XXV.—*Original Letters from* JAMES GREGORIE, *Professor of Mathematics in the University of St Andrews, to the Reverend Colin Campbell, Minister of Ardchattan, Argyleshire.*

COMMUNICATED TO THE SOCIETY OF ANTIQUARIES BY JOHN GREGORSON, OF ARDTORNISH, ESQ.

[Read, 10th January 1831.]

No. I.

St Andrews 1 *Jan*r. 1673.

SIR,

I received your of the 23 of Decr last, and am glad to have the occasion to keep a correspondence with such a knowing person as ye ar. I have not had leasur at this time to satisfie you in your problem, being drawn away all this afternoon with necessarie affairs: but with the nixt I shall doe my endeavour; for I expect not to mak the calculation considerablie short, seing the nature of the question doeth not suffer it. Our bedal his book againest Mr Sinclare is come out several weeks ago (*a*). No more at present, but being in hast, & hoping that ye will be pleased to continue this new correspondence, I rest

Your humble servant,

J. GREGORIE.

(Addressed) *ffor*
Mr Collin Campbell,
Minister at Ardchatton.

(*a*) See Note A. page 282.

No. II.

St Andrews, 6 *Janr.*
1672 [1672–3]

Sir,

Be pleased to receive here enclosed an resolution to your probleme as short & applicable to trigonometrie (*a*) as I can mak it. I thought it not necessar to follow out the operations, seeing it could doe you litle or no good, & wold require more of my time than I can spare at present. If ye doubt of anie thing in the solution, ye may advertise me with the nixt, & I shal strive to satisfie you. no more at present but desireing be all possible means to testifie my respects towards you,

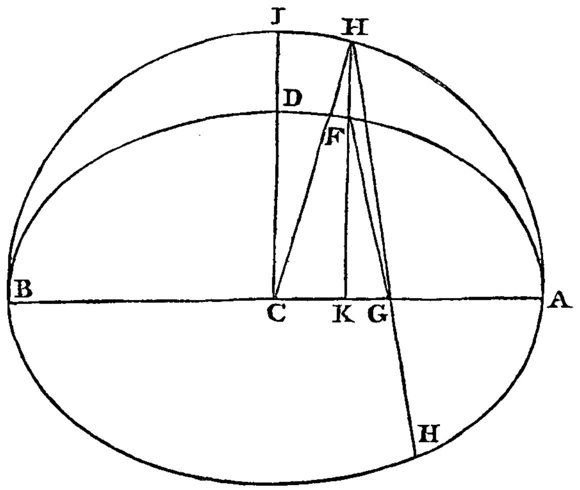
I rest

Your humble servant,

J. Gregorie.

(Addressed) *ffor*
Mr Coline Campbell,
Minister of Ardchatton.

[*In the handwriting of Mr James Gregorie.*]



In figura apposita, e datis A C, C D, C G, [angulo] F G C, invenienda sit recta F G (*b*). centro C et intervallo C A duco semicirculum A J B occurentem recte C D, producte in J; et per punctum F duco H F K ipsi J C parallelam jungoque rectas H G, H C. datur ratio H F ad F K, eadem nempe quæ J D ad D C; datur quoque ratio F K ad F G, nimirum quæ est sinus anguli dati F G K ad sinum totum: ex his igitur per unicam tantum divisionem innotescit ratio H F ad F G. habemus igitur summam angulorum F H G, F G H (nempe K F G complementum anguli dati F G C) et sinuum rationem, puta ut F G ad F H; ipsi igitur anguli ita inveniuntur. ut summa terminorum rationis sinuum ad eorundem differentiam, ita tangens semissis summæ angulorum ad tangentem semissis differentiæ angulorum. innotescit igitur angulus F G H et etiam H G C, et tandem in triangulo H C G, e datis C H, C G, C G H, facile datur angulus H C G, cujus complementi sinus est C K; cum ex hypothesi tua C H sit equalis radio 100,000: datur igitur K G; et ut radius ad secantem anguli dati K G F, ita K G ad rectam quæsitam F G, &c.

(*a*) Applicable to trigonometrie—that is, *To which trigonometry is applicable.*
(*b*) See Note B. page 283.

[*In the handwriting of Mr Colin Campbell.*]
Mr Jacobus Gregorianus, Matheseos Professor Andreapoli, mihi roganti, hujus probl. hanc solutionem invenit. 6 Jan. 1673.

No. III.

St Andrews, 11 *febr.*
1673.

Sir,

A considerable time ago I deliwered an letter to mr Grant (who gave it to your brother) directed to you: in which I resolved your problem. your brother tels me that he sent yt letter to St Johnstoun; if it can be had ther, ye may cause call for it, for I keeped no double: & I am so taken vp with other studies, that I have no leasur to doe the same thing over again. this solution of one particular case of this probleme qch ye sent to me in your last ye will find in Dr Wards (who is now bishop of Salisburie,) astronomica geometrica. no more at present but presenting my respects to you, I rest

Your humble Servant,

J. Gregorie.

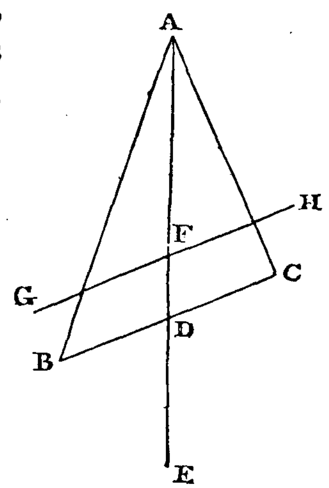
(Addressed) *ffor*
Mr Colline Campbell,
minister at Ardchatton. these.

No. IV.

St Andrews, 7. April. 1673.

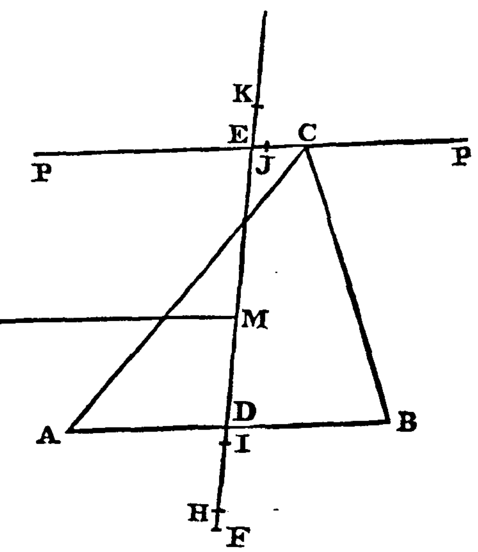
Sir,

I being in Aberdein whil your letter was given here at my house, did not receive it til the 5 of this instant that I returned. I have also received your solutions of your probleme, which are to good purpose. I easily beleive that you have not seen Wards Astr: geom: for I never yet heard of it in Scotland. that Problem, which ye propose, is the same with this. Datis tribus punctis non in directum jacentibus, invenire elipsin per data puncta transeuntem. this probleme is not determined, yea suppose ther wer 4 points; and, therefor, it suffers innumerable solutions. When it is determined, it is this, and resolved by Ward in his Ast: geom: datis quinque punctis in ellipseos peripheria, ipsam ellipsin invenire. that ye may easily see how this problem, as ye state it, is not determined, sit triangulum A B C datum, per cujus angulos transire debeat ellipseos peripheria, dividatur latus quodlibet B C bifariam in D, et producatur A D ad libitum in E, dividaturque A E bifariam in F, sitque $A\,D \times D\,E : D\,C^2 : A\,F \times F\,E : F\,H^2$; et G H parallela ipsi B C et bifariam divisa in F. evidens est ex ipsa constructione A E esse ellipseos quæsitæ diametrum transversam et G H ejusdem diametrum conjugatam: cumque A E possit capi ad libitum, modo



major quam A D, patet problema infinitas admittere solutiones. this is the most easie methode of resolving your probleme, which giveth an infinite number of solutiones, albeit not all which can be given. the more general solution giving al possible answers is this following:

Sit triangulum datum A B C, cujus latus quodlibet A B dividatur bifariam in D: ducatur lateri A B parallela ex angulo opposito C P recta indefinita, ducaturque per punctum D recta F D, secans C P in E, ita ut tam recta F D quam angulus F D B sint ad libitum, sit primo $D\,B : E\,C :: E\,C : E\,J$ et $D\,B : E\,J :: D\,F : H\,F$; sitque $E\,H : H\,F :: E\,D : E\,K$, erit K F ellipseos quæsitæ diameter transversa, quæ bifariam secetur in M; sit deinde $K\,D \times D\,F : D\,A^2 :: K\,M \times M\,F : M\,N^2$, erit M N parallela rectæ A B ejusdem ellipseos semi-diameter conjugata, cum recta D F et angulus B D F arbitrarie sumantur; evidenter patet per hanc methodum dicti problematis infinities infinitas dari solutiones. si angulus B D F ponatur rectus, inventæ diametri semper erunt ellipseos axes, quos tantum pro ellipseos diametris videris assumere.



I adde not the demonstration of this construction, it being tedious, and not werie hard to be discovered from the construction itself. this is all I am able to say to this, which can no wayes deserve these superlative applauses ye ar pleased to honor me with : however, if such speculations as these ar be pleasing to you, ye may command, according to the weakness of his capacitie,

Your humble servant
James Gregorie

(Addressed) *ffor*
Mr Colline Campbell,
Minister of the gospell
at Ardchatton.

No. V.

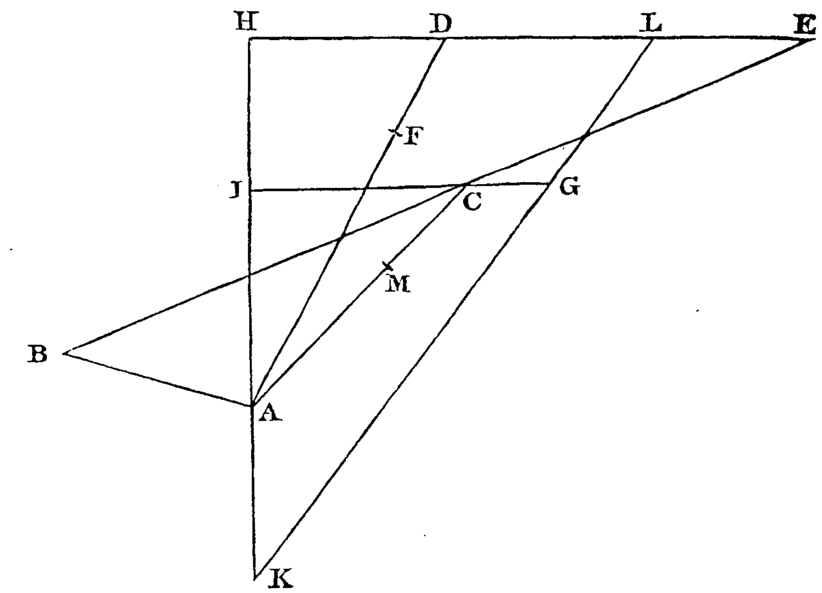
SIR, *St Andrew's*, 30 *April* 1674.

I am sorrie for my misfortun in loosing your companie whill ye wer here. It wer tedious to write down particularlie all the instruments I have brought home, yea a larger letter wold not contein all ther names & sizes, for I have of all sort : our largest quadrant is of oak, covered with brasse, 4 foot in radius and actually divided in minutes, of which we can judge $\frac{1}{3}$ or $\frac{1}{4}$: wee have two semisextans, all of brasse, 6 foot in radius, diagonally divided, in which wee can judge $\frac{1}{6}$ or $\frac{1}{7}$ of a minut. our largest telescope is 24 foot longe; which magnifys one dimension of the object 100 times *(a)*.

Your two first problems ar the same with the 27 prop : of the 8 book of Clavii geom : pract : which I beleiv yee have not seen.

This problem yee propose concerning the ellipsis is prettie subtile, but is easie ; if ye assume an circle in its place, and can be resolved by the 13 of the 4 of Euclide.

(a) The Commission granted by the Principal and Professors at St Andrews to Professor Gregory, in 1673, for purchasing these Instruments, is printed at the conclusion of these Letters, as Article XXVI.



Verum in ipsa ellipsi, sit focus A, tria puncta in ellipseos curva B, C, D : sitque A D maxima, A C (cui æqualis sit A F media, et A B, cui etiam æqualis sit A M) minima ex his oportet alterum ellipseos focum invenire. producatur B C in E, ut M C sit ad B C, ut F D ad C E : et dicta recta E D, cui productæ occurrat, ipsi perpendicularis in H, recta A H ; erit axis ellipseos quæsitus in recta A H : in quam perpendicularis cadat C J. sit L H ipsi D A, et C J ipsi C A æqualis ; productaque L G rectæ A H productæ occurrat in K, erit differentia quadratorum ab H J, D F, ad duplum rectangulj H J in D F, ut A K ad axem ellipseos quæsitum, qui ideo innotescit : estque H J ad F D, ut axis ellipseos ad distantiam focorum, quæ, etc. Non opus est ut calculum adjiciam, cum ex constructione geometrica nullo negotio colligatur ; pigeret etiam demonstrationem describere, nam plurima folia eam comprehendere vix possent.

As for observations or experiments, I dar hardlie promise anie considerable, befor the observatorie be builded : seing (whill the instruments ar keeped in the bibliotheck, wher I cannot be alon or with my own companie and conveniencie) it is hard if it be at all practicable to doe anie thing seriouslie & with exactnes.

the latitude here is 56° : 22′. the declination of the needle is 3° 35′ westward *(a)*. No further at present but y^t I am

Sir

Your most humble servant,

(Addressed) *ffor* J. GREGORIE *(b)*.

Mr Colline Campbell,

these.

Minister at Archatton.

(a) See Note C, next page. *(b)* See Note D, next page.

NOTES ON THE PRECEDING LETTERS, BY PROFESSOR WALLACE.

Note A. page 275.

The Bedals Book was a satirical piece written by James Gregory, with this Title, "The Great and New Art of Weighing Vanity: Or, a Discovery of the Ignorance and Arrogance of the Great and New Artist, in his Pseudo-Philosophical Writings, by Patrick Mathers, Arch-bedal to the University of St Andrews. To which are annexed, Some Tentamina de Motu Penduli et Projectorum. Glasgow, printed by Robert Sanders, 1672," 18mo. pp. 101.

This work was intended to expose the supposed ignorance of a Glasgow Professor, George Sinclair, by no means a despicable person. He was the Author of a work entitled *Ars Magna et Nova Gravitatis et Levitatis*, in which he described the Diving Bell, which, however, had been invented before his time. He also wrote a Treatise on Hydrostatics, and other matters of science; and, strange to say! he was the author of 'Satan's Invisible World'—a book well known to the curious in *Diablerie*. So deeply was Sinclair's mind infected with a belief in witchcraft, and the visible agency of evil spirits, that he introduced into the Miscellany Observations annexed to his Hydrostatics, the remarkable story of the Devil of Glenluce. A war of letters between the St Andrew's Masters and Sinclair began towards the end of the year 1671, and was carried on with acerbity on both sides. James Gregory would, of course, take the lead of the Masters. It is said that, besides the exposure of Sinclair's pretensions in philosophy, he had in view to chastise him for some alleged ill usage of one of his Colleagues. Sinclair, in a Postscript to his Hydrostatics, defended himself with the weapons commonly employed on such occasions in his time—a pedantic parade of learning.

Note B, page 276.

The enunciation of Colin Campbell's problem is not explicitly given in this letter. It may, however, be stated thus: Given the semiaxes A C, C D, of an ellipse, and a point G in the transverse axis, also the angle, which a line drawn from G to any point F in the curve, makes, with the axis, to find the length of that line. The solution given by Gregory is general, wherever the point G may be in either axis; but it is probable that the ellipse was supposed to be the orbit of a planet, and that G was one of the foci; then, F being the position of a planet, the angle F G C is its *true anomaly*, if G be the focus in which the Sun is placed. Or if G be the upper focus, then, according to Ward's hypothesis, it is the mean anomaly.

In the case of G being a focus, a solution more simple may be given; for, putting the transverse axis C A$=a$, the eccentricity C G$=e$, the angle B G H$=v$, the line F G$=r$, it is shewn by writers on astronomy, that

$$r=\frac{a^2-e^2}{a-e\cos. v}$$

Note C, page 282.

It may be worth while to state, that George Sinclair (mentioned in the note to the first letter) found, at or near Edinburgh, 7th November 1670, that the variation of the Magnetic Needle was three degrees and a half from the north towards the west. In the same year, Hevelius, at Dantzic, found it to be 7° 20′. Again, in the year 1734, Maclaurin found the variation to be between twelve and thirteen degrees westerly at Edinburgh; and, in the year 1823, it was found by the Writer of this Note to be $27^\circ\frac{3}{4}$.

Note D, page 282.

The publication of these Letters of James Gregory in the Transactions of a body whose object is to rescue from the ravages of time, and preserve from oblivion, every thing that can illustrate the early history of science and literature of Scotland, affords an opportunity to do him justice in regard to an important suggestion in astronomy, which is due to him, but which has commonly been ascribed to Dr Halley. That was the great advantage which astronomical science might derive from an observation of the transit of the planet Venus over the sun's disc; for this is perhaps the best of all methods by which the absolute distances of the planets from the sun, and, consequently, the magnitude of the solar system, can be determined. The importance of the observation of this rare phenomenon was indeed noticed by Kepler, who said that it would *reveal to astronomers things which perhaps they would never know otherwise.* It is not quite obvious, however, what Kepler here meant; but Gregory, in his *Optica Promota*, printed in 1663, proposed and resolved the problem, to investigate the parallaxes of two planets, from an observation of their apparent conjunction; and to his solution he adds this Scholium: *Hoc problema pulcherrimum habet usum, sed forsan laboriosum in observationibus Veneris vel Mercurii particulam solis obscurantis: ex talibus enim solis parallaxis investigari poterit.* Here Gregory shews that he was fully aware of the advantage to be derived from this rare phenomenon. I mentioned this passage in the writings of Gregory to the late Dr Hutton; and he very properly noticed it in the Life of Gregory contained in the second edition of his Dictionary.

I beg leave also here to assert for Gregory the priority of discovery of a well known series for the arc of a circle. He was the first to shew that if t denote the tangent of an arc; that arc is equal to the very simple series, $t-\frac{1}{3}t^3+\frac{1}{5}t^5-\frac{1}{7}t^7+$ &c. He communicated this series to Collins, an eminent cotemporary mathematician, in 1671, who sent it to Leibnitz in 1675, (see *Commercium Epistolicum*, &c. pp. 98 and 120); and yet it appears that Leibnitz communicated the same series to his friends on the Continent as his own discovery, and even sent it to England in 1676. The English mathematician of that period charged him with appropriating Gregory's discovery to himself; but this, of course, he denied. The distinguished mathematician, Lagrange, has ascribed the series to Leibnitz, in his *Calcul des Fonctions*, p. 68. John Bernoulli, the friend of Leibnitz, however, while he asserted that Leibnitz had found it by his own powers, admitted that it had been previously found by Gregory.

Note E, page 285.

Although, from the following Commission given to James Gregory, empowering him to erect an observatory at St Andrew's, and procure philosophical and astronomical instruments, it might be supposed that his colleagues cordially supported his views for the introduction of the study of Natural Philosophy and Astronomy into the University; yet there is good reason to believe that the reverse of this was the fact. An eminent cultivator of physical and mathematical science, distinguished also for his intimate acquaintance with the history of its progress in Scotland (Professor Leslie) found, in the course of his researches, some letters written to and from Gregory, about the time he left St Andrew's and came to Edinburgh. These he inserted in the Scots Magazine for 1810 (pages 584–6); and in a note introductory to them, he says, 'It appears from these letters 'that he encountered great opposition from the prejudices of his brother professors, who 'seem to have regarded the mathematics as exceedingly pernicious to youth; and that he 'was on that account happy to accept a call to the Mathematical Chair in the Univer'sity of Edinburgh, where his talents and pursuits were more favourably regarded.'

The correctness of this opinion seems fully established by a letter from Gregory to James Fraser, then residing at Paris: He says, 'Much honoured Sir, I received some 'days ago your very obliging letter; and not long after your arrival at Paris, I had 'another from you, to which, the truth is, I was ashamed to answer, the affairs of the 'Observatory of St Andrews were in such a bad condition; the reason of which was, the 'prejudice the Masters of the University did take at the mathematics, because some of their 'scholars, finding their courses and dictates opposed by what they had studied in the ma'thematics, did mock at their masters, and deride some of them publicly. After this, the 'servants of the College got orders not to wait on me or my Observations; my salary 'was also kept back from me; and scholars of most eminent rank were violently kept from 'me contrary to their own and their parents' wills, the Masters persuading them that 'their brains were not able to endure it. These and many other discouragements oblig'ed me to accept of a call here to the College of Edinburgh, where my salary is here 'double and my encouragements much greater.'