



III. Observations respecting the invention of the telescope

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the same ray in both observations as the mean one, the mean extraordinary index will be as follows :

	Mean Extr. Index.	Diff.
Rudberg.....	1·48971	
Malus.....	1·48330	641

Dr. Wollaston gives the two indices according to his measurements, as 1·657 and 1·488, which are nearer those of M. Rudberg; but as Dr. Young has assured us that the measures taken by Dr. Wollaston are *appropriate to the extreme red rays*, they throw no light upon the cause of the discrepancy under our consideration. The discrepancies, indeed, become more alarming, and will stand thus, by calling B the extreme red ray, and calculating its index from Malus's index for the middle green.

	Red Ray B.	
	Ordinary.	Extraordinary.
Wollaston ...	1·65700	1·48800
Rudberg.....	1·65308	1·48391
Malus	1·64152	1·47750

Hence it appears that Wollaston's measures are greater than those of Rudberg, and still more remote from those of Malus.

As it is impossible to suppose for a moment that either Malus or Rudberg could have committed errors of observation capable of reconciling these results, we are forced to conclude, that the experiments of each were made with crystals of calcareous spar which had different degrees of refractive power,—a conclusion which deprives us of the hope of obtaining invariable physical data for different minerals. Such a result, indeed, might have been expected from the variety of specific gravities which different specimens of calcareous spar exhibit; and all that science can hope to accomplish on this subject, is to define the general limits within which these variations are confined.

III. *Observations respecting the Invention of the Telescope.* By J. E. DRINKWATER, Esq.*

A VERY interesting article on the invention of telescopes is printed in the second and third Numbers of the *Journal of the Royal Institution*, in which it is clearly proved that John Lippershey, a spectacle-maker of Middleburg, possessed the invention on the 2nd of October, 1608: that Jacob Adri-

* Communicated by the Author:—In the first series of *Phil. Mag.* vol. xviii. p. 245, and vol. xix. p. 66, will be found two letters, with extracts from old English books, from which the writer infers that the telescope was known in England long before the period of its reputed invention.—*EDIT.*

aansz (commonly called Metius) also possessed the art of making them on the 17th of the same month, and that he then professed to have been engaged in the experiments which led him to it during two years previously; and it is advanced as probable that Hans, or his son Zachary Jansen, invented a compound microscope about 1590.

Dr. Moll, by whom this paper was communicated, has done me the honour to notice my sketch of the Life of Galileo, in which I had arrived nearly at the same results with respect to the claims of Lippershey and Jansen; although some of my statements were necessarily imperfect, from want of access to those official records, now for the first time produced from the Dutch archives. Dr. Moll has, however, thought fit to comment on some assertions of mine in terms which call for some reply on my part: this would have been attempted earlier, had I earlier seen the paper in question.

Dr. Moll has also pointed out an error committed by me in calling both Peter Borel the author of the treatise *De vero Telescopii Inventore*, and William Boreel the ambassador, by the Italian name Borelli; and a similar error in translating the Latin name of Van den Hore, whom I have confounded with his contemporary Gärtner, both using the same Latin signature Hortensius. For these, and I fear many other errors as well as omissions in that essay, I have little apology to offer, and feel nothing but obligation to those who may be at the pains to discover them. But I wish to defend myself (even when writing anonymously) from the charge which Dr. Moll insinuates, of affecting to quote from books which I know only by extracts. I protest against this practice as a dishonest one, by which stories often obtain currency and credit on the supposition that they have been examined by several authors, who in fact have merely copied one from another. I consider it essential to the truth of history that the *real* authority should be cited whenever any is given. In the only instance in my own case where I was not writing either with the original authority before me, or an extract copied out of it with my own hand, I have given a double reference (p. 58.) to the author whose statement I repeated, and to the manuscript from which he professed to have drawn his account. It may perhaps be true that Borel's book is scarce; but I found it in the British Museum, which is tolerably rich in scientific works of the sixteenth and seventeenth centuries; indeed the copy which I used there seems more perfect than the one alluded to in a note on Dr. Moll's article, for it contains a portrait of Jansen as well as of Lippershey.

Although my principal object in this communication is to

vindicate the honesty of my reference, I cannot refrain from attempting also some answer to Dr. Moll's challenge "to point out the passage in Borel's book, in which either Boreel or John the optician exhibit the least intention of throwing Galileo's discoveries into the shade." The charge I made was against the author; I have no quarrel with the ambassador, unless so far as he might be concerned in getting up the book in question; and I have Dr. Moll's own authority for stating that it was written "probably at his request, and certainly with his assistance". It is not indeed easy to convey the same impression by detached extracts, which is produced by the tone of the whole volume; but a few passages may be especially noticed. The eighth chapter contains the following remarks: "Some contend that it (the telescope) was known to Bacon the Englishman: some to Baptista Porta, who seems to have said something on the subject, but obscurely.—But the opinion of the majority has been in favour of Drebbel, Galileo, and Metius; *and they themselves do not blush to claim it*, although it may be made clear to every one by public documents that they had recourse to an artist of Middleburg, or borrowed it from him in some way." This charge is repeated with more particularity against Galileo in the next chapter: "Among this crowd of inventors first appears Galileo, *who attributed the invention to himself*, and to this hour has been puffed as the real inventor, and has exalted himself by his own praises, as appears by his petition to the States of the Republic of Holland." Borel chooses to disprove this supposed claim by quoting the Mercurio of Vittorio Siri, who relates how Galileo rediscovered the instrument on hearing that such a thing had been done in Holland. A more candid writer would have referred to one of Galileo's own statements, such as that in the Saggiatore, where he mentions "l'Ollandese primo inventore del telescopio", or he might have given precisely the same account which he has adopted from Siri, out of Galileo's *Nuncius Sydereus*. He there says, "A rumour reached me about ten months ago, that a perspective had been worked by a Belgian, by help of which objects, though at a great distance from the eye of the observer, appear as distinctly as if near: and of this certainly admirable contrivance some experiments were noised about, which some believed, others denied. The same thing after a few days was confirmed to me in a letter from Paris by James Badovere, a French gentleman, which at length occasioned that I set myself intently to examine the reason of the thing, and to contrive the means of inventing a similar instrument, in which I soon succeeded by help of the theory of refractions," &c. Borel had this passage before him; for he has incautiously printed it in another part of his

book, where he is discussing the subsequent progress of the invention; and it is not easy to imagine why it was suppressed in this place, except that it would necessarily have interfered with his plan of mentioning Galileo as one who shamelessly endeavoured to rob the first inventor of the credit due to him. In his petition to the States, nothing whatever is said about the invention of the telescope. This first instance of Borel's unfairness made me examine the rest of the book with more jealousy. In the twelfth chapter we are told that Zachary Jansen discovered the telescope in 1590, and "*immediately applied himself to the discovery of stars and other novelties*".—"This new Dædalus saw more with one tube and a single eye than did Argus or Lynceus."—"In the moon too, he was the first to discover spots; and afterwards Galileo following his example observed the same more accurately." These passages (in which the allusion to the society of *Lincei*, of which Galileo was a member, must not be overlooked,) seem to me to justify the first part of my assertion, that Borel "endeavoured to secure for Jansen and his son the more solid reputation of having anticipated Galileo in the useful employment of the invention." No one had heard of these pretended observations till Borel published his book in 1655, thirteen years after Galileo's death; nor do they rest on any proof but Borel's own declaration. There is indeed a communication from Jansen's son John, with respect to his own discoveries, but it does not contain a syllable in support of his father's. The substance of this communication is given in the fourteenth chapter, which Borel entitles, "The excellent evidence of the above-named inventors, by which the foregoing statements are supported." Dr. Moll finds fault with me for calling this statement a letter from John, and in fact it appears that it is only compiled from such a letter. I was misled by Borel himself, who, in referring to it, invites his readers to "learn what John himself has communicated by *his own letters*, though there are no means of confirming his statement by other evidence." In this occurs the following passage, amongst accounts of other discoveries which John positively claims as his own. "I have often observed the planet Jupiter, which appears round and indistinctly spherical. Near him I have occasionally found two little stars, situated at or near the upper part; sometimes also three. But generally I have seen four; and as far as I have been able to observe, they circulate continually round Jupiter: but this I leave to astronomers." This is the passage by which it seems to me that Borel intended to hint away (as far as he durst) Galileo's claim to the earliest discovery of Jupiter's satellites; and it is remarkable that this communication is given entirely without date, in a work which, being written to establish a chronolo-

gical fact, is everywhere else very particular in that respect. It certainly is not, as Dr. Moll would have us believe, a mere optician's report of the performance of his telescopes, but is "the excellent evidence", by means of which the discoveries of John and his father, "redounding so much to the credit of themselves and their country", were to be supported. What is the meaning of that remarkable expression, "there are no means of confirming his statement by other evidence"? What was it that required additional proof? As Dr. Moll most truly observes, "Thousands, certainly hundreds, saw the satellites in 1655; and why should not John, like other people?" That which struck me as remarkable was not that John should have seen them whenever he wrote, or was supposed to write, that letter, but that in 1655 Borel should think worth while to insert amongst his "excellent evidence" a declaration that he had; accompanying it with the cautious remark, that he had no proof of it beyond John's own assertion. This observation acquires additional force from the correction, for which I am indebted to Dr. Moll, that John's whole letter is not given; and therefore it is to be presumed that Borel extracted from it only that which he thought important. Surely the mere fact that Jupiter's satellites were visible in his glasses did not merit that distinction in 1655: if they were not, his trade would scarcely have found him a livelihood. If he wanted to give a proof *how much* his glasses were capable of showing, it would have been more decisive of their excellence to declare whether or not he had ever seen Saturn's satellite, then recently discovered by Huyghens, of which discovery Borel gives an account in this same book. Even in mentioning the satellites, he would have said simply, "I have seen Jupiter's satellites", and would not have given all the particulars of seeing sometimes four, sometimes two, or three, &c., unless he was speaking, or wished to be understood as speaking, of something of which he had never before heard. Mr. Dollond or Mr. Tully (if I may be allowed to borrow Dr. Moll's own illustration), should they be asked at the present day for an account of their best glasses, would scarcely think of stating that there is something like a ring round Saturn; and that, so far as they can judge, it appears to revolve about the planet: nor, if they should communicate such information to Dr. Moll, would it occur to him to quote it as "excellent evidence" of the discoveries of these gentlemen. It was not more to the purpose in 1655 to print John's remark, that, so far as he could tell, there were four satellites which appeared to circulate round Jupiter; since the fact that they did so had been indisputably established more than forty years, their periods had been calculated, and their future appearances predicted;—unless indeed there was a concealed intention of suggesting the idea at some future period, that John

had observed these stars independently of Galileo, and if independently, perhaps anteriorly.

If it be thought that I have put a meaning on this passage which it was not intended to bear, some excuse may still be found in the fact, that whether or not Borel intended to lay the foundation of a future claim, this end, which as I contend he had in view, has actually been attained. In the *Encyclopædia Britannica*, under the article 'Optics,' the following remark occurs, after the substance of Borel's account has been stated: "*This, it is probable, was the first observation of Jupiter's satellites*, though the person who made it was not aware of the importance of his discovery." In Dr. Young's *Lectures on Natural Philosophy*, the same idea has resulted from the perusal of this passage. Dr. Young says: "The first person, who is certainly known to have made a telescope, is Jansen, a Dutchman; —and one of his family discovered a satellite of Jupiter with them. Galileo had heard of the instrument, but had not been informed of the particulars of its construction: he reinvented it in 1609, and the following year rediscovered also the satellite which Jansen had seen a little before." It cannot therefore be doubted that owing to the manner in which Borel has introduced this account, John, the son of Zachary Jansen, has had the credit of the discovery given to him: it cannot be denied that Borel has claimed for Jansen himself the credit of first using the telescope for celestial observations without producing any proof of his assertion, and that he has spoken of Galileo in unbecoming terms, and has represented him, contrary to truth, and in the face of his own declaration, as denying the source whence he derived his first knowledge of the instrument. Finding the error which I have just mentioned in works of such reputation, and thinking myself also that Borel's account was artfully prepared with a view to produce that very misconception, I thought worth while to observe that John was only six years old in 1609, when the satellites were discovered by Galileo, and that therefore his claim must be put out of consideration. As to the question of Borel's intentions, on which my opinion remains unaltered, I am not so anxious to bring others to agree with me, as to show that I did not venture a random contradiction of a previous statement, without examination of the point on which I pretended to give an opinion.

I have one remark only to make on another question connected with this subject: Dr. Moll is unwilling to believe that in 1637 the Dutch were inferior to the Italian telescopes, as I asserted on the authority of Hortensius, who wrote to Galileo that none could be procured in Holland sufficiently good to show Jupiter's disc well defined, and of Gassendi, who wrote to him that he could not procure a good one in Venice, Paris, or Amsterdam. Dr. Moll does not notice Gassendi's

remark, but says that "Hortensius wanted more than could be accomplished in his time; and even now telescopes of a certain size, which show Jupiter's disc well defined, are not of every day's occurrence." The term 'well defined' will of course bear different meanings in different stages of the art: and it is probable that Dr. Moll would be dissatisfied with the performance of a glass, with which Huyghens would have been enraptured. Such expressions are necessarily comparative, and we can only attach a 'well defined' meaning to them by comparing contemporary statements. The letter of Hortensius to which I alluded contains the following passage (*Opere di Gal.* tom. ii. p. 466. Ed. Pad.): "De telescopio agere cœpimus, comperimusque nulla in Bataviâ hodie quæ tantam præcisionem polliceri queant, quanta ad eas observationes requiritur. *Solent enim etiam optimi discum Jovis hirsutum offerre et malè terminatum*, unde Joviales in ejus vicinia non recte conspiciuntur.—Omnes artifices rudes experimur, et Dioptricæ quam maximè ignaros." Galileo answered in the following terms (p. 474): "Quanto al secondo punto che è del trovarsi Telescopij di maggior efficacia di quelli che si fabbricano costì; mi pare d'aver scritto altra volta la facoltà di quello che ho adoprato io esser tale, che *mostra primieramente il disco di Giove non irsuto ma terminatissimo, non meno che l'occhio libero scorga il lembo della Luna*, e così terminati mostra ancora i Satelliti di quello." And in a subsequent letter to Deodati he says again (p. 472): "Mi vengono ancor domandati dell'istesso Sig. Ortensio i vetri per un Telescopio, i quali sieno di perfezione tale che mostrino ben terminato il disco di Giove, e chiaramente apparenti i quattro suoi Satelliti, effetto che, come egli scrive non se ha da quelli, che si fabbricano in Olanda: se me succederà prontamente il farne provisione, gli invierò a V. S. molt. Ill. insieme colle presente." C. Huyghens had made the same complaint of the inferiority of the Dutch glasses (p. 490): "Del resto i Telescopi che si fanno in queste parti non assicurandoci i quattro Satelliti di Giove, de' quali si tratta se non con certe scintillazioni le quale potrebbero impedire l'osservazione subite," &c. There is not even the pretext left that Galileo might entertain a better opinion of his glasses than others would have done; for although Gassendi was dissatisfied with the best glass he could get in Amsterdam, yet on receiving Galileo's present, he wrote (Venturi, vol. ii. p. 21): "*Eximio illo telescopio quo me beare dignatus es*, effigiari lunam procuro suis lineamentis et coloribus." These extracts show that Dr. Moll has been rather too hasty in advancing that "the assertion of the inferiority of the Dutch telescopes is wholly unsupported by proof." There are a few other trifling oversights in his valuable communication, which I forbear to notice, fearing lest my

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motive in doing so should be misunderstood: nor can I conclude without expressing the great pleasure I have derived from the perusal of his paper, which has finally settled the question of the original discovery, and thrown much light on the early history of this wonderful instrument.

Athenæum, April 24, 1832.

J. E. DRINKWATER.

IV. *On the Encouragement given to Science by the King of Denmark.*

IN various articles published in England relative to the decline of science, and the encouragement which is given to it by the Sovereigns of foreign countries, no notice has been taken of the King of Denmark, who has displayed an ardour and a liberality in the cause of science, in which he has not been surpassed, if he has been equalled, by any other prince.*

It is not our design at present to give any account of the scientific establishments which he so liberally supports in his own dominions, of his munificence to the men of science that adorn his reign, or of the honours which he has so judiciously conferred upon them. We propose to limit this notice to the instances of his liberality in rewarding and honouring the distinguished philosophers of other nations,—a species of patronage of the noblest and most disinterested description, and one of which there have been very few examples in the history of Europe. We trust that the example of Frederick VI. will be imitated by other Sovereigns; and that those who promote the common interests of their species by useful inventions and discoveries, will receive some acknowledgement of their services from every nation to which they have been beneficial.

The King of Denmark presented the late General Mudge, the Superintendent of the Ordnance Survey; General Muffling, the Director of the Topographical Survey of Prussia; Admiral Krusenstern, the celebrated Russian circumnavigator; Baron Alexander Humboldt; Baron Lindenau, &c. with gold chronometers, executed by the celebrated Danish artists Jurgensen and Keffels. These noble and appropriate gifts bore the simple inscription of "*Frederick the Sixth to Bernhard v. Lindenau*," &c. The King also presented to General Fallon, the Director of the Austrian Survey, a superb pendulum clock by Jurgensen; and he sent to our own distinguished countryman, Mr. Troughton, his gold medal, with the inscription "*Merito*."

In order to evince his high regard for foreign merit, the King of Denmark conferred the order of Dannebrog on Reichen-

* An account of the prize-medal for the discovery of a new telescopic comet, offered by the King of Denmark, will be found in *Phil. Mag. and Annals*, vol. xi. p. 155.