Use of Telescopic Sights in Astronomical Observations." In looking over this letter, we find that the number of fasciculi in Hevel's possession was not twenty-two, as stated (or at least implied) by Prof. Frisch, but twenty-nine fasciculi. One thing, moreover, is certain, that Hevel must have possessed all the MSS.; deriving them from a source where certainly they had received the highest possible attention. In perusing, therefore, the catalogue of these MSS., as given by Hevel in his letter to the Royal Society, we shall find that Prof. Frisch's hopes or expectations as to what the St. Petersburg documents may contain, can be at once answered, because Hevel could never have had *less* than what is at St. Petersburg *now*; though he might have had more, which, however, would make the case worse. A very short time, in fine, will now set the matter at rest. In regard to Kepler's life, Hevel says as follows:—"At Kepleri vitam studio conscriptam non invenio; interim plurima notatu dignissima, vitam ejus spectantia passim notavi, ex quibus vita ejus possit haud obscurè depingi. Quæ verò in specie ex scriptis ejus penes me habeo, catalogus hicce indicabit" (Ibid.). Whatever fates these MSS. might have subsequently undergone, Hevel's Catalogue must ever be considered the most complete. The extract from Hevel's letters to the Royal Society (as printed in the Phil. Trans.) does not imply any especial offer or request. But there exists among the MSS. of the *British Museum*, another document relating to these MSS., and this is an *autograph* letter of Hansch to the Royal Society; it is dated Vienna, November 20, 1734. There Hansch speaks of twenty-two fasciculi, and as this was written *after* his *Epistolæ ad Keplerum* were published, it may be presumed that seven might have merged (whether entirely or partially is not known) in this undertaking. Hansch's letter contains *also* a list of the Kepler fasciculi, but they seem to have been re-arranged, as the contents of most, as given by Hevel and Hansch, do not correspond. It is, moreover, curious that Prof. Frisch says that the *Epistolæ ad Keplerum* were all that Hansch published, while the letter in the British Museum says, "Præter Epistolas, quæ in folio charta augusta prodierunt, et Librum singularem de Calendario Gregorio quem Ratisbone 1726—in folio pariter typis imprimendum curavi—reliqua MSS. Regiam desiderant munificentiam." Hansch's letter is entirely lachrymose and supplicatory; and it is a pity to perceive that these MSS. had something ominous in them, as not only their author, but even several of their subsequent owners fell into deep distress.

Having been so far successful in my research, I resolved to see whether some of the works of Kepler, which Prof. Frisch could not discover in Germany, might not be found in our libraries, which certainly are surpassed by the richness of *especial* departments of those of the *respective* countries; and none would expect, for instance, to find more Austrian Incunabula in English libraries than there are in Vienna, &c. But taking the biographical opulence at a fair average, the balance will not be unfavourable for this small and insulated empire. The very first glance I cast in the Catalogue of the British Museum (even in its present transitory state) was encouraging, as I found No. 5 of Prof. Frisch's *Desiderata*. The full title of this little rarity is as follows:—"*Joannis Kepleri Mathematici ad Epistolam Clarissimi Viri D. Jacobi Bartschii Laubani Medicinæ Candidati Præfixam Ephemeridi in anno* 1629 *Responsio: de Computatione et Editione Ephemeridum, Typis Saginensibus* 1629." It is a small 4to pamphlet of only eleven pages, printed on paper and with a type of the then current publications of the day. The conclusion is so characteristic of the man, that we shall translate it:—"But while the storm is raging, and the shipwreck threatens public affairs, nothing remains to us but to let the anchor of our innocuous studies go down to the profound of eternity! Given at Sagan in Silesia, with our own types, anno 1628." It is known that Kepler had been in some relation with the great Wallenstein, and the place of printing is one of the possessions of the great warrior, he having been Duke of Sagan. The name of the duke is also mentioned in the contents of the work.

London, April 15, 1846.

LXIV. *On the Aberration of Light, in Reply to* Mr. Stokes.

By the Rev. J. Challis, *M.A., Plumian Professor of Astronomy in the University of Cambridge.*

To the Editors of the Philosophical Magazine and Journal.

Gentlemen,

I HAD reason to expect, when I made my last communication on the Aberration of Light, that I should not have occasion to trouble you again on this subject. Mr. Stokes's remarks in the April Number compel me to say a few words more.

I can assure Mr. Stokes that I take the aberration of light in its usual acceptation, and I have no doubt that he does also. The difference between us is not in the thing explained, but in the *principles* of our explanations. My explanation, which is very simple and brief, being entirely contained in

page 91 of the February Number of the Philosophical Magazine, does not even suppose the existence of an æther. On the contrary, Mr. Stokes's rests both on the hypothesis of an æther and on a gratuitous and very particular supposition respecting its motion. By Mr. Stokes's admission, I have shown on my principles, that if to the earth's way, as measured by an astronomical instrument, be added in the same plane an angle equal to the product of the ratio of the earth's velocity to the velocity of light and the sine of the earth's way, we obtain the direction in which light from a star progresses just before it enters the eye. By measures taken with astronomical instruments, it is found that if to the same angle in the same plane be added the product of 20″·42 and the sine of the earth's way, the mean place of the star is obtained. [The numerical quantity is that adopted in the British Association Catalogue of Stars.] Now it happens that the ratio of the earth's velocity to the velocity of light is known independently of the above-mentioned measures, by observations of the eclipses of Jupiter's satellites. Delambre states (*Abrégé d'Astronomie*, p. 493), that by very exact and extensive researches on the satellites of Jupiter, he found for this ratio 20″·25. The close approximation of these numerical values justifies me in concluding that the light from the star enters the eye, *quam proxime*, in the direction of a line drawn to the eye from the star's mean place; or, in Mr. Stokes's notation, that s_2 coincides very nearly with s. Mr. Stokes appears to be dissatisfied because this inference is not deduced by theory alone. I conceive that it is not the less certain because it is deduced from *facts*; and as Mr. Stokes does not contend that it is not *true*, I need say no more on this point.

The "confession" which Mr. Stokes says that I made, I am ready to make again. I allow that, anterior to the above comparison with the result of astronomical measures, it could not be anticipated that aberration would be wholly accounted for by the motion of the earth and the finite velocity of light, without reference to any theory of light. The comparison shows that it *is* so accounted for, and the inevitable consequence is, that any explanation which rests on a hypothetical motion of the æther, must be *fictitious*.

I really think that I have now said quite enough in defence of a very unexceptionable piece of reasoning, and if Mr. Stokes should have anything further to urge, I must decline answering it.

I am, Gentlemen,
Your obedient Servant,
J. Challis

Cambridge Observatory,
April 11, 1846.

LXV. *On the Finite Solution of Equations.*

By James Cockle, *M.A., Cantab.; Special Pleader*.*

[The subject concluded from p. 191.]

15. Let $\lambda', \lambda'', \ldots, \mu$ be n unequal integers, then it might be shown† that x^n equals

$$p_0 + p_{\lambda'} x^{\lambda'} + p_{\lambda''} x^{\lambda''} + \&c.; \quad . \quad . \quad . \quad . \quad (ae.)$$

and, hence, that‡ $\Lambda''' x^{\lambda'''} + \Lambda^{iv} x^{\lambda^{iv}}$ may be reduced to the same form (ae.). Consequently its second and third terms will amalgamate, respectively, with the first and second terms of the right-hand side of (a.) (thus becoming unavailable), and its only effective part is

$$p_0 + p_{\lambda^v} x^{\lambda^v} + \&c. \quad . \quad . \quad . \quad . \quad . \quad (af.)$$

If, therefore, the number of terms in (af.) be < 2, we shall have (*sup.* p. 132),

$$b'' = a''_2 p_{\lambda''}, \quad b' = a'_1 p_{\lambda'} + a_1'' p_{\lambda''}. \quad . \quad . \quad . \quad (ag.)$$

16. In general, then, the transformation (b.) of that page can be effected for equations of the FOURTH degree without the necessity of fulfilling (ag.); but in *critical*§ cases we are limited to the FIFTH and higher degrees, since p_0 disappears. On this account biquadratics cannot be reduced to a binomial form, as we might otherwise have inferred‖, for in such case we have, ultimately, to satisfy two homogeneous equations between two quantities of the form $\Lambda + p_\lambda$.

17. So, beyond all doubt, the transformation (o.) of p. 190 can, in general, be effected for equations of the SIXTH degree, without satisfying (ag.) by means of *one* cubic, two quadratics, and five base equations. But in critical cases we meet with the same obstacle as that mentioned in the last paragraph, and are limited to the SEVENTH and higher degrees; so that the solutions of equations of the fifth and sixth degrees present distinct difficulties¶. If they are absolutely insoluble, may we not hope, from a consideration of the modes in which they evade different proposed methods of solution, to arrive at a more elementary demonstration of the fact than has yet appeared?

On the Reduction of certain Functions.

In those cases, in which the length of the calculations is

* Communicated by T. S. Davies, Esq., F.R.S. and F.S.A.
† *Sup.* p. 191, Note *. ‡ *Sup.* p. 132. § *Sup.* p. 191, par. 12.
‖ *Sup.* p. 133, par. 5.
¶ See Sir W. R. Hamilton's "Inquiry" (cited *sup.* p. 191, Note *), p. 298, line 25, and p. 317 [9.].