1985-05-29
UPPSALA

1985
180

MATHEMATA

FESTSCHRIFT FÜR HELMUTH GERICKE

STEINER

BOETHIUS

TEXTE UND ABHANDLUNGEN ZUR
GESCHICHTE DER EXAKTEN WISSENSCHAFTEN

BEGRÜNDET VON JOSEPH EHRENFRIED HOFMANN
FRIEDRICH KLEMM UND BERNHARD STICKER

HERAUSGEGEBEN VON MENSO FOLKERTS

BAND XII

FRANZ STEINER VERLAG WIESBADEN GMBH
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Ivor Grattan-Guinness

A PARIS CURIOSITY, 1814: DELAMBRE'S OBITUARY OF LAGRANGE, AND ITS 'SUPPLEMENT'*

1. The Occasion

Lagrange, the most eminent mathematician of his day, died in Paris on Saturday, 10 April 1813. The next Monday, at the weekly meeting of the mathematical and physical class of the *Institut de France*, there was announced next day's burial service at the church of St.Gênéviève[1], where Lacepède and Laplace gave speeches[2]. A few obituaries were quickly written: Biot and Poisson produced a short anonymous one for the newspapers[3], and the doctors Virey and Potel wrote an interesting piece, which included an account of Lagrange's medical history and presented his autopsy[4].

The principal tribute, however, was prepared by Delambre, as *secrétaire perpétuel* for the mathematical sciences. He read his obituary, together with one for the physicist Malus (who had died in 1812), at a public meeting of the class on 3 January 1814. A fortnight later extensive extracts appeared in the official newspaper, the *Moniteur universel*[5], and were reprinted in the February issue of the *Magazin encyclopédique*[6]. The full text, consisting of a slightly revised version of the 1814 printing together with a long extra passage surveying several of Lagrange's published papers, appeared in 1816 in the 'Histoire' department of the *Mémoires* of the class for 1812[7]; and it is this version which is usually discussed and cited. Our concern, however, lies with the *Moniteur* edition; for it stimulated a remarkable response.

About five weeks after the printing of the extracts, the

Folkerts/Lindgren, Hg.: Mathemata
Festschrift für Helmuth Gericke (Reihe „Boethius", Bd. 12)
Franz Steiner Verlag Wiesbaden GmbH – Stuttgart 1985

Moniteur for 26 February carried a short letter to the editor, dated 10 February, 'followed by some remarks, and by a supplement to this obituary'[8]. In the letter the writer praised Delambre's efforts, but then claimed that 'I believe to have noticed an error on a point which has some importance, while on a small number of others, which have much less [importance], I would have desired more exactitude [or] not to find subject matter to doubt'. To back up his remarks, 'The advantage that I had to see Lagrange close to [*voir de près*] for several years, is a guarantee of their authenticity, and makes me think that they will be read with interest by lovers of geometry'[9]. The signature was given simply as 'L.B.M.D.G.'.

There followed more than two pages, in 85 column inches, of extraordinary material[10]. G.described certain features of Lagrange's life and achievements; but he interlaced them with alleged quotations from Lagrange's conversations with him and quotations from letters from Euler to 'a French *savant*'. Further, the text was adorned by fourteen footnotes; note (a) by 'the editor of the *Moniteur*' with notes (b) - (g) by 'the editor', some with mathematical content; notes (1) and (2) unsigned; and notes (3)-(7) by 'the author of the letter' (the last requiring a footnote of its own), again sometimes discussing mathematics. In the final section below I discuss the autorship(s) of the text; for now I describe and quote from its content. For convenience I shall use the word 'letter' to refer to the *full* document, and use 'G.' as the name(s) of its author(s).

2. Some Details of Biography

It will be useful here to recall Lagrange's life and works briefly. Born in Turin in 1736, he rapidly became attracted to algebraic aspects of mathematics, and adopted positions involving the algebrisation of branches of the subject: the calculus founded on the Taylor-series expansion of a function, and also enriched by the calculus of variations on his own highly algebraic form with the δ operator; dynamics founded

as far as possible on the principle of least action, and then reduced to statics via d'Alembert's principle and the principle of virtual velocities. Many of his individual case studies followed or used principles of these kinds. The results included the Lagrange series and various related expansions and summations; contributions to the general theory of ordinary and partial differential equations; important results in the propagation of sound, potential theory for spheroids, the three-body problem and the stability of the planetary system; and many related themes. Number theory, probability and the theory of equations were among the other branches of mathematics to benefit from his attention, again often with an algebraic slant[11].

Lagrange left Turin to succeed Euler at the Berlin Academy in 1766, and then moved to Paris in 1787. While in Berlin, he wrote his *Méchanique analitique*, which was published in Paris in 1788; and after the Revolution he taught at the *École Normale* and the *École Polytechnique* for a time in the 1790s. For the latter school he prepared textbooks on the calculus, especially the *Théorie des fonctions analytiques* (1797) and the *Calcul des fonctions*, which came out in various different editions in the 1800s. When he died in 1813, his 78th year, he was revising his books; the first volume of the second edition of the *Mécanique analytique* (as it was now called) came out in 1811, and the second edition of the *Théorie* appeared in 1813; but the second volume of the *Mécanique* was published only posthumously in 1815, under the care of Binet, Garnier, Lacroix and de Prony[12].

Let us turn now to some of the details raised by G. in the remarks attached to his short letter. The first two concerned Delambre's account of Lagrange's youth: firstly, that Lagrange was inspired by a paper by Halley to take up 'modern analysis'; secondly, that he was already a professor at the Turin Artillery School at the age of 16. Footnotes (a) and (b) dealt fairly convincingly with these details[13], claiming that Lagrange mentioned the first himself at a meeting of the *Bureau des Longitudes*, and citing the Biot/Poisson piece and Lagrange's conversation with the chemist Chaptal (which Delambre had cited) on the second[14].

G. also found 'but little intelligible' Delambre's account of Lagrange's early mathematical discoveries, since it confused the calculus of variations with the principle of least action. He then quoted from pertinent texts by Euler and Lagrange distinguishing these two theories, and the 'principle of virtual velocities' from both. He won this round: footnote (c) from the editor apologised for the condensed character of the *Moniteur* extract, and referred the reader to the (still unpublished) full version, which in fact was nearly the same[15].

The next criticism was another detail of biography. Delambre had written that Lagrange had been attacked '*only on one occasion*. It would be better to say: *only by one person*', recommended G., recalling that 'Fontaine attacked Lagrange in the *Mémoires* of the Academy on two occasions: in 1767, on the method of variations, and in 1768, on the solution of the problem of tautochrones', and he recalled also Lagrange's two replies at the time[16]. The editor agreed in footnote (d) of the letter[17].

'After these observations, for the most part quite meticulous, let us pass to the supplement which we have promised', continued G., 'and recall faithfully what a long association [*fréquentation*] with this great geometer has permitted us to gather from his conversation'[18]. Then began the most important part of this letter. While the claim of veracity is exaggerated -- in particular, the implied verbatimhood of the quotations from Lagrange, some of which are long, may only reflect a convention of the time -- I see no reason to doubt the basic truthlikeness of their content.

G. began with Delambre's quotation from Lagrange: 'If I had had a fortune, I would probably not have made my profession [*état*] in mathematics'. This seemed to G. to be believable, for he recalled an occasion when Lagrange had met 'a young man devoting himself to the exact sciences with much ardour', and upon asking him 'Do you have a fortune?' and receiving a negative answer had replied: 'so much the worse, sir. The lack of fortune and of the existence it can give in the world, is a constant stimulus which nothing can replace, and without which one cannot

bring to hard tasks all the necessary progress [*suite*]'[19]. Lagrange had a reputation for miserliness -- 'Lagrange saves' was a phrase used around town -- but he did have to support his brother living in his home city of Turin[20]. However, he must have died quite a wealthy man, with his various scientific appointments and his Senatorship.

Some of Lagrange's remarks bore on the learning and teaching of mathematics. This author of a standard treatise on mechanics and two major textbooks on the calculus felt 'sorry for the young geometers who have such thorns to swallow. If I had to start again, I would not study: these large *in*-4° would make me too scared'. He proposed instead a one-volume reprint of original works of the calculus by Fermat, Leibniz, l'Hôpital and especially John Bernoulli's lectures on the integral calculus, together with another volume comprising items by Euler and d'Alembert[21].

It is said that Lagrange was not a very good lecturer[22]. G. remembered that his 'researching intelligence' could cause sudden lapses in conversation[23], and described the effect on his lectures at the *École Polytechnique*[24]:

> *Who has not seen him suddenly interrupt himself thus in the lectures which he gave at the École Polytechnique, appearing sometimes embarrassed like a beginner, leaving the blackboard and coming to sit down opposite the audience, while teachers and students, confused on the seats* [bans], *expected in a respectful silence that he would have led his thought back from the spaces that it had gone to travel through*[25]!

3. Some Details of Autobiography

After reporting Lagrange's disinclination to advise others on their researches, G. presented a lengthy passage in which he described his methods of working:

> *It is not that I could not have spoken of them, just like another; for I believe to have reflected well early* [*in my life*] *on the best route to follow in the study of analysis,*

and I made for myself a certain number of principles which I have always followed faithfully, and which I am going to tell you:

I never studied only one work at the same time; but if it was good, I read it until the end.

I never bristled up at first against difficulties, but I left them to come back to later [,] twenty times if necessary; if after all these efforts I did not understand well, I sought how another geometer had treated that point.

I did not leave the book that I had chosen, without knowing *it, and I passed everything that I knew well when I met it again.*

I regarded as quite useless the reading of large treatises of pure analysis: too large a number of methods pass at once before the eyes. One should study them in works of application; one judges their utility and appraises the manner of making use of them. For me, it is to the application that one should acknowledge above all to give one's time and trouble; and it is necessary to limit oneself, in general, to consulting *the great works on the calculus, unless one encounters methods which are unknown or surprising in their analytical use.*

In my reading I reflected principally on what could have guided my author to such or such a transformation or substitution, and to the advantage which resulted from it; after that I sought if some other would not have succeeded better, in order to accustom myself to practising ably this great method of analysis.

I always read with pen in hand, developing all the calculations, and exercising myself on all the questions that I encountered; and I regarded as an excellent practice to make an analysis of the methods, and even an extract of the results, when the work was important or esteemed.

From my first stages I sought to investigate thoroughly certain subjects in order to have occasion to invent; and to make theories mine, *as much as possible, on essential points, in order to engrave them best in my head, to make them my own, and to exercise myself on the composition.*

I took care to return frequently to geometrical considerations, which I believe very appropriate to give to the judgement of authority and clarity [donner au jugement de la force et de la netteté].

Finally, I never *failed to give myself each day a* task *for the morrow. The spirit is lazy: it is necessary to obstruct its natural laxity and to hold it spellbound in order to develop all its forces and to have them ready as needed; there is only practice for that. It is still a good habit to do, as much as one can, the same things at the same hours, reserving the most difficult of them for the morning; I have taken this from the king of Prussia, and I have found that this regularity makes the work little by little easier and more agreeable*[26].

Of the end product, the publications, G. reported Lagrange as repenting 'for not returning more often to those parts which offered errors to correct or omissions to repair'. He quoted Lagrange as saying: 'I have not done it, because it was the habit of d'Alembert and because one made fun of him for it; but in addition I allowed myself to inflate well important discoveries which were the consequences of my papers'. Among these papers, apparently the one which G. 'saw him show esteem the most frankly' was his paper on elliptic integrals published in 1784[27].

This choice may seem surprising; so also is the penultimate paragraph of the long quotation above, for the alleged emphasis placed by Lagrange on geometrical considerations. As was stressed at the head of section 2, algebraisation was very much his style, and in it the geometrical was not normally allowed to enter. ('One will find no diagrams in this work', from the preface to his *Méchanique analitique*, is a famous example.) For geometrical traditions in 18th-century mathematics one would think of men such as Euler; and here the letter provides some more surprises.

4. Some Judgements of Contemporaries

Lagrange expressed opinions to G. on various contemporaries, especially Euler. His published writings are often politely described as 'reserved' concerning Euler; one can be forgiven for wondering if he wanted to denigrate Euler's achievements[28]. By contrast, in these farewell thoughts we find the following quotations:

> *One would do well, [if] true amateurs will have always to read Euler, because in his writings everything is clear, well said, well calculated, because they teem with good examples, and because it is always necessary to study in the sources...*
>
> *From my first studies, I had conceived a passionate admiration for d'Alembert, and I have always conserved it, because it is he who has made the most of brilliant discoveries. However, I agree [conviens] that one will rather study Euler at all time, and with reason, because he has written well. Those are my two great men, the ones whom I esteem the most after Newton; but everybody cannot be as lucky as Newton...*
>
> *Study Euler, and apply yourself to resolving all the problems that you will encounter, for in [merely] reading the solutions of another, you will not perceive either the reasons he has had for turning this or that way, or the difficulties which he has found in his passage...*
>
> *If one wants to be a geometer, it is essential to study Euler*[29].

The last judgement is particularly striking. G. placed it at the end of his letter as reporting the end of a conversation on dynamics, where Lagrange remembered learning not only dynamics but also the integral calculus from Euler's *Mechanica* (1736). From it he was able to ready Newton's *Principia* more easily. 'Read it with care, therefore', he advised of Euler's book,'as well as the beautiful theory *of the motion of solid bodies* which is the successor to it'[30].

Lagrange's 'passionate admiration' for d'Alembert, reported in the second paragraph of the above quotation, is more to be expected, since Lagrange's love of algebrising was a development of some of d'Alembert's tendencies. But G. had a surprise for us here, too. Delambre had quoted, among other things, a letter of 1759 from Euler to Lagrange praising his work and had spoken of Euler 'then holding the sceptre of mathematics' when Lagrange began his researches[31]. G. replied with three extracts from letters written by Euler to 'a French *savant*, in the years 1752 and later', in which Euler praised d'Alembert's studies of precession and nutation and his lunar theory; and in footnote (3) he added a passage from a letter of 1763 in which Euler expressed his pleasure at d'Alembert's assumption of the presidency of the Berlin Academy and help in obtaining a post for his (Euler's) eldest son Jean[32].

These are the most surprising passages in G.'s letter; seemingly the first publication of the extracts, and presented without indication of addressee or their current location[33]. And the 'editor' of the *Moniteur* complicated the text still further, for to the remark on Euler holding the sceptre of mathematics he chimed in with footnote (f), feeling that Euler's 1759 letter to Lagrange, in being

> *addressed to a friend of d'Alembert* [,] *would not be the very exact expression of the sentiments of Euler. One sees there, however, that he believes himself* [*to be*] *in the state* of discovering everything, if he could know some little thing of the method of d'Alembert; as little as would do. *Some living geometers, who knew d'Alembert, doubt a little the pleasure that Euler would have felt in seeing d'Alembert at the head of the* [*Berlin*] *Academy. Euler was the geometer of whom Lagrange spoke with more admiration, and among the French geometers of that period, Clairaut was the one whose calculations he adopted with more confidence and without thinking himself obliged to verify them*[34].

Lagrange could be sharp-tongued at times, apparently. Of a colleague whom G. did not identify but which the context

suggests might be Monge, he said one day: 'see this diagram [*dia...*] of ***! with its application to the generation of surfaces, he will be immortal, he will be immortal!'[35] But his sharpest remarks were directed at another follower of d'Alembert: Condorcet. G. quoted Lagrange's opinion that Condorcet 'Has done passable [mathematics] only [in] his first work, that his other productions were mediocre or bad, and that he did not integrate a new [differential] equation in all his life; that he would have spoiled analysis if one had let him do it, and that it would become a complete barbarism in his hands'[36]. According to G., it was Condorcet's desire to see 'direct methods of integration' (presumably in preference to Lagrange's own interest in general theory and in variational methods[37]) that motivated the ire.

G. quoted or reported opinions issued by Lagrange on certain aspects of mechanics which were not mentioned in Delambre's obituary. Lagrange criticised d'Alembert for claiming that 'the question of *live forces*' (that is, energy conservation) was only a question of words[38]. On perturbation theory, he offered a witticism:

> *It seems that nature had disposed these orbits [of the heavenly bodies] specially so that one may calculate them. Thus the* [sic] *eccentricity of the planets is very small, and that of the comets is enormous. Without this disparity [,] so favourable to approximations, and if these constants [of the orbits] were of an average magnitude,* goodbye geometers; *one could do nothing*[39].

G. then reported that Lagrange felt

> *some unease on the imperfection of the methods of approximation employed in physical astronomy, and appeared to fear that they would become a kind of mine from which one could draw more or less what one would like. But he hardly ever manifested such doubts but in a low voice, so to say, and accompanying them with several* I do not knows[40].

These doubts were well put; for an interesting feature of mathematical astronomy during the early 19th century is that the French tended to produce ever longer, and thereby more "exact"

solutions, and so lost some of the initiative to German approximative methods, introduced by Bessel, Encke, Gauss, Olbers and others[41]. In ways such as this Paris was to lose some of the dominance of mathematics which it had enjoyed for some decades, not least for having had Lagrange there.

5. The Author?

G.'s various comments and quotations complemented, and occasionally contradicted, the picture of Lagrange presented by Delambre in the *Moniteur* version of the obituary. Some other nice details decorated his text. For example, he reported that 'in our civil troubles' (presumably of the Revolution) Lagrange had 'burned nearly all his papers and his correspondence' except his letters from d'Alembert and Euler[42]. In his last footnote he called for 'the publication of a *selection* of the most important papers of Lagrange' which were at present 'dispersed in several academic collections that it is difficult and sometimes impossible to obtain'[43]. In the end an *Oeuvres*, more or less *complètes*, was produced, but not for many decades; when it began to appear, in 1867, the full version of Delambre's obituary was placed at its head[44].

Perusal of that complete text, first published in 1816, shows that Delambre had made hardly any use of G.'s letter: for example, even the detail concerning 'one person' rather than 'one occasion' over Fontaine, described in section 2 above, was unaltered[45]. The efforts of G. were largely in vain. But who was he? The question was raised, but not answered, in the only reaction of the time of which I am aware: the eccentric Polish-born mathematician and "philosopher" Hoëné Wronski, who reprinted the letter in one of his high-flown metaphysical discourses on mathematics[46]. Here is my own tentative solution to the question that he posed.

Note first the frankness of some of the statements (on Condorcet in section 4, especially) and also the substantial amount of autobiography. G. must have been a person of some standing and intimacy fit to be given such information by an introvert

such as Lagrange, and also to want to have it made public so soon after Lagrange's death. One person who is ruled out is the chemist Chaptal, for his reminiscences appear in Delambre's obituary, as was mentioned in section 2[47]. But his professional colleague Guyton de Morveau seems a likely candidate, for two reasons..

The first concerns the initials, L.B.M.D.G., a light anagrammisation of Louis Bertrand Guyton de Morveau, eminent in chemistry as was Lagrange in mathematics, born almost a year after Lagrange (and to die three years later, in 1816). I know of no other *savant* of the time who carried these initials; and it seems most unlikely that anyone else would choose them and endanger such easy mis-identification with an eminent man of science.

The second reason is related to the full version of Delambre's obituary; for when it appeared in the *Mémoires* in 1816 it was followed by five paragraphs of 'Notes furnished by M. Guyton-Morveau'. Although in content they did not relate to that of the *Moniteur* letter[48], their existence shows his friendship with Lagrange and his interest in the obituary. It is a pity that they were omitted when it was reprinted in Lagrange's *Oeuvres*.

However, the identification of Guyton as G. cannot be the full answer, since many parts of the letter, and several of both series of footnotes, reveal mathematical competence which he could not possibly have displayed. There must have been an editor, or even ghost-writer, of the text following G.'s brief opening letter; and moreover, someone with historical interest enough to appraise the 18th-century developments in which Lagrange had played a role. Biot and Poisson, the authors of the anonymous obituary mentioned in section 1, seem to be good candidates; but in fact authorship was claimed in 1819 by the Swiss-born mathematician Maurice, who had been a good friend of Lagrange[49]. Even then, it is not clear if he was the *sole* recipient of the opinions stated by Lagrange or whether Guyton (and/or others) contributed some; or if he wrote the mathematical footnotes in the series (a)-(f) attributed to 'the

editor of the Moniteur' (it is most unlikely that the newspaper employed someone capable of writing them). These were the uncertainties which prompted me to refer conventionally to 'the' author, and call him 'G.', in the above account; I do not doubt that Maurice is the principal source.

This letter is one of the most interesting pieces that has been written on Lagrange. Its rapid demise is astonishing, therefore[50]; but he himself would have been pleased. For, according to Biot's later reminiscence, Lagrange was burning some of his manuscripts one day[51], and said:'I do not want to make posthumous works'[52].

FOOTNOTES

* For HELMUTH GERICKE and LUDOVICO GEYMONAT, on the occasion of their 75th birthdays.

1. *Procès-verbaux des séances de l'Académie ... 1795-1835*, 10 vols. (1910-22, Hendaye), vol.5, 197. POINSOT was elected as LAGRANGE's successor in May (pp.210, 217-219).
2. *Mon. univ.*,(1813), 405-406.
3. *Journal de l'Empire*, 28 April 1813; reprinted in *Mon.univ.*, (1813), 482, and then in BIOT's *Mélanges scientifiques et litteraires*, vol.3 (Paris, 1858), 117-124 (where the authors were identified).
4. J.J.VIREY and POTEL, *Précis historique sur la vie et la mort de JOSEPH LOUIS LAGRANGE* (1813, Paris). P. COSSALI must have rapidly written the lengthy *Elogio di Lagrange* (1813, Padova) of his Turin-born compatriot, for it was received by the class in August (*Procès-verbaux* (fn.1),241).
5. J.B.J.DELAMBRE,'Notice historique sur la vie [*sic*] et les ouvrages de M.MALUS et de M. le comte LAGRANGE, lue dans la séance publique de la classe des sciences de l'Institut impérial, le 3 janvier 1814', *Mon.univ.*, (1814), 63, 67-68, 69-71,73-75 (issues for 16-19 January: MALUS in the first, LAGRANGE in the other three). It is cited by page and column numbers below, thus:'*Mon.*, 67(3)'.
6. J.B.J.DELAMBRE,[*ibid.*],*Mag. enc.*, (1814), vol.1, 335-345 (MALUS), 346-393 (LAGRANGE). The text seems to be identical with that in the *Moniteur*; I do not cite it in later footnotes.
7. J.B.J. DELAMBRE, [*ibid.*, to 'LAGRANGE'], *Hist.cl.sc.math.phys. Inst. France*, (1812) pt.2 (pb. 1816), XXVII-XXXIV (MALUS), XXXIV-*LXXVIII (LA*GRANGE). The LAGRANGE manuscript is at *Bibliothèque de l'Institut*, ms.2041; the text was reprinted unaltered in content in LAGRANGE's *Oeuvres*, vol.1,IX-LI, and this version is cited by page number below thus: '*Hist.*,XI'. The extra part mentioned in the text here occurs at pp.XXV (line 13 d)-XXXIII(line 3u); the paragraph bridging pp.XIII-XIV, on the theory of wind instruments, was also new. There were many alterations of punctuation and sentence construction, and some minor technical revisions. A few of the latter reflected the slight changes in political situation between 1814 and 1816, especially at p.XLVI (line 7d) where 'the *savants* were honoured in France' was felt to improve upon 'the EMPEROR loved and honoured the *savants*' (*Mon.*, 74(2)). See also fn.45 and text, and fn. 47.

8. 'Lettre à M.le Redacteur du *Moniteur universel*, sur l'éloge de LAGRANGE, par M. DELAMBRE, publié dans les N^os^ de ce journal des 17, 18, 19 janvier 1814; suivie de quelques remarques, et d'un supplément de cet éloge', *Mon. univ.*, (1814), 226-228. I cite this item below by page and column numbers thus:'"Lettre",226(3)'. When quoting LAGRANGE from the letter, I omit G.'s interpolations ('he added', and the like).
9. 'Lettre', 226(2). We recall that 'geometry' had the same snob connotation as 'geometer' to refer to mathematics as a whole, above the level of calculators' mere 'mathematics'.
10. For those who prefer French Revolutionary measures, this is around 215 centimetres. The full text is around 6,000 words.
11. A valuable bibliography of LAGRANGE's publications is furnished in R.TATON, 'Inventaire chronologique de l'oeuvre de LAGRANGE', *Rev.d'hist. sci.*, 27 (1974), 3-36.
12. This second volume appeared, therefore, between the *Moniteur* and 'Histoire' versions of DELAMBRE's obituary; the former has information on its preparation lacking from the latter. Apparently at LAGRANGE's death the printing 'of it is now at the 26th folio of the second volume' (*Mon.*, 74(1)); DELAMBRE's 1816 text reads, in updated form, 'suspended for a long time, was completed only in 1815' (*Hist.*,XLIV). Further on, the inaccurate 1816 insertion '(This volume was published in 1816)' (p.XLVI) replaced these two 1814 sentences (*Mon.*, 74(2)):

    > *we gather at this instant that the countess LAGRANGE has just given over to M.PRONY the complete manuscript of the second volume, where one will find important additions and completely reworked sections. With the attention of an editor as clever as [he is] devoted to the memory of the author, the* savants *are assured of having it as accurately and as quickly as possible, which must complete the work, and perhaps some totally unknown papers.*

    In fact, the manuscript was not complete; LAGRANGE had died while rewriting the ninth section on rotating bodies. It was completed from the previous text by the editors, who also reprinted the closing two sections on hydrodynamics. Some use was made of manuscripts in preparing the volume; on the *Nachlass*, see fn.51.
13. *Mon.*, 67(1); *Hist.*, X; 'Lettre', 226(2), where the remark in footnote (a) suggests that the HALLEY item was 'An instance of the excellence of the modern algebra, in ... finding the foci of optick glasses universally', *Phil.trans.Roy.Soc.London*, 17 (1691-93: pb. 1694), 960-969. G. went on to record LAGRANGE's early reading, including EUCLID and CLAIRAUT's *Élémens d'algèbre* (1746); 'then, *in less than two years*, he read in the order in which I announce them': AGNESI's *Instituzioni* (1748), EULER's *Introductio* (1748), JOHN BERNOULLI's lectures (see fn.21), EULER's *Mechanica* (1736), NEWTON's *Principia* (books 2 and 3), D'ALEMBERT's *Traité de dynamique* (1743), BOUGAINVILLE's *Traité de calcul-intégral* (1754-56), and 'finally' EULER's *Differentialis* (1755) and *Methodus inveniendi* (1744).
14. CHAPTAL's notes on the conversation with LAGRANGE are kept with the DELAMBRE manuscript cited in fn.7 above. They were quoted by DELAMBRE in *Mon.*, 74(1-2); *Hist.*, XLIV-XLVI.
15. *Mon.*, 67(2)-68(1); *Hist.*, XV-XVIII; 'Lettre', 226(3)-227(1). While not really confused, DELAMBRE's text is too brief. On the relevant history of the calculus of variations, see H.GOLDSTINE, *A History of the Calculus of Variations* (1980, New York), chs.2 and 3; and on least action and virtual velocities, see G.FRASER, 'J.L.LAGRANGE's early contributions to the principles and methods of mechanics', *Arch.hist.exact sci.*, 28 (1983), 197-241.

16. *Mon.*,70(2). For some background on this dispute, see J.L.GREENBERG, 'ALEXIS FONTAINE's "fluxio-differential method" and the origins of the calculus of several variables', *Ann.sci.* 38 (1981), 251-290 (pp.283-286).
17. 'Lettre', 227(1).
18. *Ibid.* The conversations are not dated.
19. *Mon.*, 67(1); *Hist.*, X; 'Lettre', 227(1).
20. Letters from LAGRANGE to his brother survive in the *École Polytechnique* Archives, LAGRANGE collection, with some other materials. He does not seem to have felt family ties strongly; for example, the invading French forces entered Piedmont in 1798-99 and drank his toast with his nonagenarian father, who had not seen him for 32 years ... (see *Mon.univ.*, (an 7), 389,464).
21. 'Lettre', 227(1-2). LAGRANGE's writings show that he had a notable interest in the history of mathematics; here he anticipated the conception of the *Ostwald Klassiker* series. The EULER items were specified only as 'on the motions of rotation (Berlin, 1758)' (reprinted in *Opera omnia*, ser.2, vol.8, 178-312), while D'ALEMBERT's dealt with 'some methods of the integral calculus (Berlin, 1748)' (presumably his first papers on the vibrating string problem: *Mém.Acad.Berlin*, 3 (1747: pb. 1749), 214-253).
22. According to FOURIER's remarks at the time (1795), as a student at the *École Normale* (see A.CHALLE, 'Lettres de JOSEPH FOURIER', *Bull.Soc.Sci. Hist.Nat.Yonne*, (1) 12 (1858), 105-134 (p.116).
23. The expression ('intelligence rechercheuse') of the Revolutionary leader HÉRAULT DE SÉCHELLES, in 'Lettre', 227(3).
24. For most interesting reminiscences of LAGRANGE's involvement with the *École Polytechnique*, and the inferior educational efficacy of his algebrised calculus to the LEIBNIZian approach using differentials, see R.de PRONY, 'BRUNACCI', *Biog.univ.anc.mod.*, vol.59 (1835), 363-367 (p.365). This article was reprinted in some later biographical editions. DELAMBRE was similarly reserved about LAGRANGE's approach (*Mon.*, 74(3); *Hist.*, XLIV).
25. 'Lettre', 227 (3).
26. 'Lettre', 228 (1-2); the mention of the King of Prussia at the end refers to LAGRANGE's period at the Berlin Academy. In footnote (6) G. said that this whole passage was said by LAGRANGE during one evening.
27. 'Lettre', 228 (1). His paper is 'Sur une nouvelle méthode de calcul intégral ...', *Mém.Acad.Roy.Sci.Turin*, 1 (1784-85), pt.2 (pb.1786), 218-290 (also in *Oeuvres*, vol.2, 253-312).
28. For example, in his *Méchanique analitique*, 1st ed. (1788, Paris) LAGRANGE attributed to MACLAURIN EULER's proposal to use NEWTON's law along each Cartesian co-ordinate direction appropriate to a physical situation (p.165), and deprecated EULER's contributions to the principle of least action after discussing only one of his relevant papers (pp.188-189). LAGRANGE's praise of EULER, quoted here, is not appraised in R.TATON's interesting study of 'Les relations d'EULER et de LAGRANGE',in [E.A. FELLMANN (ed.)], *Leonhard Euler 1701-1783* (1983, Basel), 409-420.
29. 'Lettre': in turn, 227(1), 227(2) (on NEWTON compare p.227(3); *Mon.*, 70(1); *Hist.*,XX), 228(1), 228(2).
30. *Ibid.*,228(2). LAGRANGE presumably had in mind items by EULER such as his paper 'Découverte d'un nouveau principe de mêcanique', *Mém.Acad. Sci.Berlin*, 6 (1750: pb. 1752), 185-217 (also in *Opera omnia*, ser.2, vol.5, 81-108), which also contained the non-MACLAURINesque proposal mentioned in fn.28.

31. *Mon.*,67(3); *Hist.*, XV. The letter in question is published in full in EULER's *Opera omnia*, ser. 4A, vol.5, 418-422. DELAMBRE's translation is not mentioned in the editorial notes, but its excessive freedom is disclosed there by the new translation into French furnished by G.PICOLET.
32. 'Lettre', 227(2).
33. Not much of EULER's correspondence is published yet; a list of preserved items is given in his *Opera omnia*, ser. 4A, vol.1. Among candidates for recipient of these letters, many of those to CLAIRAUT are lost, and all of them to LALANDE; maybe these extracts were sent to them. Presumably they were first published in the *Moniteur*; for the record, here is the third (on the second, see fn.46):

> *M. D'ALEMBERT a surtout le génie de l'invention, et on le voit à tout ce qu'il fait. Son chef-d'oeuvre est son ouvrage sur la précession et la nutation; et cette question est tout ce que l'on peut de plus difficile. ...*
>
> *Je suis dégouté de travailler sur la théorie de la lune, depuis surtout que M.D'ALEMBERT a dit avoir une manière particulière de traiter les approximations et de fort peu négliger. Je voudrais en savoir quelque petite chose, aussi peu que ce fût: je me chargerais bien de découvrir tout. ...*
>
> *Je vous suis bien obligé des éclaircissemens que vous m'avez donnés de l'ouvrage de M.D'ALEMBERT sur la lune, dont j'attends avec la plus grande impatience la publication. Plus j'approfondis les difficultés dont cette recherche est enveloppée, plus je suis convaincu que personne n'est capable de les surmonter que M.D'ALEMBERT, dont la pénétration excite en moi autant d'admiration que d'estime. ...*
>
> *J'ai eu l'honneur de voir ici M.D'ALEMBERT qui m'a témoigné à tous égards tant d'amitié que j'en suis tout-à-fait pénétré de reconnaissance, et que je serais infiniment ravi s'il acceptait la place de président de notre académie. Ce serait assurément le seul moyen de nous rendre heureux ici; or, je me flatte qu'à la fin il se rendra aux instances qu'on lui a faites.-- Maintenant, mon fils aîné est assez bien établi, depuis que sur la recommendation de M.D'ALEMBERT, le roi lui a accordé une pension de six cents écus, etc.*

   The reference to D'ALEMBERT's lunar theory suggests the mid 1750s for the second extract.
34. 'Lettre', 227(2). The underlined passage paraphrases EULER from the second paragraph of fn. 33.
35. *Ibid.*,227(3). Typical of MONGE's work of this kind is his *Feuilles d'analyse appliquée à la géométrie, à l'usage de l'École Polytechnique*, 1st ed. (1795, Paris).
36. 'Lettre', 227(3); LAGRANGE criticised FONTAINE for the same reason (compare fn.16 and text). His letters to CONDORCET are generally respectful (see his *Oeuvres*, vol 14, 3-52). CONDORCET's 'first book' is presumably his *Traité du calcul intégral* (1765, Paris), which LAGRANGE praised in general but criticised on a detail in a letter of 1765 to D'ALEMBERT (*Oeuvres*, vol. 13, 42). On the book and related manuscripts, see A.P. YOUSCHKEVITCH, 'La notion de fonction chez CONDORCET', in R.S.COHEN and others (eds.), *For Dirk Struik* (1974, Dordrecht), 131-139.
37. 'Lettre', 227(3). On these methods, see for example, S. ROTHENBURG, 'Geschichtliche Darstellung der Theorie der singularen Lösungen...', *Abh. Gesch. Math.* 20 (1910), 315-404; and S.ENGELSMAN, 'LAGRANGE's early contributions to the theory of first-order partial differential equations', *Hist. math.*, 7 (1980), 7-23.

38. 'Lettre', 227(3). At the time of LAGRANGE's death the principle of the conservation of energy was about to enter a period of prominence which *challenged* several aspects of LAGRANGian mechanics (see my 'Work for the workers....', *Ann. sci.*, 41 (1984), 1-33).
39. 'Lettre', 228(1). On the history of such topics, one of the best sources is still A.GAUTIER, *Essai historique sur le problème des trois corps...* (1817, Paris).
40. 'Lettre', 228(1). It was thought that LAGRANGE planned a third volume of the second edition of his *Mécanique analytique*, to be devoted to mathematical astronomy (see VIREY and POTEL (fn.4),17).
41. Little has been written on these developments. BOWDITCH gave some of the details *passim* in his translation of LAPLACE's *Celestial mechanics*, 4 vols.(1829-39, Boston).
42. 'Lettre', 227(2). In fact, several older manuscripts were to survive in the *Nachlass* (on which see fn. 51). According to DELAMBRE (*Mon.*, 73(3); *Hist.*, XLI), LAGRANGE applied at this time for a passport to HÉRAULT DE SÉCHELLES (on whom see fn.23); GUYTON DE MORVAU also helped him (see fn. 48).
43. 'Lettre', 228(2).
44. *Oeuvres de LAGRANGE*, 14 vols. (1867-92, Paris); vols. 13 and 14 contain some of his correspondence (to the benefit of fn.35). Files relating to its preparation are held at *Archives Nationales*, F^{17} 3247; and *Bibliothèque de l'Institut*,ms.2737.
45. *Hist.*,XXIV; see fn. 16 and text on FONTAINE.
46. J.M.HOËNE-WRONSKI, *Philosophie de l'infini* ... (1814, Paris), 101-103, 119-121 (commentary), 103-119 ('Lettre', with footnotes (a)-(f) attributed to DELAMBRE (p.102) and footnote (7) omitted (*pace* his claim of completeness on p.102)).
47. See fn. 14 and text. However, DELAMBRE did incorporate a small correction made by G. to the account of the origins of LAGRANGE's approach to the calculus (*Mon.*,73(3); 'Lettre', 227(1); *Hist.*,XLII). Further, the new quotation on astronomers (*Hist.*,XLIX) may reflect reaction to the remarks by G. reported at fn. 40 and text. These modifications, and the many small changes in punctuation between the *Moniteur* and *Histoire* versions (see fn.7), strongly suggest that the latter was *not* on proof before the letter was published.
48. 'Notes fournies par M.GUYTON-MORVEAU', *Hist.cl.sci.math.phys.Inst. France*, (1812 pt.2, pb. 1816), LXXVIII-LXXX. The notes concerned LAGRANGE's appointment of 1792 as an 'administrator of currency'; some danger of his deportation as an (Italian-born) foreigner during the Terror (GUYTON played a role in LAGRANGE's remaining in France); his interest in CHARLES HUTTON's work on artillery (on which he was preparing, but never completed, some extensions); and the consequences of CHLADNI's experiments to determine the nodal lines of a vibrating membrane (which were exciting a dispute over the theory in which LAGRANGE was involved, at the time of his death: see L.C.BUCCIARELLI and N. DWORSKY, *SOPHIE GERMAIN* ... (1980, Dordrecht)).
49. J.F.-T.MAURICE, 'LAGRANGE', *Biog.univ.anc.mod.*, vol.23 (1819), 157-175 (p.175): he made rather little use of the letter in this article. It was reprinted in some other biographical editions, at least once in abbreviated form. It is perhaps surprising that LAGRANGE became intimate with someone 40 years his junior and of no special scientific achievement (although he had a distinguished administrative and public career). Perhaps it was a case of foreigners together in Paris?

50. Soon after the publication of the 'Lettre', B.VON LINDENAU quoted several of LAGRANGE's conversation pieces of pp. 227(1)-228(2) in his (German) 'Einleitung' to his and J.Z.F.BOHNENBERGER's new *Ztsch.Astron. verw.Wiss.*, 1 (1816), 1-123 (pp.111-116). B.HOLMBOE transcribed them in turn to his protégé ABEL as parts of a letter, quoted in C.A.BJERKNES, *NIELS-HENRIK ABEL* ... (1885, Paris), 174-177 but for some reason excluded from ABEL's correspondence in *NIELS HENRIK ABEL. Mémorial publié à l'occasion du centenaire de sa naissance* (1902, Christiania). G.LORIA briefly recalled the 'Lettre' in a note motivated by the occasion of the bicentenary of LAGRANGE's birth, where he translated into Italian much of the lower half of p.227(3) (*Boll.mat.*, (2) 15 (1936), sez.stor.-bibl., XVII: soon afterwards he transcribed on p.LXXV the inscription on LAGRANGE's tomb in the crypt of the *Panthéon* in Paris).

In his recent lengthy dictionary article on LAGRANGE, J.ITARD did not draw on the contents of the 'Lettre' and gave it a fictional title in his bibliography ('LAGRANGE', in *Dictionary of scientific biography*, vol.7 (1973, New York), 559-573 (p.572)).
I reprinted LAGRANGE's conversation pieces in my 'Recent researches in French mathematical physics in the early 19th century', *Ann. sci.*, 38 (1981), 663-690 (p.679: the surrounding account there is updated by the present paper).

51. After LAGRANGE's death his manuscripts were purchased by the government and given to the first class of the *Institut* in May 1815 (*Procès-verbaux* (fn.1), vol.5, 513: two months earlier the catalogue of his library was published (p.466) and the books presumably sold). A commission composed of LACROIX, LEGENDRE, POISSON and DE PRONY examined the manuscripts, with the help of MAURICE. They recommended that only a few items be published. Files on the commission's work are held at the *Académie des Sciences, dossier personnel* for LAGRANGE; and *Archives Nationales* F^{17}3604. LACROIX's report of November 1817 to the recently reconstructed *Académie* was published in DELAMBRE's notice of the year's work (*Hist.Acad.Roy.Sci.*,2 (1817: pb.1819, LVII-LX and *Mag.enc.*,(1818), vol.2, 318-320). It appeared again in LAGRANGE's *Mécanique analytique*, 3rd ed. (ed.J.BERTRAND), vol.2 (1855, Paris), 389-390; LAGRANGE's *Oeuvres*, vol.12, 377-378; and in *Procès-verbaux* (fn.1), vol.6, 233-234. The manuscripts themselves are kept at *Bibliothèque de l'Institut*, mss.901-916; note also the items mentioned in fn.20.

52. J.B.BIOT, [Review of J.B.J.DELAMBRE, *Histoire de l'astronomie au dix-huitième siècle* (ed. C.L.MATHIEU: 1827, Paris)], *Journ.des sav.*,(1828), 195-202 (p.201). LAGRANGE also refused to be drawn or painted from life; such was his distaste for the geometrical.

Felix Schmeidler

ÜBER DEN EINFLUSS DER BIEGUNG AUF DIE MERIDIANKREISBEOBACHTUNG VON BESSEL, GAUSS UND SOLDNER

1. Das Problem der Biegung bei Meridiankreisen

Nachdem O.Römer (1644-1710) im Jahr 1704 den ersten Meridiankreis in der Geschichte der Astronomie in Kopenhagen aufgestellt hatte, verging beinahe ein Jahrhundert, ehe der Gedanke, der diesem Instrument zugrundelag, wieder aufgegriffen wurde. Die beobachtenden Astronomen erkannten bald nach Römer, daß die Lagerung der Achse des Instruments auf zwei Pfeilern erheblich mehr Stabilität gewährte als die Befestigung an nur einer Säule; aber die Verbindung des Geräts mit einem Höhenkreis, der von 0° bis 360° durchgehend geteilt war, fand erst in der Zeit um 1800 Nachahmung. So sind im Lauf des 18. Jahrhunderts von mehreren Astronomen Durchgangsinstrumente verwendet worden, deren Achsen auf zwei Pfeilern ruhten, während für die Messung von Zenitdistanzen in dieser Zeit fast ausschließlich Mauerquadranten zur Anwendung kamen (R e p s o l d 1908).

Der erste Meridiankreis nach Römer wurde im Jahr 1802 von J.G.Repsold (1770-1830) erbaut und von ihm mehrere Jahre lang auf seiner privaten Sternwarte in Hamburg benutzt; später wurde das Instrument von Gauss für die Göttinger Sternwarte gekauft und dort 1818 aufgestellt. Der erste Meridiankreis in England wurde 1806 von Troughton (1753-1835) gebaut und von Groombridge (1755-1832) zu Beobachtungen verwendet. Ungefähr zehn Jahre später wurde Reichenbach (1772-1826) auf diesem Gebiet tätig und war dabei so erfolgreich, daß die in seiner Werkstatt hergestellten

Folkerts/Lindgren, Hg.: Mathemata
Festschrift für Helmuth Gericke (Reihe „Boethius", Bd. 12)
Franz Steiner Verlag Wiesbaden GmbH – Stuttgart 1985