadvantage. If any dependence could be placed upon the method of magnitudes, it would follow, that no less than eleven stars in the constellation of the Lion, namely, $\beta\ \sigma\ \pi\ \xi$ A *b c d* 54 48 72, had all undergone a change in their lustre since FLAMSTEED's time. For if the idea of magnitudes had been a clear one, our author, who marked β 1.2m, and γ 2m, ought to be understood to mean that β is larger than γ; but we now find that actually γ is larger than β. Every one of the eleven stars I have pointed out may be reduced to the same contradiction; and as the subject is of some consequence, I shall give a few other instances of them.

σ by FLAMSTEED is 4.5m, $\iota\ \varphi\ \upsilon\ \lambda\ \varkappa\ \pi\ \xi$ are all marked 4m, and therefore ought to be larger; but σ is larger than any of them.

π is marked 4m; *d* 6.5m, χ and *e* 4.5m, *c* and 72 5m; therefore π should be larger than all the former; but it is less.

ξ is marked 4m; but there are eleven stars, namely, σ *b* 54 A *d* χ *e c* 72 27 48 69, all marked in various manners less than that star, yet they all exceed it in magnitude.

Not to proceed any farther with particulars, we ought to account for this by allowing that FLAMSTEED did not compare the stars to each other, but referred each of them separately to its own imaginary standard of magnitude. This is the real source of all such contradictions, which therefore cannot be charged to our author. As we should, however, take it for granted, that the magnitudes were affixed to the stars with as much care as the nature of an unsettled standard would allow, a short inquiry into the extent of the confidence we may place upon the method of magnitudes will be of considerable use.

We have observed that in this method the brightness of stars is referred to unsettled standards; but admitting that a pretty general though coarse idea may be formed of these magnitudes, it may be granted that a mistake of a whole order in the first class cannot be supposed. The difference between a star of the first and second magnitude is so palpable that it excludes all suspicion of taking one for the other.

When subdivisions are introduced, the case becomes doubtful. 1.2m may easily pass for 2.1m. But though these two notations should not be sufficiently clear to be distinguished from each other, yet I am inclined to believe that the former may be precise enough to point out a difference from 2m, and the latter from 2.3m.

With the next order of stars the difference is much less striking; but yet 2m will convey an idea which may be pretty

well distinguished from 3m. 2.3m, however, cannot be sufficiently kept apart from 3.2m, or either of these expressions from 3m, or from 2m. Perhaps the former may be distinguished from 3.4, and the latter from 4m.

The following step from 3m to 4m, or indeed from 3.4m to 4.5m, is less decisive than from 2 to 3m.

Again, if a star had changed from 4m to 5m, or from 4.5m to 5.6m since FLAMSTEED's time, we could hardly entertain more than a very slight suspicion of the alteration. From 4 to 5.6m, or from 4.5 to 6m, would be a pretty considerable step, and might serve as a foundation for an argument.

A change from 5m to 6m is such as no stress could be laid upon; and such are the changes from 5.6 to 6.7m, and from 6 to 7m. In all these inferior orders less than an alteration of a magnitude and an half could hardly deserve attention.

Here we have supposed all references to be made to the same author; for when other astronomers are consulted the uncertainty is much increased. A star which in FLAMSTEED's catalogue stands 1.2m, may be found 2m in another author: 2m in the former may be rated 2.3m, or even 3m by the latter. Of course 3m and 4m may be written for the magnitude of the same star by different persons. 4 and 5m as well as 5 and 6m are frequently interchanged, and no stress can be laid upon such nominal differences in different catalogues. We can hardly allow less than half a magnitude in the higher orders, and a whole one in the inferior classes, for this uncertainty.

To apply what has been said: suppose there should be some inducement to believe a certain star, such as β Leonis, to have changed its lustre. Now having no real, existing type of

comparison, we can only refer to the general, imaginary one; and here the rules we have laid down will be of considerable service. The magnitude of this star given by FLAMSTEED is 1.2m; but as we have shewn that there is some ground to admit that 1.2m, even in this coarse way of reference, may be distinguished from what the same author seems to have taken for 2m, we conclude that the star has probably lost some of its former brightness. Again, he gives β 1.2m, and γ 2m. This notation may be taken to imply, though indirectly, that β is larger than γ; which not being the case, we have an additional reason to suspect a change. DE LA CAILLE puts down β 2m. Now the difference between the notation 1.2m of FLAMSTEED and 2m of the latter author, can add nothing to the force of the argument for a change; as we have observed before, that a considerable allowance must be made for nominal varieties in different authors. Nor can we draw any support from the magnitude itself, because the star will pass very well for one of that order, when compared with other stars which are marked 2m by the same author. But when DE LA CAILLE marks β 2m, and γ 3m, we may then conclude that he estimated β to be larger than γ, though we do not know that he compared these two stars together; because a whole magnitude in the second class, as we have said, cannot well be mistaken, coarse as is the type to which the reference is made. Upon the whole, therefore, we conclude that β Leonis is now less brilliant than it was formerly.

In this manner, with proper circumspection, we may get at some certainty, even by the method of magnitudes; the imperfection of it, however, in other cases is very obvious. σ Leonis, for instance, being marked by FLAMSTEED 4.5m, the

star itself will in every respect pass for one of that magnitude, when compared to a mental standard taken from other stars of the same author. Nor can its being brighter than stars which have a magnitude of a superior lustre affixed to them, do more than raise a considerable suspicion of a change. But as this subject will occur again hereafter, and as it must be sufficiently apparent that the present method of expressing the brightness of the stars is very defective, we now proceed to propose a different one.

I place each star, instead of giving its magnitude, into a short series, constructed upon the order of brightness of the nearest proper stars. For instance, to express the lustre of D, I say CDE. By this short notation, instead of referring the star D to an imaginary uncertain standard, I refer it to a precise, and determined, existing one. C is a star that has a greater lustre than D; and E is another of less brightness than D. Both C and E are neighbouring stars, chosen in such a manner that I may see them at the same time with D, and therefore may be able to compare them properly. The lustre of C is in the same manner ascertained by BCD; that of B by ABC; and also the brightness of E by DEF; and that of F by EFG.

That this is the most natural, as well as the most effectual way to express the brightness of a star, and by that means to detect any change that may happen in its lustre, will appear, when we consider what is requisite to ascertain such a change. We can certainly not wish for a more decisive evidence, than to be assured, by actual inspection, that a certain star is now no longer more or less bright than such other stars to which it has been formerly compared; provided we are at the same

time assured that those other stars remain still in their former unaltered lustre. But if the star D will no longer stand in its former order CDE, it must have undergone a change; and if that order is now to be expressed by CED, the star has lost some part of its lustre; if on the contrary, it ought now to be denoted by DCE, its brightness must have had some addition. Then, if we should doubt the stability of C and E, we have recourse to the orders BCD, and DEF, which express their lustre; or even to ABC, and EFG, which continue the series both ways. Now having before us the series BCDEF, or if necessary even the more extended one ABCDEFG, it will be impossible to mistake a change of brightness in D, when every member of the series is found in its proper order, except D.

Here I have used the letters of the alphabet merely to explain my way of fixing the order of brightness of the stars. In the journal or catalogue itself, which gives this order of brightness, each star must bear its own proper name, or number. For instance, the brightness of the star δ Leonis may be expressed by $\beta\ \delta\ \varepsilon$ Leonis, or better by 94 — 68 — 17 Leonis; these being the numbers which the three above stars bear in the British catalogue of fixed stars.

Perhaps it may be thought that the known introduction of letters, added to the magnitudes of the stars, seems to be that very method which I now recommend, as different from what has already been used. And certainly if letters had been annexed to stars with a strict view to their order of brightness, they would now be of considerable service; but the intention of the astronomers who lettered the stars seems only to have been to give them a name, whereby to call them more readily, than by the descriptive method of pointing out their situation.

It was indeed natural enough to give the name α to the brightest star, on account of its being the most remarkable in a constellation; and we may admit that with a few of the most conspicuous stars the letters $\alpha\beta\gamma$ would present themselves in succession; but whoever compares all the letters of the Greek and English alphabet that have been used, with the numerical magnitudes annexed to the same stars, will immediately give up all thoughts of intended order. In the constellation of Andromeda, which happens to lie before me, I find the following arrangement: $\delta o \mu \varepsilon$, $\theta \pi \xi$, $\lambda \upsilon \upsilon \lambda$, and *d b c*. In that of Hercules $\varepsilon \delta$, $\xi \lambda \varkappa$, $\pi \theta$, $\varrho \mu$, $\sigma \nu$, τo, and *h* A *e b k q c m* Z.

It will be needless to point out the irregularities which take place in every other constellation; they go indeed so far, that it would be wrong to call them irregularities, because certainly no order could be intended in the arrangement of the letters. A doubt has even arisen whether any succession of brightness might be argued from the very first, second, or third letters of the alphabet; and when we find them arranged thus: $\beta\alpha$ Cassiopeæ, $\beta\alpha$ Cancri, $\gamma\beta$ Aquilæ, $\beta\zeta$ Canis minoris, 41 γ Arietis, we can hardly think it safe to regard the order of letters as of the least consequence. To which may be added, that in many constellations $\alpha\beta\gamma$ are all marked to be of the same magnitude, in which case again the order of the letters can bring no information. And therefore, even in those cases where the order of the letters agrees with the different magnitudes assigned to them, the knowledge we can have of the former state of the heavens must be derived from the magnitudes, and cannot be from the letters.

It may in the next place be remarked, that if not the

letters, at least the numerical magnitudes affixed to the stars by astronomers, point out an order of brightness; and therefore contain my method already established. A succession of the marks 1, 2, 3, 4, 5, *&c.* and other intermediate notations, which are to be found in the British, and other catalogues, give us a long list of stars that are (or should be) in a regular order of brightness, from a star of the first magnitude down to one of the eighth or ninth.

That these marks, denoting the magnitudes of the stars, are of some use every astronomer will readily perceive; but if we would apply them to the purpose of detecting a change in the lustre of some suspected star, the defect of this method will easily appear, and has already been shewn in the instance of σ Leonis. It was hinted before that the subject would recur again, I shall therefore mention two other instances, in the first of which the common notation is sufficiently expressive. It will be so in all cases where a very considerable change takes place. Thus, β Persei being marked 2.3m, and ϱ of the same constellation 4m, there could be no doubt of a change in the light of Algol when it was found to be not brighter than ϱ. But let us in the next place take an observation recorded in my journal.

"May 12, 1782. β Lyræ is much less than γ."

Now, examining the British catalogue, we find β 3m, and γ 3m. Had the method of orders been adopted by FLAMSTEED, we should at once have pronounced this star to be changeable. For it would have been $\beta\,\gamma$ in his time, and $\gamma\,\beta$ at the time of observation; but since we have shewn that no inference can be drawn from the order of the letters, we have only the magnitudes to refer to. And here again the deviation

of β from its usual brightness not being so considerable, but that a star such as it appeared to be at the time of observation might pass for one of the third magnitude, we are left in the dark; notwithstanding which a few years after, this star was actually found to be not only changeable, but periodical.*

M. DE LA LANDE in mentioning the change of δ Ursæ majoris arranges the seven bright stars of that constellation as they appeared to him; and remarks that sometimes γ and ε should stand before β, and sometimes after it. Here we have something like an order of seven remarkable stars; but as it happens, the stars themselves are not favourable to the formation of a regular series. Mr. PIGOTT and Mr. GOODERICKE also compared the stars whose changes they were examining to other neighbouring stars that were proper to be estimated with them, and were in a manner forced to lay aside the method of magnitudes.† These instances contribute to support the arguments I have used, to shew that another method of ascertaining the lustre of the stars is required, while at the same time they sufficiently indicate that the comparative brightness of stars is the only safe one to which we can have recourse.

It will be necessary now to enter into a full display of my proposed method; for simple as it is in its principle, it is not only difficult but very laborious in its progress. I began to put it into execution about 14 years ago; but other very interesting astronomical pursuits have broken in upon the regular continuation of it. By relating the difficulties or inconveniences as they happened, it will appear that my present

* Phil. Trans. Vol. LXXVI. Part I. page 197.

† Phil. Trans. Vol. LXXV. Part I. page 127 and 154.

notation, as well as method of arranging the observations, are liable to the fewest objections.

The general disposition of the stars is in constellations. This order is to be preferred to that of right ascension, or polar distance, because the stars being to be compared to the nearest proper stars that can be found, the constellations themselves will generally answer that purpose better than other selections.

My first design was to draw each whole constellation into one series. Accordingly I began July 16, 1781, to arrange the stars in Ophiuchus thus:

"Order of the stars in Ophiuchus; $\alpha\,\beta\,\delta\,\zeta\,\eta\,\varkappa\,\gamma\,\varepsilon$."

This way of placing the stars agrees so far with my present one, that any star, such as $\varkappa$ for instance, may be taken, and the expression of its lustre will be had by $\eta\,\varkappa\,\gamma$. And as FLAMSTEED marks the magnitudes of these stars 3m 4m 3m, my arrangement does not agree with his. If we should now suspect $\varkappa$ to have changed its lustre, recourse may be had to another star on both sides, which gives $\zeta\,\eta\,\varkappa\,\gamma\,\varepsilon$. The magnitudes of FLAMSTEED are 3m 3m 4m 3m 3.4m, where $\varkappa$ again seems to be placed in a situation to which it is not intitled.

A defect of this arrangement, which was not immediately perceived, is that in taking the stars of a constellation we have not always a proper connection of the steps of the series that may be formed of them: there being too much difference in the lustre of some of the stars, and too little in others.

Other inconveniences will also arise from the multiplicity of the members of a general series, and the trouble of arranging them when they are nearly equal. To get over these difficulties I marked the stars that differed much in lustre by

magnitudes or degrees of difference; in which I assumed three different sorts of each; namely, $1'\ 1''\ 1'''\ 2'\ 2''\ 2'''$, *&c.* For instance,

"May 12, 1783. Order of the stars in Bootes;

"$\alpha 1'\ \varepsilon 2''\ \eta 2'''\ \gamma\beta\delta 3'\ \varrho 3''\ \zeta 3'''\ \pi 4$."

That this is not recurring to the old method of magnitudes, will appear when we consider that the stars are strictly compared. The series $\alpha\varepsilon\eta\gamma\beta\delta\varrho\zeta\pi$ remains established, but the difference in the gradation of brightness between the members of the series is added to it. At first this seemed to answer the intended purpose; for $\alpha\varepsilon\eta$ not being sufficiently distinguished, the addition $1'$ to α, and $2''$ to ε, shewed that α was very much brighter than ε, while $2'''$ added to η denoted only a very small difference between this and ε. The difficulty which immediately after arose in the choice of the magnitudes, however, soon convinced me that the fallacy of them would still have some influence upon the arrangements. The same evening I marked the stars in Leo thus:

"Order of the stars in Leo;

"$\alpha 1'''\ \gamma 2'\ \beta 2'\ \delta\varepsilon\ \zeta\theta\eta\ \mu o\ \varrho\nu\sigma$."

Here I parcelled them together in the order of brightness, but could not find a convenient way to denote the different degrees by using any derivation from magnitudes; therefore I contented myself with placing those close together that agreed nearly with each other, and kept a little distance between those that differed rather more. This might perhaps have answered the required end, if the confusion which would arise from the distance of letters had not proved a great objection. And that it would unavoidably bring on mistakes we

may see by the other constellations which were arranged that evening.

" Draco $\gamma\ \eta\ \beta\quad \delta\ \zeta,\quad \theta\ \lambda\ \alpha\ \kappa\quad \xi$

" Cygnus $\alpha\quad \gamma\ \varepsilon\quad \beta\ \delta\ \zeta\quad \theta$

" Hercules $\beta\ \zeta\ \alpha\quad \delta\ \eta\ \pi\quad \gamma\ \varepsilon\ \mu\quad r$* changed."

August 16, 1783, being upon the same subject of assigning comparative magnitudes, I introduced lines to shew the intended distances of the letters, with a view to prevent mistakes that might be made in transcribing them, and expressed the order as follows:

" Order of the stars in Auriga;

" α —— $\gamma\ \beta$ —— $,\ \theta$ —— $\varepsilon\ \eta\ \zeta$ —— $\upsilon\ \pi\ \tau$"

The marks denoted that all the stars were in succession, but that the distance between those which are separated by lines was greater than that between the rest. When stars occurred that were nearly equal, I placed them under each other, thus:

" Order of the stars in Ursa Minor, $\alpha\ \beta$ —— γ —— $\begin{matrix}\delta\\ \varepsilon\\ \zeta\end{matrix}$

But in this expression there is the inconvenience of its breaking in upon th lines above and below.

Another cause of disorder arose from the stars which are not lettered. For here we are obliged to use numbers in lieu of them; and these, unless properly separated, will run into one another, and occasion mistakes.

* I called it *r* changed, because this star, which in my edition of 1725 is marked 3 m, is only of the 5th magnitude. At that time I ascribed the difference to a change in the star; but I have since found that there is an error in the edition of 1725 which is not in that of 1712, where the star is marked as it ought to be, of the 5th magnitude.

In the next place, the letters themselves became troublesome; for a star cannot be found so readily in a catalogue or in an atlas by a letter, as it may be by a number.

The inconveniences attending the above different ways of notation having now been sufficiently pointed out, it remains only to lay down the method upon which, after many trials, I have fixed, in order to avoid them.

Setting aside the letters entirely I use only numbers in all my observations, and these numbers are such as I have added with red ink both to the edition of 1725 of the British catalogue, and to the Atlas Cœlestis taken from that catalogue, and printed in 1729. When I use other stars than what are contained in the British catalogue, the authors who have given them, and their numbers in the catalogues from whence they are taken, are particularly mentioned.

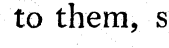
In the choice of the stars which are to express the lustre of any particular one, my first view is directed to a perfect equality. When two stars are perfectly alike in brightness, so that by looking often and a long while at them, I either cannot tell which is the brightest, or occasionally think one the largest, and sometimes, not long after, give the preference to the other, I put down their numbers together, only separated by a point. For instance, 30 . 24 Leonis. However, it can happen but very seldom that the equality in the lustre of two neighbouring stars is so perfect as not to leave an inclination to prefer one to the other; therefore I place that first which may probably be the largest, even though I do not particularly judge it to be so. But this preference is never to be understood to extend so far as to make it improper to change the order of the two stars; and the expression 24 . 30 Leonis will be equally good with the

former. When a third star is concerned, such as 30 . 24 . 77 Leonis, the order of them ought not to be changed; notwithstanding an equality between each member of the series has been strictly ascertained. The reason of this is obvious. For by the order in which they are placed, it appears that 30 has been deemed equal to 24, and 24 equal to 77; but it is not affirmed that 30 has been compared to 77. There will be a great probability that these two last stars do not differ sensibly or materially; but since actual comparison is what we are to go by, the order in which the stars are given must remain.

When two stars are so nearly alike in their lustre that they may be almost called equal, and even now and then leave us doubtful to which to give the preference; but when upon a longer inspection of them we always return to decide it in favour of the same, I separate the numbers that denote these stars by a comma. For instance, 41 , 94 Leonis. This expression can certainly not be changed to 94 , 41 Leonis; much less can the order of three such stars, as 20 , 40 , 39 Libræ, admit of a different arrangement. If ever the state of the heavens should be such as to require a different order in these numbers, we need not hesitate a moment to declare a change in the brightness of one or more of the stars that are contained in the series to have taken place.

When two stars differ but very little in brightness, but so that even a doubt cannot arise to which the preference ought to be given, I separate the numbers by which they are to be found in the catalogue by a short line. For instance, 17 – 70 Leonis; or 68 – 17 – 70 Leonis. If, in the former instance, a breaking in upon the order is to be looked upon as a proof that at least one of the stars has undergone a change in its

lustre, much more must that change be evident in this case, where the stars are separated by lines instead of commas.

When two stars differ so much in brightness that one or two other stars might be put between them, and still leave sufficient room for distinction, they become partly unfit for standards by which the lustre of other stars can be ascertained. But as proper intermediate stars sometimes cannot conveniently be had, we are often obliged to retain them; and in that case I distinguish them by a line and comma –, or by two lines, as 32 – – 41 Leonis. A difference which exceeds those that are expressed by the above marks, I denote by a broken line, thus – – – for instance, 16 – – – 29 Bootis. It would be very easy to give a more extensive signification to lines by adding cross marks to them, such as, +  *&c.;* but in estimations that are to ascertain the brightness of stars, such expressions would rather throw us back again to look for imaginary differences, resembling those which have been rejected in the old system of magnitudes. On the contrary, the marks I have introduced admit of so precise a definition, that they cannot possibly be mistaken: a point denoting equality of lustre: a comma indicating the least perceptible difference: a short line to mark a decided but small superiority: a line and comma, or double line, to express a considerable and striking excess of brightness; and a broken line to mark any other superiority which is to be looked upon as of no use in estimations that are intended for the purpose of detecting changes.

In a foregoing paragraph we have said that this method of ascertaining the lustre of the stars was difficult and laborious. The difficulty consists in avoiding the various causes of error

that may bias our judgment in assigning the comparative brightness of the stars: the different altitudes at which we view them: the state and situation of the moon: the time of the night with regard to twilight: the uncertainty of flying clouds: the twinkling and continual change of star-light, to whatever cause it may be owing; I mean such changes as last but few moments, or at most but a few minutes: a return into the dark after having been writing by candle-light: the zodiacal light: aurora borealis: and dew or damp upon the glasses or specula when a telescope is used. All these, it must be confessed, are real difficulties, which it requires much attention and perseverance to get the better of.

That the method is also laborious may be easily conceived; for each star must at least have two other stars to be compared with, and even these will often be found not to be sufficient. To look out for such proper objects, and then to make the necessary comparisons for every star in the heavens, can be no easy task, especially when we remember the difficulties I have enumerated, to which every single estimation of comparative brightness is subject. This ought, however, not to discourage us from a work which has in view the investigation of a point of great importance; and as I have already made a considerable progress, I shall give the result of my labour in small catalogues, of which I have joined one at the end of this paper.

That these investigations are of the importance we have ascribed to them, will appear when we call to our remembrance the great number of alterations of stars that we are certain have happened within the last two centuries, and the much greater number that we have reason to suspect to have

taken place. If we consider how little attention has formerly been paid to this subject, and that most of the observations we have are of a very late date, it would perhaps not appear extraordinary were we to admit the number of alterations that have probably happened to different stars to be a hundred; this compared with the number of stars that have been examined, with a view to ascertain their changes, which we can hardly rate at three thousand, will give us a proportion of 1 to 30. But we are very certain that had a number of observers applied themselves to the same subject, which is of such a nature as to require the attentive scrutiny of many diligent persons at the same time, many more discoveries might probably have been made of changeable and periodical stars, whose variations are too small to strike a general observer. In the application we shall make of this subject however, a proportion, such as 1 to 30, or even 1 to 300, is sufficiently striking to draw our attention.

By observations such as this paper has been calculated to promote and facilitate, we are enabled to resolve a problem not only of great consequence, but in which we are all immediately concerned. Who, for instance, would not wish to know what degree of permanency we ought to ascribe to the lustre of our sun? Not only the stability of our climates, but the very existence of the whole animal and vegetable creation itself is involved in the question. Where can we hope to receive information upon this subject but from astronomical observations? If it be allowed to admit the similarity of stars with our sun as a point established, how necessary will it be to take notice of the fate of our neighbouring *suns*, in order to guess at that of our own! That *star* which among the multi-

tude we have dignified by the name of *sun*, to-morrow may slowly begin to undergo a gradual decay of brightness, like β Leonis, α Ceti, α Draconis, δ Ursæ majoris, and many other diminishing stars that will be mentioned in my catalogues. It may suddenly increase, like the wonderful star in the back of Cassiopea's chair, and the no less remarkable one in the foot of Serpentarius; or gradually come on like β Geminorum, β Ceti, ζ Sagittarii, and many other increasing stars, for which I also refer to my catalogues. And lastly, it may turn into a periodical one of 25 days duration, as Algol is one of 3 days, δ Cephei of 5, β Lyræ of 6, η Antinoi of 7 days, and as many others are of various periods.

Now, if by a proper attention to this subject, and by frequently comparing the real state of the heavens with such catalogues of brightness as mine, it should be found that all, or many of the stars which we now have reason to suspect to be changeable, are indeed subject to an alteration in their lustre, it will much lessen the confidence we have hitherto placed upon the permanency of the equal emission of light of our sun. Many phænomena in natural history seem to point out some past changes in our climates. Perhaps the easiest way of accounting for them may be to surmise that our sun has been formerly sometimes more and sometimes less bright than it is at present. At all events, it will be highly presumptuous to lay any great stress upon the stability of the present order of things; and many hitherto unaccountable varieties that happen in our seasons, such as a general severity or mildness of uncommon winters or burning summers, may possibly meet with an easy solution in the real inequality of the sun's rays.

A method of ascertaining the quantity or intenseness of solar light might be contrived by some photometer or instrument properly constructed, which ought probably to be placed upon some high and insulated mountain, where the influence of various causes that affect heat and cold, though not entirely removed, would be considerably lessened. Perhaps the thermometer alone might be sufficient. For though the lustre of the sun should be the chief object of this research, yet, as the effect of light in producing expansion in mercury seems to be intimately connected with the quantity of the incident solar rays, it may be admitted that all conclusions drawn from their action upon the thermometer will apply to the investigation of the brilliancy of the sun. And here the forms laid down by Mr. MAYER, in his little treatise *De Variationibus Thermometri accuratius definiendis*,* may be of considerable service to distinguish the regular causes of the change of the thermometer from the adventitious ones, among which I place the probable instability of the sun's lustre.

Introductory Remarks and Explanations of the Arrangement and Characters used in the following Catalogue.

This catalogue contains nine constellations, which are arranged in alphabetical order. I have called the present collection the first catalogue. The rest of the constellations, which are pretty far advanced, will be given in successive small catalogues as soon as time will permit to complete them.

Each page is divided into four columns, the first of which gives the number of the stars in the British catalogue of Mr. FLAMSTEED, as they stand arranged in the edition of 1725.

* *Tobiæ Mayeri opera inedita*, I.

The second column contains the letters which have been affixed to the stars.

The third column gives the magnitude assigned to the stars by FLAMSTEED in the British catalogue; and

The fourth contains my determination of the comparative brightness of each star, by a reference to proper standards.

All numbers used in the fourth column refer to the stars of the same constellation in which they occur, except when they are marked by the name of some other constellation; and in that case the alteration so introduced extends only to the single number which is marked, and which then refers to the constellation affixed to the number.

The numbers at the head of the notes, which will be found at the end of the catalogue, refer to the stars in the same constellation to which the notes belong. They contain particulars which it will be useful to know for those who wish to review that constellation.

To each star which I could not find in the heavens, and which, upon examining FLAMSTEED's observations, appeared never to have been seen by him, I have put down "Does not exist." To such as I could not find in the heavens, but which nevertheless appeared to have been observed by FLAMSTEED, I have put down "Lost." This is to be understood only to mean that the star in question was not to be seen when I looked for it, but that possibly at some future time, if it be a changeable or periodical star, it may come to be visible again.

The observations in the notes, distinguished by marks of quotation, " " are taken from my own journals.

Errors in FLAMSTEED's catalogue, or in the Atlas Cœlestis,

are pointed out at the end of the constellations in which they occur, that they may be corrected.

Simple Characters.

‘ The least perceptible difference less bright.
. Equality.
, The least perceptible difference more bright.
– A very small difference more bright.
–, A small difference more bright.
– – A considerable difference more bright.
– – – Any great difference more bright in general.

Compound Characters, expressing the wavering of Star-light.

: From the least perceptible difference less bright to equality.

; From equality to the least perceptible difference more bright.

⁊ From a very small difference more bright, to the least perceptible difference.

=, From –, to – *&c.*

⁘ The wavering expressed by the passing of the light from a state of the least perceptible difference less bright to equality, and to the least perceptible difference more bright.

⁇ The wavering expressed by the changes from – to , and to . or from . to , and to –

General Characters.

= Perfect equality.
< Less, but undetermined.
> Larger, but undetermined.

All the observations contained in this catalogue have been made in very fine nights, where no suspicion of any whitish haziness or thin clouds can be admitted that might have deceived me.

The compound expressions which occur in the catalogue are not such as have arisen from want of attention, but on the contrary from more than common and long inspection.

Whoever looks a long while at two stars which are equal, A and B for instance, will find that he is not always pleased with the expression A . B, but would incline rather to put them down A , B when A seems to have the preference, or A ' B when the advantage is on the side of B. Since, therefore, these three expressions A ' B A . B A , B seem equally to belong to the stars, my compound character A § B is in that instance an useful one, which includes them all. This may seem to be a doubtful expression, but it is in fact a very positive one, amounting to A = B. For had the stars not been perfectly equal, the same causes which bring on these little waverings in the appearance of stars, whatever they are, would have operated so as perhaps to produce the comparative wavering lustres expressed by A ; B and A ⫠ B or A ⫡ B which denotes the union of the three expressions A . B and A , B and A – B. But if this had been the case, we could certainly not admit A = B.

Sometimes, when I was not willing to put down these compound marks, I have cast my eyes upon the ground, and after a few moments lifted them quickly up to the stars AB, and instantly decided which of the expressions ought to be used: this being repeated perhaps a dozen or more times, I took that expression for the most proper one which would occur oftener than any other in these transitory glances.

All observations upon stars of any considerable magnitude have been made with the naked eye. I was unwilling to introduce the fallacies, or at least the difficulties that occur in the use of a telescope, owing to various causes that need not be mentioned, where I could possibly do without it. In numberless instances, however, the telescope has been recurred to, notwithstanding the stars under examination were not so small but that I saw them very well with the naked eye; for in very fine nights, and in high situations, all the stars of the sixth, and most of the seventh magnitude, are sufficiently visible. But when small stars were situated very near each other, or very near brighter ones, it became necessary to remove the objection arising from the light of one star either overpowering or blending with that of the other.

Care has been taken in observations with the naked eye not to fix upon a star as a standard which has another close to it; for the united light of the two stars would certainly cause deceptions. And stars that stand in this predicament of course have been referred to others with the assistance of a telescope.

The largest stars, and in general all such as had no convenient stars in the same constellation to be compared with them, have their lustre ascertained by such as I could find in the neighbouring part of the heavens.

Whenever I use the expression of magnitude, which though not of so nice and critical distinction as would be required for the purpose of my catalogue, is still a very useful one for general purposes, I have endeavoured to conform my mental standard to the notation of FLAMSTEED.

The most remarkable expressions of brightness which are contradictory to FLAMSTEED's magnitudes, are pointed out in

the notes annexed to the constellations. They are pretty numerous, and with many stars so considerable, that we have great reason to suspect changes in their lustre since FLAMSTEED's time. It is to be noticed, that in collating my observations of brightness with FLAMSTEED's magnitudes, I have not only taken those which are in the British catalogue, but also those that are to be found in the *Observationes Fixarum*. The very extraordinary disagreement between the former and the latter ought not to pass unnoticed. Were it not for what FLAMSTEED says in his *Prolegomena*, when he mentions the arrangement of the catalogue, "Undecima columna indicat "cujus magnitudinis stellam esse arbitratus sum quando eam "observatam habui," I should entirely reject the magnitudes of the catalogue as being without authority to support them. Nor can I conceive how such a remarkable disagreement could escape the author's notice, or remain unperceived by astronomers till this time, if the lustre of the stars in general had not been looked upon as a thing of no material consequence.

To shew what the difference is to which I allude, let us cast an eye upon the 9 constellations which are contained in the following catalogue of brightness.

In Aquarius there are 108 stars. To 49 of these no magnitudes can be found in FLAMSTEED's observations; of 38 the magnitudes annexed to them agree with those of the catalogue; and of 21 they disagree with them.

In Aquila there are 71 stars. 39 are not observed; 16 agree; 16 disagree.

In Capricornus are 51 stars. 22 not observed; 17 agree; 12 disagree.

In Cygnus are 81 stars. 47 not observed; 21 agree; 13 disagree.

In Delphinus are 18 stars. 11 are not observed; 3 agree, and 4 disagree.

In Equuleus are 10 stars. 5 are not observed; 3 agree, and 2 disagree.

In Hercules are 113 stars. 10 are not observed; 54 agree, and 49 disagree.

In Pegasus are 89 stars. 22 are not observed; 37 agree, and 30 disagree.

In Sagitta are 18 stars. 3 are not observed; 13 agree, and 2 disagree.

To this may be added, that the disagreement in several stars is so considerable as to amount to two magnitudes; in many to one and an half, and in still more to one magnitude: not only with stars of a small size, but with some of the brightest in the constellation. I do not include α Cygni, which is marked 2m in the catalogue, and in the observation 7m, as that must certainly be a mistake; but cannot help regretting that a work to which every astronomer has been taught to look up as the first authority, should have been sent to the press with so many errors, that we hardly know how far to give our confidence to what is laid down in it.

I. *Catalogue of the comparative Brightness of the Stars.*

Lustre of the stars in Aquarius.			
1		6	70 Aquilæ, 1
2	ε	5.4	2 – 23. 2 – – 6
3		5	3 – 5
4		6	5, 4
5		6	3 – 5, 4
6	μ	4.5	13, 6 – 7 6, 18 2 – – 6 – 7
7		6	6 – 7 – – 8 18, 7
8		6.7	7 – – 8, 9
9		6	8, 9
10		6	11, 10
11		6	12, 11, 10
12		6	12, 11
13	ν	5	23. 13, 6
14		6	17 – 14
15		6	21. 15, 16
16		6	15, 16, 20
17		6	19, 17 – 14
18		6	6, 18, 7
19		6	19, 17
20		6	16, 20
21		6	21. 15
22	β	3	34 ; 22, 49 Capricorni
23	ξ	6	2 – 23. 13
24		6	26 – 24
25	*d*	6	25. 27
26		6	27, 26 – 24
27		6	25. 27, 26
28		6	32, 28 28, 30

Lustre of the stars in Aquarius.			
29		6	35, 29
30		6	46, 30 30 - 60 28, 30 30 -- 36
31	o	5	31 - 32
32		6	31 - 32, 28
33	ι	4	73, 33, 57 33 . 23 Capricorni
34	α	3	34 . 88 Pegasi 34 ; 22
35		6 . 5	41, 35, 29
36		6	30 -- 36 37, 36
37		6	45 . 37 37, 36
38	e	6	38, 42
39		6	42 . 39, 45
40		7 . 8	45 . 40 40, 61
41		6	47, 41, 35 41 - 49
42		7	38, 42, 45 42 . 39 42, 53
43	θ	4	71, 43, 57
44		6	51, 44
45		6	42, 45 39, 45 . 40 45 . 37 45 . 50
46	ϱ	5 . 6	46, 30
47		5 . 6	47, 41 59, 47 . 68
48	γ	3	62 . 48 - 52
49		5	41 - 49
50		6	45 . 50, 56
51		6	63, 51, 44
52	π	5	48 - 52
53		6	42, 53
54		6	58 . 54
55	ζ	4	76 . 55, 62
56		6	50, 56, 61
57	σ	5	33, 57 43, 57
58		6	58 . 54 74 - 58 - 64
59	υ	5	66 ; 59, 47
60		6	30 - 60
61		6	56, 61 40, 61

Lustre of the stars in Aquarius.			
62	η	4	55, 62 . 48
63	$\varkappa$	5	63, 51
64		6	58 – 64 . 65
65		6	64 . 65 . 75
66	g^1	6	66 ∓ 59
67		6	67 . 78
68	g^2	6	47 . 68
69	τ^1	5	7 –, 69 69 ∓ 77
70		6	70 . 74
71	τ^2	6 . 5	73, 71, 43 71 –, 69
72		6	Does not exist.
73	λ	4	73, 33 73, 71 73, 88
74		6	70 . 74 – 58
75		7	65 . 75
76	δ	3	76 . 55
77		6	69 ∓ 77
78		6	67 . 78 81, 78 80 - 78 . 80
79		2 . 1	8 Pegasi, 79, 44 Pegasi
80		7	80 – 78 . 80
81		7	82, 81, 78
82		7	82, 81
83	b^1	6	83, 92
84	b^2	7	87 – 84
85	b^3	6	92 – – 85, 87
86	c^1	6	18 Piscis aust . 86 99, 86 . 89
87	b^4	6	85, 87 – 84
88	c^2	4	88 – 18 Piscis aust 73, 88 ∓ 98
89	c^3	5 . 6	86 . 89 . 101 89, 104
90	φ	5	93 . 90 – 92 91, 90 . 93
91	ψ^1	5	91, 90
92	$\varkappa$	6	90 – 92, 96 83, 92 – – 85
93	ψ^2	5	93 . 90 90 . 93
94		6	94, 95

Lustre of the stars in Aquarius.			
95	ψ^3	5	94, 95, 97
96		6.7	92, 96
97		6	95, 97
98	b^1	5	88 ; 98, 99
99	b^2	5	98, 99, 86
100	b^3	5	101 – 100
101	b^4	5	89 . 101 – 100
102	ω^1	5	105, 102
103	A^1	5	104 . 103 . 106
104	A^2		89, 104 . 103
105	ω^2	5	105, 102
106	A^3	5	103 . 106 . 107
107	A^4	6	106 . 107 . 108
108	A^5	6	107 . 108
Lustre of the stars in Aquila.			
1	*m*	4	16, 1, 12
2	*o*	5	2 . 3
3	*n*	5	2 . 3, 9
4		5	9, 4, 5
5		6	4, 5
6	*l*	4	6 . 12 6 . 63 Serpentis
7		6	8, 7
8			8, 7
9	*k*	5.4	3, 9 12, 9, 14 9, 4
10		6	11, 10
11		6	18 ; 11, 10
12	*i*	4	1, 12 6 . 12, 9 12 . 63 Serpentis
13	ε	3.4	13 – 18
14	*g*	6	9, 14, 15
15	*h*	6	14, 15
16	λ	3	16, 30 16, 65 16, 1
17	ζ	3	50, 17 – 65

Lustre of the stars in Aquila.			
18		6	13 – 18 , 11 18 , 19 18 – 11
19		6	18 , 19 , 22 21 ; 19
20		5.6	26 . 20 37 . 20
21		5	21 ; 19 23 . 21
22		6	19 , 22
23		7	23 . 24 23 . 21 23 – 24
24		7	23 . 24 23 – 24
25	ω^1	6	28 . 25 25 –, 29
26	f	6	39 , 26 . 20
27	d	6	32 – 27 27 – 35
28	A	6	31 , 28 . 25
29	ω^2	7	25 –, 29
30	δ	3	65 , 30 , 55 16 , 30 65 ; 30
31	b	6	31 , 28
32	ν	5	41 – 32 – 27 38 , 32 , 44
33		6	Does not exist.
34		6	Does not exist.
35	c	6	27 – 35
36	e	6	36 , 42 36 – 45
37	k	6	37 . 20 39 , 37 , 51
38	μ	4	41 – 38 . 44 38 , 32 38 ; 59 67 ; 38
39	$\varkappa$	3.4	39 , 26 39 , 37
40		6	Does not exist.
41	ι	3.4	55 – 41 – 38 41 – 32 41 ; 71 41 , 55
42		6	36 , 42 , 45 62 , 42 . 66 58 , 42
43		6	Does not exist.
44	σ	5	38 . 44 32 , 44 59 , 44 . 54
45		6	42 , 45 36 – 45
46		6	61 . 46 47 , 46 , 48
47	χ	6	47 . 52 47 , 46
48	ψ	6	46 , 48
49	υ	6	63 . 49
50	γ	3	53 – – – 50 , 17 50 , 34 Sagittarii

Lustre of the stars in Aquila.			
51		5	37, 51 56. 51
52	π	6	47. 52. 61
53	α	1.2	53 – – – 50 21 Scorpii – – 53 – – 50 Cygni
54	o	6.5	44. 54 54, 63 59 – 54
55	η	3.4	30. 55. 60 55 – 41 41, 55
56		5	57 – – 56. 51
57		6	57 – – 56
58		6	62, 58, 42 58 – 66
59	ξ	5	38 ; 59, 44 59 – 54
60	β	3.4	30, 60. 55
61	φ	6	52. 61, 46
62		6	62, 58 66. 62, 64
63	τ	6	54, 63. 49
64		6	66, 64 62, 64
65	θ	3	17 – 65, 30 16, 65 65 ; 30
66		5.6	42. 66 66, 64 66. 62 58 – 66
67	ϱ	5	67 ; 38
68		6	69, 68 69 – 68
69		5	70, 69, 68 70, 69 – 68
70		5	71 – 70. 69 70, 1 Aquarii
71		4	71 – 70 41 ; 71
Lustre of the stars in Capricornus.			
1		6	2, 1. 3
2	ξ	6	2, 1
3		6	1. 3
4		6	7, 4
5	α^1	4	6 – 5 –, 8
6	α^2	3	6 – 5
7	τ	obs.	10, 7, 12 15. 7, 4
8	ν	6	5 –, 8, 11
9	β	3	49 – 9 – – 40
10	π	obs.	11, 10, 12 10, 7 10, 15
11	ϱ	6	8, 11, 10

Lustre of the stars in Capricornus.			
12	o	obs.	10, 12 7, 12 15, 12
13		6	15 – 13 14 =; 13
14	τ	6	14, 15 14 =; 13
15	ν	6	10, 15, 12 15 . 7 14 . 15 – 13
16	ψ	5	16, 18
17		6	24 ; 17
18	ω	6	16, 18; 24
19		6.7	23 – – 19, 21
20		6.7	20 . 21 22 – 20 . 25
21		6	19, 21 20 . 21
22	η	5	23 –, 22 – 20 22 – 24
23	θ	5	23 – – 19 23 –, 22 33 Aquarii . 23
24	A	6	18; 24 ; 17 22 – 24, 25
25	χ^1	6	20 . 25 –, 26 24, 25
26	χ^2	6	25 –, 26 . 27
27	χ^3	6	26 . 27
28	ϕ	6	36 – 28, 33
29		6	32 – 29 – 30
30		6	32 – – 30 – 31 29 – 30
31		7	30 – 31
32	ι	5	32 – – 30 32 – 29
33		6	36, 33, 35 41, 33 28, 33, 35 34 Sagittarii . 33
34	ζ	5	34, 39 34 – – 36
35		6	33, 35
36	*b*	6	39 – 36, 43 36, 33 34 – – 36 – 28
37		6	43 –, 37, 38
38		6	37, 38
39	ε	4	34, 39 – 36
40	γ	4	9 – – 40
41		6	41, 33
42	d^1	6	42 – 44 42 –, 44 42 ; 51 42 . 48 51 ; 42 ; 48

Lustre of the stars in Capricornus.			
43	$\varkappa$	5	36 , 43 –, 37
44	d^2	6	42 – 44 . 45 42 –, 44 , 45 44 ; 45
45		6	44 ; 45 44 , 45 44 . 45
46	c^1	6	46 –, 47
47	c^2	6	46 –, 47
48	λ	5	42 . 48 , 51 48 – – 50 42 ⁻ 48
49	δ	3	49 – 9 22 Aquarii , 49
50	.	6	48 – – 50
51	μ	5	42 ; 51 48 , 51 51 ; 42
Lustre of the stars in Cygnus.			
1	$\varkappa$	4	1 . 10 1 ⁻ 10 10 ⁻ 1 10 . 1 1 – 32
2		5	12 ; 2 ⁻ 9
3		6	8 Vulpeculæ . 3 3 Vulpeculæ – – 3
4		6	14 . 4 12 , 4 15 , 4 – 11 8 – 4 , 11
5			Does not exist. A small star near the place 9 – – 5
6	β	3 . 4	53 , 6 , 18 18 ; 6 53 ⁻ 6 6 –, 14 Lyræ
7		6	16 , 7
8		6	17 . 8 8 ; 15 8 , 12 8 , 14 8 – 4 21 – 8 – 17
9			12 ⁻ 9 12 – 9
10	ι	6	1 . 10 10 . 1 10 ⁻ 1 65 ⁻ 10
11		6	4 , 11
12	ϕ	5	12 ; 2 8 , 12 , 4 12 – 9
13	θ	4	32 , 13 33 , 13 , 20 33 , 13 , 23
14		6	8 , 14 . 4
15		6	15 , 22 8 : 15 , 4 15 , 25
16	c^1	6	16 , 7
17	χ	5	8 – 17 21 – – 17 . 8 21 = ⁻ 17
18	δ	3 . 4	6 , 18 , 64 53 , 18 53 –, 18 – 64 53 , 18 , 64 8 ; 6 18 ⁻ 64
19		6	22 , 19 25 , 19

Lustre of the stars in Cygnus.			
20		5.6	24 . 20 . 26 13 , 20
21	η	6	21 . 41 21 – – 17 21 = 7 17 21 – 8
22		6	25 . 22 22 , 25 15 , 22 , 19
23		6	13 , 23
24	Ψ	5	24 . 20
25		6	15 , 25 . 22 22 , 25 , 19
26	c^2	6	20 . 26
27	b^1	5	36 – 27
28	b^2	5	34 ; 28 , 36 28 . 35 28 . 34
29	b^3	6	29 . 34 34 . 29
30	o^1	4	32 – 30 32 –, 30
31	o^2	5	31 , 32
32		5.6	32 . 33 32 , 13 31 , 32 – 30 1 – 32 31 – 32 –, 30
33			32 . 33 , 13
34		6	29 . 34 ; 28 28 . 34 34 . 29 34 , 36 34 , 40
35	m	6	28 . 35 39 – 35
36		6	28 , 36 – 27 34 , 36
37	γ	3	37 , 53 37 – 53 37 –, 53 37 7 8 Peg. 37 – 8 Peg. 37 ; 8 Pegasi 5 Cephei –, 37
38			Does not exist, or is lost.
39	b	6	41 – 39 – 35 47 – 39 – 35
40		6	34 , 40 40 , 42
41	i	4	41 , 52 21 . 41 41 – 39
42		6	40 , 42 , 44
43	w^1	5	46 , 43
44		6	42 , 44
45	w^2	5	45 , 46
46	w^3	5	45 , 46 , 43
47	l	6	47 – 39
48		6	49 – 48 ; 48 49 –, 48 ; 48 49 – – 48 . 48
49		6	49 – 48 ; 48 49 –, 48 ; 48 49 – – 48 , 48

Lustre of the stars in Cygnus.			
50	α	2	50 – – – 37 53 Aquilæ ; 50 53 Aquilæ – – 50
51		6	56 , 51
52	k	6	41 , 52
53	ε	3	37 , 53 , 6 37 – 53 , 18 37 – 53 –, 18 37 –, 53 ; 6
54	λ	4	67 . 54
55		6	56 . 55 – 59 55 . 63 63 . 55 , 59
56		6	57 , 56 . 55 57 , 56 , 51
57		6	57 , 56
58	ν	4	62 . 58 . 67
59	f^1	5.6	55 – 59 , 60 63 , 59 55 , 59 59 , 68
60		6	59 , 60
61		6	70 . 61 , 69
62	ξ	4	65 , 62 , 58
63	f^2	6	55 . 63 , 59 63 . 55 68 , 63
64	ζ	3	18 , 64 18 ; 64
65	τ	4	65 , 62 65 – 66 65 ; 10
66	υ	5	66 , 78 65 – 66 , 67
67	σ	4	58 . 67 . 54 67 ; 78 66 , 67
68	A	6	59 , 68 , 63
69		6	69 . 70 70 – 69 79 , 69 61 , 69
70		6	69 . 70 72 , 70 – 69 70 . 61
71	g	6	80 . 71
72		6	72 , 70 74 , 72
73	ϱ	4	73 – 81
74		6	74 , 72 74 – 77 75 . 74 , 72
75		6	75 . 74
76		6	77 , 76
77		6	74 – 77 , 76
78		3.4	66 , 78 67 ; 78 – 14 Pegasi
79		6	79 , 69
80	π^1	4	81 – 80 . 71
81	π^2	5	73 – 81 – 80

Lustre of the stars in Delphinus.			
1		6	8, 1, 10
2	ε	3	12, 2, 11
3	η	6	5·3, 8
4	ζ	5	11–4·7
5	ι	6	7, 5·3
6	β	3	6, 9
7	κ	6	4·7, 5
8	θ	6	3, 8, 1
9	α	3	6, 9·12
10		6	1, 10
11	δ	3·4	2, 11–4
12	γ	3	9·12, 2
13		5	13–14 1 Equulei–13
14		6	13–14
15		6	18, 15
16		6	17, 16, 18
17		6	17, 16
18		6	16, 18, 15

Lustre of the stars in Equuleus.			
1		5	10, 1–13 Delphini
2		6	4, 2
3		6	3·4
4		6	3·4, 2
5	γ	4	8––5·7 5–6
6		6	5–6
7	δ	4	5·7, 10
8	α	4	8––5
9		6	10–9
10	β	4	7, 10, 1 10–9

Lustre of the stars in Hercules.			
1	χ	6	1–, 4 1, 30 30 . 1
2		6	4, 2–, 14
3		5	3–9
4		6	1–, 4, 2
5	r	5	7––5–16
6	υ	6	35, 6––14 35–6, 30 6, 52 11, 6 11, 6
7	$\varkappa$	5	7––5
8	q	5.6	16, 8
9		6	3–9, 43 Serpentis
10		5	10–17 10–19
11	φ	6	11 . 35–6 11–––14 35 . 11, 6 11, 6 22, 11
12		6	21––12–15
13		5.6	15 . 13
14		7	6––14 11–––14 2–, 14
15		6	12–15 . 13
16		6	5–16, 8
17		6	10–17, 18 19, 17, 18
18		7	17, 18
19		6	10–19, 17
20	γ	3	64–, 20 22, 20 . 58 22–20
21	o	6	21––12 28–21
22	τ	4	44, 22, 20 22, 85 44–22–20 22, 11
23		5	20 Coronæ–23 · 23–26
24	w	6	24, 29 24, 60 24–29 24–, 29
25		5	30–25 30–, 25 59, 25
26		7.6	23–26 26–31
27	β	3	27–, 64 40–27 27 ; 40 27––64 27 ; 40 27, 40
28		6	28–21
29	b	4	24, 29 60 ; 29 24–29 24–, 29

Lustre of the stars in Hercules.			
30	*g*	5	1, 30 30–25 6, 30 52, 30 42, 30, 34 30 . 1 30–, 25
31		7	26 – 31
32		6	48, 32
33		6	41, 33
34		6	30, 34
35	σ	4	58, 35 85, 35 11, 35, 6 35 . 11
36	*m*	6	37 – – 36 38 – 36
37			37 – – 36 37 – 38 37, 45
38		6	37 – 38 41, 38 – 36
39		5	39 – 50
40	ξ	3	40 – 27 27 ; 40 27 ; 40 27, 40 27 ; 40 37 Serpentis – 40 –, 64
41		6	45 – – 41 47, 41, 38 41, 33
42		5	52, 42, 30
43	*i*	5.6	45, 43, 47
44	η	3	65, 44, 22 44, 86 44 – 22 65 – 44 – 58
45	*e*	5	45 – – 41 37, 45, 43
46		7	48 – 46
47	*k*	5	43, 47, 41
48		6	50 – 48, 32 48 - 46
49		6	60 – – 49
50		5	39 – 50 – 48 53 – – 50
51		5	53 . 51 – – 56
52		5.6	6, 52, 30 52, 42
53		5	53 – – 50 53 . 51
54		5	One of these two does not exist.
55			60, 54 or 55
56		6	51 – – 56 . 57
57		6	56 . 57
58	ε	3	20 . 58, 35 58, 91 44 – 58 103 – 58 – 76
59	*d*	6	68, 59, 61 59, 25

Lustre of the stars in Hercules.			
60		6	24, 6 ; 29 60 – – 49 60, 66 60, 54 or 55
61	*c*	6	59, 61
62		6	71 – – 62
63		6	72 . 63 63, 78
64	α	3	64 – 27 Ophiu . 27 Ophiu – 64 64 , 65 65 –, 64 27 –, 64 –, 20 64 ; 67
65	δ	4	65 – 64 67, 65 64, 65 – 44
66	ω	6	60, 66, 37 Ophiuchi
67	π	3 . 4	67, 65 67, 27 Ophiuchi
68	*u*	5	70 . 68, 72 68, 90 68, 59 69 – 68
69	*e*	4 . 5	76 – 69 69 – 68 94, 69 – 99
70		4	70 – – 62 70 . 68 70 – 73
71		5	Does not exist.
72	*w*	6	68, 72 . 63 90, 72
73		6	70 – 73
74		6	77, 74 . 88
75	ϱ	4	75, 76 91, 75 75 . 94
76	λ	4 . 5	75, 76 – 69 58 – 76
77	$\varkappa$	6	82 . 77, 74
78		6 . 7	63,78 78, 93
79		6	79 – 83 89, 79
80		4	Does not exist.
81		4	Does not exist.
82	*y*	6	82 . 77
83		7	79 – 83 . 84
84		7	83 . 84
85	ι	4	22, 85, 35 14 Lyræ, 85
86	μ	4	44, 86, 92 86 – 92
87		6	87 – 89
88	Z	6	74 . 88
89		6	87 – 89, 79
90	*f*	6	68, 90, 72

Lustre of the stars in Hercules.			
91	θ	4	58, 91, 75 92 . 91
92	ξ	4	86, 92 . 103 103 . 92 . 91 92 . 109 92, 109 86 – 92 ; 103
93		5	78, 93
94	ν	5	75, 94, 69 103 – 94 . 100 109, 94
95		4	102, 95, 101 95 . 98
96		5	101, 96 . 97 101 . 96 – 98
97		5.6	96 . 97 98, 97
98		5	95 . 98 96 – 98, 97
99	*b*	5	69 – 99 – 104 106 . 99 100, 99 107, 99 . 108
100	*i*	6	94 . 100, 99
101		5	95, 101 . 96 95, 101 . 96
102		4.5	102, 95
103	*o*	4	109 . 103 92 . 103 – 94 92 ; 103 – 58
104	A	4.5	99 – 104
105		5	106 – 105
106		5.6	106 . 99
107	*t*	6	107, 99
108		6	99 . 108
109		4	92 . 109 . 103 92, 109, 94 109, 111
110		4.5	111, 110, 113
111		4	109, 111, 110
112		5	113, 112
113		5	110, 113, 112
Lustre of the stars in Pegasus.			
1	*e*	4	24 – 1, 10 1 . 9
2	*f*	4.5	10 – 2, 16 9 – 2 . 13 2 – 13
3		6	3, 4
4		6	3, 4 . 7
5		6.7	13 – 5 12, 5 13, 5
6		6	16, 6 – 11

Lustre of the stars in Pegasus.			
7		6	4 . 7
8	ε	3	8 – 54 37 Cygni – 8 21 Andr ; 8 , 54 8 , 53 8 ; 16 Ceti 8 , 24 Pisc austr
9	g	4 . 5	1 . 9 – 2
10	κ	4	1 , 10 – 2
11		6	6 – 11
12		6	16 , 12 , 5
13		6	2 . 13 – 5 13 , 17 13 , 5 2 – 13
14		6	16 , 14 , 15 78 Cygni – 14
15		6	14 , 15
16		6	2 , 16 16 , 6 16 , 12 16 , 4
17		6	13 , 17 . 21 17 , 21
18		5	22 – 18 . 19 19 , 18
19		6	18 . 19 19 , 18 22 – 19
20		6	21 , 20
21		5	17 . 21 , 20 17 , 21 , 20
22	ν	5	46 , 22 – 18 22 , 35 22 – 19 31 , 22
23		6	38 , 23
24	ι	4	24 – 1
25		6 . 7	25 – 28
26	θ	4	42 , 26 – 46
27		5	29 – 27
28		6 . 7	25 – 28
29	π	4 . 5	29 – 27
30		6	35 , 30 31 , 30 – 36 31 =' 30
31		4 . 5	31 , 30 31 =' 30 31 , 22 50 . 31 , 49
32		6	43 , 32 , 38 43 . 32
33		6 . 7	39 . 33
34		6	37 , 34
35		6	22 , 35 , 37 35 , 30
36		6 . 7	30 – 36
37		6	35 , 37 , 34
38		6	32 , 38 , 23

Lustre of the stars in Pegasus.			
39		6.7	41, 39, 45 39 · 33
40		6	40, 41
41		6.7	40, 41, 39
42	ζ	3	48, 42, 26
43	o	5	47 – 43, 32 56, 43, 32
44	η	3	53 ; 44 ; 48 53, 44, 88 54, 44; 88 16 Ceti ; 44
45		6.7	39, 45
46	ξ	5	26 – 46, 22 46 – 50
47	λ	4	48, 47 – 43 47, 68 47 –, 68 48, 47 – 68
48	μ	4	44 ; 48, 47 88 – – 48, 42
49	σ	6	50, 49, 52 31, 49
50	ρ	6	46 – 50, 49 50 · 31
51		6	56 – 51, 60
52		6	49, 52
53	β	2	54, 53 ; 44 54 · 53, 44 8, 53 · 54
54	α	2	8 – 54 54, 53 8, 54 · 53 53 · 54, 44
55	l	5	55, 59
56		5.6	62 – 56 – 51 56, 64 56 · 72 56, 71 62 – 56 56 · 43 78; 56
57	m	6	58, 57
58	n	6	59, 58, 57
59	p	6.5	55, 59, 58
60		6	51, 60, 61
61		6	60, 61
62	τ	6	68, 62 – 56 62, 78 84, 62 62 – 56
63		6	67 – 63 · 73
64		6	56, 64 · 67
65		6	69, 65
66		6	70 – 66, 86
67		6.7	64 · 67 – 63
68	υ	6	47, 68, 62 68, 70 47 –, 68 47 – 68
69		6	71, 69, 65

Lustre of the stars in Pegasus.			
70	η	5 6	68 , 70 – 66 70 , 82
71	γ	6	56 , 71 , 69 71 , 85
72		6	56 . 72
73		6	63 . 73
74		7	75 , 74 , 76 75 ; 74 , 76
75	S	6	81 , 75 , 74 75 ; 74
76		6	74 , 76
77		6	82 , 77 – 80
78		5 . 6	62 , 78 – 79 62 , 78 ; 56
79		6	78 – 79
80		6	77 – 80
81	φ	6	80 , 81 , 75
82		6	70 82 , 77
83	r	6	87 , 83 23 Piscium – 83
84	ψ	6	84 . 62 84 , 89
85		6	71 , 85 87 . 85
86		. 6	66 , 86
87	u	6	87 . 85 87 , 83
88	γ	2	44 , 88 44 ; 88 – – 48 34 Aquarii . 88 88 ; 6 Arietis
89	χ	6	84 , 89 , 81
Lustre of the stars in Sagitta.			
1		6	1 Vulpeculæ – 1 2 Vulpeculæ , 1
2		6	2 , 3
3		6	2 , 3
4	ε	5	6 –, 4
5	α	4	5 . 6 7 –. 5 . 6 5 – 9 Vulpeculæ
6	β	4	5 . 6 –, 4 5 . 6 , 8
7	δ	4 . 5	7 –, 5 12 – 7
8	ζ	6	6 , 8 – 9 8 . 16 9 Vulpec , 8 12 Vulp . 8
9		6	8 – 9

Lustre of the stars in Sagitta.			
10		6	11, 10 . 15
11		6	11, 10
12	γ	4	12 – 7
13	χ	6	15 . 13
14	y	6	14, 15
15	Z	6	14, 15 . 13 10 . 15
16	η	6	8 . 16 –, 17
17	θ	6	16 –, 17 – 18
18		6	17 – 18

Notes to Aquarius.

2 "August 2, 1788. 20-feet reflector 2 (ε) 4.3m FL. 5.4 m." The difference amounts to one whole magnitude. In FLAMSTEED's observations no magnitude is mentioned.

6 Is less than 13, and very little brighter than 18. The former is contrary to the catalogue, and the latter inconsistent with the magnitude assigned to 18. None of these stars have any magnitude in FLAMSTEED's observations.

8 Is larger than 9, contrary to the catalogue. In the observations 8 is 6m, but 9 has no magnitude.

13 Is less than 23, and is larger than 6; both are contrary to the catalogue. There are no magnitudes of either of these stars in FLAMSTEED's observations.

23 Is larger than 13, contrary to the catalogue, and from the expression 2 – 23 (see 2) it appears that 23 is undervalued by FLAMSTEED, or has changed its lustre. FLAMSTEED's observations give no magnitude of 23.

34 Is equal to 88 Pegasi, which the catalogue has 2m. See 88 Pegasi.

35 Is less than 41, contrary to the catalogue, "Oct. 13, 1786, 5 . 6m." There is no magnitude of 35 in FLAMSTEED's observations.

40 Is larger than 61, contrary to the catalogue. This is a considerable deviation, amounting to $1\frac{1}{2}$m. In the observations 40 is 7m, 61 6m.

41 Is larger than 49 and 35, contrary to the catalogue. It is also contrary to the observations. "Oct. 13, 1786, 41 6 . 5m."

42 Is larger than 45, 39 and 53, contrary to the catalogue. The observations give 6m to 53.

43 Is less than 71. See 71. There is no magnitude to either of these stars in FLAMSTEED's observations.

48 Is less than 62, contrary to the catalogue; and is now probably less bright than it was formerly. 48 being but little brighter than 52 confirms the same. There is no observation of 48, but 62 is 5m.

59 Is less bright than 66, contrary to the catalogue. The observations give 59 6m.

71 Is brighter than 69, contrary to the catalogue. These stars are so near each other that a change must be evident, unless FLAMSTEED should have made a mistake in writing down their magnitudes. 71, 43 confirms the same conclusion. In the observations neither 69 nor 71 has a magnitude assigned.

72. There is no observation of FLAMSTEED upon this star.

78 Is less than 81, contrary to the catalogue; and in the observations it is 5m.

79 Is less than 8 Pegasi, contrary to the catalogue. The difference between 2.1m and 3m would be striking, if the lowness of the situation of 79 did not render its real magnitude very uncertain. In my estimation no allowance is made for that low situation. In the observations there is no magnitude to either of these stars.

80 There are two stars, the smallest of which agrees best with the place of 80 in Atlas, but neither of them seems to accord completely in relative situation with 81 and 82. In one of my sweeps a star, supposed to be 80, was taken with the following deduction; "Sept. 12, 1785. This star requires a correction of — 1′ 13″ in time of RA, and — 6′ in PD."

84 Is larger than 87, contrary to the catalogue. In the observations they are both 8m.

85 Is much less than 92, which does not agree with the magnitudes of the catalogue. In the observations it is marked 8m.

86 Is larger than 89, contrary to the catalogue. There is no magnitude to either of these stars in the observations.

88. "Oct. 13, 1786, 20-feet reflector, 4.3m." FLAMSTEED'S observations give it 4m.

89 Is larger than 101 and 104, contrary to the catalogue. In the observations 104 is 6m.

94 Is larger than 95, contrary to the catalogue. In the observations they are both 5m.

96. "Sept. 12, 1785, 6m." In FLAMSTEED'S observations it is also marked 6m.

Catalogue.

80 Requires — 18′ in RA, and — 6′ in PD.
The PD of 96 requires — 8′.

Atlas.

The RA of 30 requires + 1°.
72 must be out.
80 requires — 18′ in RA, and — 6′ in PD.
84 requires — 10′ in RA, and — 12′ in PD.
85 requires — 28′ in RA.
96 requires — 8′ in PD.

Notes to Aquila.

"July 23, 1781. Order of magnitude $\alpha\,\gamma\,\zeta\,\theta\,\delta\,\eta\,\beta\,\varepsilon$."

3 Is larger than 9, contrary to the catalogue. In FLAMSTEED's observations both are marked 6m.

6 and 12 are both larger than 63 Serpentis; but that star is placed among the changeable ones. See Phil. Trans. Vol. LXXVI. page 211. FLAMSTEED's observations give 3m. to 6.

13. "Sept. 3, 1784; 20-feet reflector, 13 (ε) 5.6 FL. 3.4m, but strong twilight." It is not much larger than either 11, 18, or 19, so that we may be pretty certain it must have lost some of its lustre since the time of FLAMSTEED. In his observations it is marked 4m.

20 Is less than 26 and 37, contrary to the catalogue. In the observations 20 is marked 5m.

21 Is less than 23, contrary to the catalogue. But in the observations 23 is marked 5m. The error therefore is probably in the catalogue.

24 The star I estimate is one of two small ones.

33 There is no observation of this star in FLAMSTEED'S work.

34 This star was never observed by FLAMSTEED.

37 Is larger than 20 and 51, contrary to the catalogue. The latter is marked 6m in the observations.

38 Is less than 67, contrary to the catalogue.

39 Is not much larger than 26 and 37, which will not agree with 3.4m of the catalogue; but in FLAMSTEED'S observations it is put down only 5m.

40 There is no observation of this star in FLAMSTEED'S work.

43 There is no observation of this star in FLAMSTEED'S work.

55 This star is periodical. The time of its period as given by Mr. PIGOTT, the discoverer, is $7^d\ 4^h\ 15'$. See Phil. Trans. Vol. LXXV. page 127.

56 Is much less than 57, contrary to the catalogue; but in the observations 56 is only marked 6m.

66 Is less than 42 and 58, contrary to the catalogue, and it is moreover marked 5m in the observations.

Atlas.

The RA of 23 requires — 20′.

29 Should be 30′ from 25, and 48′ from 28, on the south following side of the two stars.

The stars 33, 34, 40, and 43 should be out.

Notes to Capricornus.

"Sept. 27, 1782. Order of magnitude $\delta \beta \alpha \gamma$."

6 in 1780 was less than $\beta \gamma \delta \zeta \eta \theta \iota$.

13 Is not equal to 14 as the catalogue gives it. In FLAMSTEED's observations 14 is without magnitude assigned to it.

19 and 20 are larger than 21, contrary to the catalogue. In the observations 19 is marked 6m.

34 Is larger than 39, contrary to the catalogue. Neither of them has any magnitude given with them in FLAMSTEED's observations.

36 Is larger than 43, contrary to the catalogue. It has either been under-rated, or gained additional lustre since FLAMSTEED's time. Neither of the stars has any magnitude in his observations.

42 Is larger than 48, contrary to the catalogue. The latter has no magnitude in the observations, and the former is marked once of the 5th and once of the 6th, which may be put down 5 . 6m.

Catalogue.

The letter *e* should be added to 26. FLAMSTEED has used it in his observations, page 75.

Atlas.

31 requires about + 22′ in RA.

Notes to Cygnus.

"May 12, 1783. Order of magnitude $\alpha \quad \gamma \varepsilon \beta \delta \quad \zeta \quad \theta$."

5. There is no observation of this star by FLAMSTEED.

Page 67 a star was observed without time, but by page 71 and 122 it appears that the defective observation belongs to 2. There is a star 8 or 9m, about 50′ from 2, 1° 20′ from 9, and and 1° 30′ from 6; and calling that star 5, its brightness may be expressed by 9 – – 5.

10. "Sept. 15, 1783. 10 is at least 4m. It is larger than 13." If the authority of the catalogue be good, there can be no doubt of a change since FLAMSTEED'S time; but in his observations there is no magnitude to this star.

12 Is less than 8, contrary to the catalogue. "Sept. 7, 1784, 12 (φ) 6m." In FLAMSTEED'S observations there is no magnitude to either of the stars.

13 Is less than 32, contrary to the catalogue. But in the observations 13 has no magnitude.

17 Is less than 21, contrary to the catalogue. But in the observations neither of the stars have any magnitude.

18 Is larger than 64, contrary to the catalogue. But in FLAMSTEED'S observations neither of the stars have any magnitude.

21 Is larger than 41, contrary to the catalogue. But 21 is without magnitude in the observations.

23. The expression 13, 23 does not agree with the catalogue. But 13 has no magnitude in the observations.

27 Is less than 36, contrary to the catalogue; but in FLAMSTEED'S observations are no magnitudes of these stars.

30 Is less than 32, contrary to the catalogue; it is also contrary to the observations, which give 30 5m and 32 6.5m.

31 Is larger than 30, contrary to the catalogue. It is also contrary to the magnitudes given in the observations "Sept.

27, 1788; 20-feet reflector 30 (1st.o) 5m, FL. 4m. 31 (2d. o) 4m, FL. 5m."

34 Is a changeable star. Its period perhaps is about 18 years. See Phil. Trans. Vol. LXXVI. page 201.

38. In FLAMSTEED's observations, page 75, a star was taken without RA, marked "quæ præcedit ω." The time of this observation however is sufficiently determined by the 37 before it, and 45 and 46 just after; but there is no star visible in the space pointed out that can possibly be taken for 38. "Sept. 22, 1783, 38 lost. There is not a star of the 7, 8, 9, or 10th magnitude near the place." It therefore does not exist, or rather is lost.

41 Is less than 21, and not much larger than 52, which is contrary to the catalogue. "It is less than 4m." In FLAMSTEED's observations it is marked 4m, but 21 and 52 are without magnitudes.

48. "Sept. 5, 1784; I could not see this star, but instead of it found in the neighbourhood 2 stars of the 7th magnitude within 5 or 6′ of each other." "Nov. 15, 1795. If one of the stars be 48, its magnitude is over-rated, and must be about 7.8m. That of the two which is nearest to 49 is the largest."

59 Is less than 55, 56 and 63, contrary to the catalogue. It is also contrary to the magnitudes given in the observations: 63 is without magnitude.

66 Is larger than 78, contrary to the catalogue. See 78. "Sept. 13, 1784; 20-feet reflector 66 (υ) 4m, FL. 5m. It is larger than 54 (λ), contrary to the catalogue." Neither 66 nor 54 have any magnitude in FLAMSTEED's observations.

71 Is equal to 80, contrary to the catalogue. Neither of them has any magnitude given with them in the observations.

78 Is less than 66 and 67. "It is much too small for 3 . 4m." In FLAMSTEED'S observations I find it marked 6m.

81 Is larger than 80, contrary to the catalogue. But in the observations there is no magnitude to either of the stars. "Sept. 27, 1788; 20-feet reflector, 81 ($2^d \pi$) 3 . 4m, FL. 5m." It is either undervalued in the catalogue, or grown brighter since FLAMSTEED'S time.

P. The changeable star in the neck of the swan. Its period is 396 days 21 hours. See Phil. Trans. Vol. LXXVI. page 200. Its present lustre is 17 – – P.

Atlas.

14 requires + 1° in PD.

5 should be out.

Notes to Delphinus.

"Aug. 14, 1781. Order of magnitude $\beta\ \alpha\ \gamma\ \delta\ \varepsilon$"

9. In the catalogue it is marked 3m; in FLAMSTEED'S observations it is 6m. My expression 6 , 9 . 12 agrees best with the catalogue.

13 "Aug. 7, 1785, 6m." In FLAMSTEED'S observations it is also marked 6m.

Atlas.

12 Should be placed about 52′ more south on plate 23. It is right on plate 25.

Notes to Equuleus.

"Aug. 13, 1781. Order of magnitude $\alpha\ \begin{matrix}\gamma\\ \delta\end{matrix}\ \beta$"

6. In the catalogue we have 4m; in the observations FLAMSTEED has once marked it 6m, and once 8m. If there

be any accuracy in these various notations, the star must certainly be changeable.

Notes to Hercules.

"May 12, 1783. Order of magnitude $\beta\,\zeta\,\alpha\quad\delta\,\eta\,\pi\quad\gamma\,\varepsilon\,\mu$."

5 Is much less than 7. My edition has this star 3m; that of 1712 has it 5m. FLAMSTEED's observations give 6m, which agrees best with 7 - - 5 as I give its present lustre.

8 Is less than 16, contrary to the catalogue. But in the observations this star has been marked twice 7m, twice 6m, and once 5m.

11 Is larger than 6 and 35, contrary to the catalogue. But in the observations we have this star given twice 4m, and once 3m. It is therefore undervalued in the catalogue, or is subject to changes in its lustre.

13 Is less than 15, contrary to the catalogue. The observations give them both 6m. "May 25, 1795, 13 and 15 are both smaller than FL. gives them, and are about 7.8m."

20 Is less than 22, contrary to the catalogue. In the observations they are both 4m.

22 "May 12, 1787. 22 (τ) 3m, FL. 4m."

23 Is not much larger than 26, contrary to the catalogue. The observations give 23 6m, and 26 7m.

25. "May 16, 1787. 25 7.6m, FL. 5m." In the observations this star is also 5m.

27. By my observations the light of this star seems to be subject to change. FLAMSTEED's observations give it twice 3m, and once 2m.

29 Is less than 24 and 60, contrary to the catalogue. In the observations 24 is marked 6 and 5m; 60 is given 5m, 6m, and

4m; and 29 is put down five times 5m, once 6m, and once 4m. Very possibly this star may be changeable.

30 Is larger than 1 and 52, contrary to the catalogue. In the observations 30 is given three times 5m; 1 twice 5m, and twice 4m; and 52 twice 5m.

37 Is larger than 45, contrary to the catalogue. But in the observations we have 37 twice 6m, once 5m; and 45 twice 6m, and twice 5m.

40. From the expressions I have given of the brightness of this star, we have great reason to suppose it to be changeable. FLAMSTEED's observations give it 3m.

47 Is less than 43, contrary to the catalogue. The observations, however, give 47 three times 6m, and only once 5m.

52 Is larger than 42, contrary to the catalogue. In the observations both are twice marked 5m.

54 or 55. FLAMSTEED observed but one of these stars, once 4m, once 5m, and once 6m.

58 Is less than 103, and not much larger than 76, contrary to the catalogue. It is also contrary to the magnitudes of the observations.

62 "Is less than it is marked. I suppose it to be 7 or 7.8m." FLAMSTEED's observations give it 6m.

64. From my expression of brightness it appears that this star is changeable, and I may venture to announce it periodical. A series of observations upon it will be given when the period of the changes shall have been more fully ascertained. FLAMSTEED has but one observation of its magnitude, which is 5m.

65. This star is probably changeable, but its connected re-

ference to neighbouring changeable stars has hitherto rendered it difficult to come at the truth. In FLAMSTEED's observations it is three times 3m, and twice 4m.

67. This star is probably changeable. FLAMSTEED's observations give it twice 3m.

69 Is less than 94, contrary to the catalogue; but the magnitudes in the observations are favourable to my notation.

78 Is larger than 93, contrary to the catalogue. The latter has no magnitude in the observations, and the former is marked 6m.

95 Is less than 102, contrary to the catalogue. The observations give 95 twice 4m, and 102 once 4m, and once 5m.

99 Is less than 100, 106 and 107, contrary to the catalogue; and also to the magnitudes of the observations. It is larger than 104, which is doubly inconsistent with the catalogue, and yet the observations also give to 104 a larger magnitude.

105 Is less than 106, contrary to the catalogue. The observations give once 3m, and once 6m. "July 17, 1785; 20-feet reflector, 105 7.6m FL. 5m is visibly less than 106."

Catalogue.

In the edition of 1725, 5 (*r*) should be 5m.

Atlas.

The PD of 2 requires + 34′.
The RA of 4 requires + 16′ and the PD — 34′.
The RA of 110, 111, 112 and 113 requires + 5°.
55, 71, 80 and 81 should be out.

Notes to Pegasus.

2. The expressions 2, 16 and 2.13 shew that this star is over-rated in the catalogue. In FLAMSTEED'S observations it stands 6m.

8 Is larger than 53 and 54, contrary to the catalogue. In the observations are no magnitudes of these stars.

18 Is not sufficiently distinguished from 19 to agree with the magnitudes of the catalogue. In FLAMSTEED'S observations 18 is marked once 5m, once 6m, and once 7m; and 19 is 7m.

20. "Oct. 19, 1784, 7m." In FLAMSTEED'S observations it stands 6m.

21 Is less than 17, contrary to the catalogue. It is also contrary to the magnitudes given in the observations. If there be any accuracy in the magnitudes of the catalogue and of the observations, we ought to look upon this star as changeable; for the latter give it once 3m, and once 6m, while the former has 5m.

27. "Sept. 6, 1784, 6m." In FLAMSTEED'S observations there is no magnitude of this star.

31 Is no larger than 50, contrary to the catalogue, "Sept. 5, 1784, 6m," and "Oct. 19, 1784, 5.6m." FLAMSTEED'S observations give it twice 5m, and 50 also 5m.

32. "Sept. 8, 1784, 6.5m." In FLAMSTEED'S observations it stands once 4m, and once 5m.

42 Is less than 48, contrary to the catalogue. But in the observations there is no magnitude to 48. "Sept. 19, 1784, 48 (μ) 4.3m."

43 Is less than 56, contrary to the catalogue. It is also

contrary to the magnitudes in the observations, where 43 is 4m, 56 5m.

47. "Sept. 19, 1784, 4.3m." FLAMSTEED's observations give no magnitude.

62 Is larger than 56 and 78, contrary to the catalogue. In the observations 56 is 5m.

63 Is less than 67, contrary to the catalogue. The observations give no magnitude of these stars.

68 Is larger than 70, contrary to the catalogue. In the observations 68 is without magnitude, and 70 is 5m and 6m.

76 Is less than 74, contrary to the catalogue. In the observations both stars are marked 6m.

79. "Sept. 8, 1784, 6.7m." The observations give no magnitude.

86 Is less than 66, contrary to the catalogue, and contrary to the observations, where the former is marked 5m, the latter 5m, and twice 6m.

88 Is less than 44, contrary to the catalogue. There are no magnitudes of these stars in the observations. It is also less than 34 Aquarii, which FLAMSTEED has observed 3m, and hardly larger than 6 Arietis, which he has also observed 3m. Therefore, if the catalogue may be trusted where this star is 2m, it must have lost some of its former lustre. But I rather suppose that this star, as well as 53 and 54, have been overvalued in the catalogue.

Catalogue and Atlas.

The letter *t*, which FLAMSTEED has annexed to 31 in his observations page 57 and 130 should be added.

Notes to Sagitta.

" Sept. 7, 1781. Order of magnitude $\gamma\ \delta\ \begin{matrix}\alpha'' \\ \beta\end{matrix}$

7 Is larger than 5 and 6, contrary to the catalogue. By the order of magnitude, it appears that 14 years ago it was also larger. In FLAMSTEED'S observations 5, 6 and 7 are marked 4m.

WM. HERSCHEL.

Slough, near Windsor,
Jan. 1, 1796.