

Citoyen de Genève and Philosopher to the Queen of England*

JOHN HEILBRON

■ "Had ye believed Moses, ye would have believed me; for he wrote of me. But if ye believe not in his writings, how shall ye believe my words?" John 5: 46-47.

■ "Take away from Genesis the belief that Moses was the author...and there remains nothing of Genesis but an anonymous book of stories...or downright lies." Tom Paine, *The age of reason*. Part II (London, 1795), 14.

The long-lived and long-winded subject of this paper, Jean-André Deluc (1727-1817), has several claims to our attention on this occasion. For one, he was closely tied to Geneva. Although he spent the second forty-five years of his life in England, he always styled himself "citoyen de Genève" on the title pages of the many books he published. Secondly, he knew all the savants who made Geneva so extraordinary a center of natural philosophy during the eighteenth century. Among these savants were George-Louis Lesage, whom Deluc regarded as his master, and Marc-Auguste Pictet, who collaborated with Deluc and corresponded with him for many years after he had left Geneva. Thirdly, through his brother Guillaume-Antoine Deluc, Pictet, and others, Deluc kept informed about the work of the Société de physique et d'histoire naturelle and occasionally contributed to it. Finally, Deluc's compulsion to unify his vast knowledge fit with the program, though it transcended the limits, of the society and of the other scientific academies that promoted his career.

The paper begins (§1) with Deluc's liberal politics and exact science in Geneva, proceeds to his move to England (§2), outlines his application of geology to Genesis (§3), and ends with his attempt to unify his Calvinist religion, descriptive science, and increasingly reactionary politics into a program for the salvation of Europe (§4).

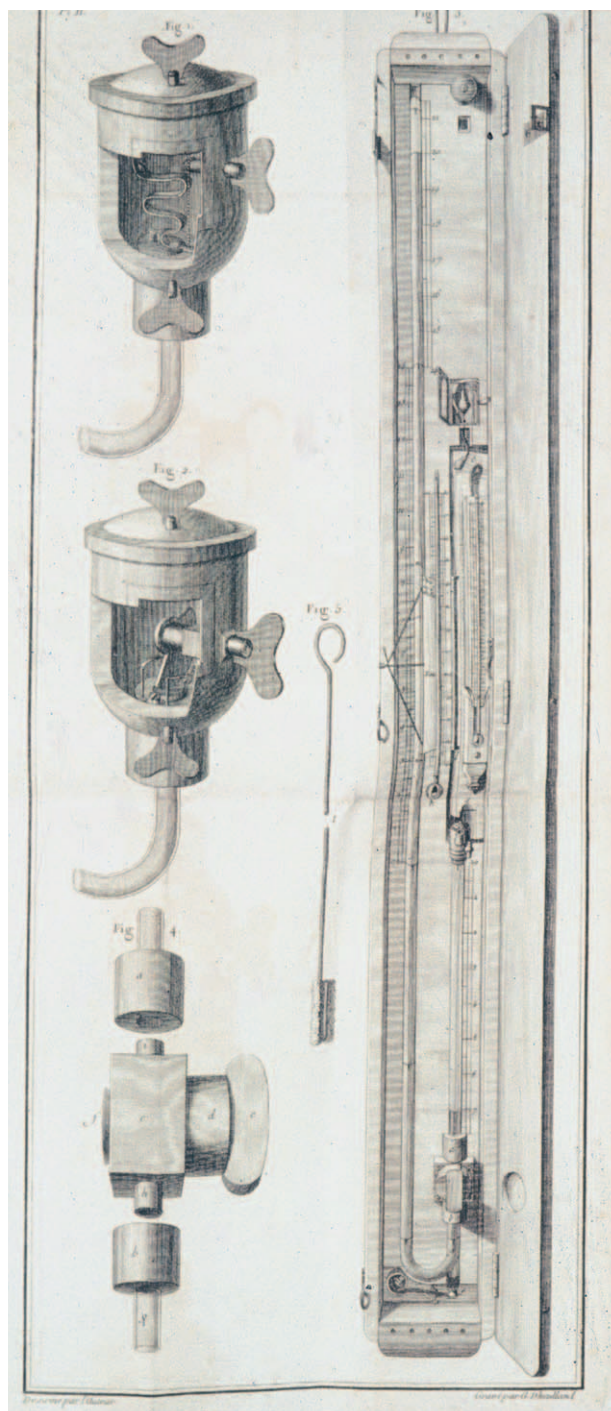
■ Deluc and Geneva

Jean-André Deluc and his brother Guillaume-Antoine were among the first to climb the high Alps for instruction as well as recreation; they became

experts in Alpine natural history and strove to understand the processes that had created the scenery. To promote understanding, Jean-André cultivated the arcane art of barometric hypsometry, that is, the measurement of height with a barometer; and he

* Adapted from an address at the award of the Pictet medal, 22 October 2004. The following abbreviations are used: BPU, manuscript (followed by shelf number and folio) at the Bibliothèque publique et municipale, Geneva; *LPM*, J.A. Deluc, *Lettres physiques et morales sur l'histoire de la terre et de l'homme* (5 vols., The Hague: De Tune; Paris: V. Duchesne, 1779); RA GEO, manuscript at the Royal Archives Windsor Castle, quoted with the permission of Her Majesty Queen Elizabeth II; YUL, manuscript at the Sterling Memorial Library, Yale University, New Haven.

Fig. 1. Deluc's portable barometer; with details of valves and stopcocks. From Jean-André Deluc, *Recherches sur les modifications de l'atmosphère* (Geneva, 1772). Courtesy of The Beinecke Library, Yale University.



spent much of his leisure and income improving the instrument on the theory that knowing how tall mountains are would help explain how they got so big.¹ This fixation resulted in the publication in 1772 of *Recherches sur les modifications de l'atmosphère*, a work of 900 quarto pages on the history, errors, perfection, uses, and care of barometers and

thermometers. In it Deluc shows how the application of Bacon's empiricism combined with precise, even pettifogging quantitative detail can produce an entire physics.²

An insight into Deluc's approach to science on the eve of his emigration to England may be gained from inspection of a few plates engraved for his *Recherches*. Figure 1 shows the perfected traveling barometer and details of its parts; the accompanying text includes such minutiae of manufacture as the way to choose, cut, and mount the cork employed in the stopcock that separates the tube from its reservoir during transport. Deluc evidently had mastered the tools and materials needed to make an instrument perfect in its kind. Figure 2 compares the heights of mountains determined by various formulas; it demonstrated the need for a new standard and a new protocol if barometric hypsometry were to give reliable and reproducible results. Figure 3 supplies the protocol: it exemplifies Deluc's method of deducing heights from corrected barometer readings. Deluc lavished good money and good sense on overcoming the difficulties of making measurements in the mountains. The stopcock in the traveling barometer was one result. Another was the sturdy apparatus pictured in figure 4, which determined the temperature of boiling water as a function of altitude.³ Altogether these illustrations suggest, or betray, the virtues of a practical technician and a compulsive bookkeeper. They were the virtues of his inheritance (his father was a watchmaker) and his trade (he kept the ledgers for his input-export business).

Deluc's *Recherches* made an epoch in science. Already before the book's publication its reputation had gained him election to corresponding member of the Paris Academy of Sciences. Reviews were ecstatic. The *Gentleman's magazine*, a general journal of literature published in London, praised the 500 pages Deluc lavished on criticism of previous barometers as a product of more than ordinary compulsiveness, something "exceedingly interesting to those who love to consider the progress of the human mind."⁴ Pictet agreed, from direct experience. One of his earliest contributions to physics was an improvement of Deluc's measurement protocols. He rated Deluc's barometer design not merely as consummate

¹ LPM, 1, 349.

² J.L. Heilbron, "Jean-André Deluc and the fight over Bacon around 1800," in J.L. Heilbron, ed., *Advancements of learning. Essays in honor of Paolo Rossi* (forthcoming).

³ Cf. W.E. Knowles Middleton, *The history of the barometer* (Baltimore: Johns Hopkins U.P., 1964), 93, 135-40, 178-80, 188, 216, 232-5, 244-5.

Hauteur du mercure dans le Baromètre.	Abaissement du mercure dans le Baromètre.	Suivant les principes de Mr. Mariotte (253).	Suivant la Règle de Mr. Mairaldi par le changement de la progression arithmétique de 212.	Suivant les principes de Mr. Halley (261).	Suivant la Règle de Mr. Mairaldi (268).	Suivant les principes de Mr. J. Schuchter, publiés par Mr. J. G. Schuchter (276).	Suivant la Règle de Mr. Jussieu (282).	Suivant l'Hypothèse de Mr. Daniel Bernoulli (313).	Suivant la Règle de Mr. Horrebow (323).	Suivant la Règle de Mr. Bouguer (325).
27. 11. 0.	0.	61.	61.	75.	60.	64.	65.	65.	75.	75.
27. 11. 1.	1.	771.	780.	924.	798.	790.	780.	814.	914.	916.
27. 11. 2.	2.	1571.	1515.	1883.	1740.	1610.	1614.	1692.	1863.	1866.
27. 11. 3.	3.	2402.	2504.	2879.	2826.	2514.	2514.	2640.	2850.	2854.
27. 11. 4.	4.	3256.	3447.	3917.	4056.	3722.	3666.	3866.	3876.	3882.
27. 11. 5.	5.	4170.	4441.	4998.	5410.	4274.	4154.	4732.	4944.	4954.
27. 11. 6.	6.	5113.	5494.	6128.	6948.	5239.	5172.	6000.	6064.	6074.
27. 11. 7.	7.	6100.	6599.	7302.	8610.	6250.	6138.	7133.	7234.	7246.
27. 11. 8.	8.	7134.	7758.	8550.	10495.	7110.	6800.	8400.	8462.	8475.
27. 11. 9.	9.	8222.	8970.	9853.	12366.	8425.	7972.	10411.	9751.	9767.
27. 11. 10.	10.	9367.	10317.	11227.	14460.	9599.	11632.	12212.	11111.	11129.
27. 11. 11.	11.	10580.	11564.	12580.	16698.	10841.	13590.	14295.	12547.	12569.
27. 11. 12.	12.	11856.	12933.	14220.	19080.	12159.	15702.	16500.	14071.	14096.
27. 11. 13.	13.	13187.	14367.	1567.	21491.	13486.	16090.	16905.	14334.	14359.
27. 11. 14.	14.	14571.	15867.	1731.	2405.	1486.	1751.	1801.	1571.	1571.
27. 11. 15.	15.	16008.	17217.	1902.	2686.	1634.	1911.	2001.	1711.	1711.
27. 11. 16.	16.	17500.	18717.	2083.	3000.	1792.	2151.	2251.	1861.	1861.
27. 11. 17.	17.	19047.	20817.	2274.	3366.	1954.	2301.	2411.	2011.	2011.
27. 11. 18.	18.	20650.	22517.	2475.	3766.	2121.	2351.	2461.	2161.	2161.
27. 11. 19.	19.	22308.	24217.	2686.	4200.	2292.	2401.	2511.	2261.	2261.
27. 11. 20.	20.	24022.	25917.	2907.	4666.	2468.	2451.	2561.	2361.	2361.
27. 11. 21.	21.	25892.	27617.	3138.	5166.	2649.	2501.	2671.	2461.	2461.
27. 11. 22.	22.	27818.	29317.	3379.	5700.	2834.	2551.	2741.	2561.	2561.
27. 11. 23.	23.	29800.	31017.	3630.	6266.	3024.	2601.	2831.	2661.	2661.
27. 11. 24.	24.	31838.	32717.	3891.	6866.	3219.	2651.	2921.	2761.	2761.
27. 11. 25.	25.	33932.	34417.	4162.	7500.	3419.	2701.	3011.	2861.	2861.
27. 11. 26.	26.	36082.	36117.	4443.	8166.	3624.	2751.	3101.	2961.	2961.
27. 11. 27.	27.	38288.	37817.	4734.	8866.	3834.	2801.	3191.	3061.	3061.
27. 11. 28.	28.	40550.	39517.	5035.	9600.	4049.	2851.	3281.	3161.	3161.
27. 11. 29.	29.	42868.	41217.	5346.	10366.	4269.	2901.	3371.	3261.	3261.
27. 11. 30.	30.	45242.	42917.	5667.	11166.	4494.	2951.	3461.	3361.	3361.
27. 11. 31.	31.	47672.	44617.	5998.	12000.	4734.	3001.	3551.	3461.	3461.
27. 11. 32.	32.	50158.	46317.	6339.	12866.	4984.	3051.	3641.	3561.	3561.
27. 11. 33.	33.	52700.	48017.	6690.	13766.	5239.	3101.	3731.	3661.	3661.
27. 11. 34.	34.	55300.	49717.	7051.	14700.	5500.	3151.	3821.	3761.	3761.
27. 11. 35.	35.	57958.	51417.	7422.	15666.	5774.	3201.	3911.	3861.	3861.
27. 11. 36.	36.	60674.	53117.	7803.	16666.	6050.	3251.	4001.	3961.	3961.
27. 11. 37.	37.	63448.	54817.	8194.	17700.	6330.	3301.	4091.	4061.	4061.
27. 11. 38.	38.	66280.	56517.	8595.	18766.	6614.	3351.	4181.	4161.	4161.
27. 11. 39.	39.	69170.	58217.	9006.	19866.	6902.	3401.	4271.	4261.	4261.
27. 11. 40.	40.	72118.	59917.	9427.	21000.	7194.	3451.	4361.	4361.	4361.
27. 11. 41.	41.	75124.	61617.	9858.	22166.	7490.	3501.	4451.	4461.	4461.
27. 11. 42.	42.	78188.	63317.	10299.	23366.	7790.	3551.	4541.	4561.	4561.
27. 11. 43.	43.	81310.	65017.	10750.	24600.	8094.	3601.	4631.	4661.	4661.
27. 11. 44.	44.	84490.	66717.	11211.	25866.	8402.	3651.	4721.	4761.	4761.
27. 11. 45.	45.	87728.	68417.	11682.	27166.	8714.	3701.	4811.	4861.	4861.
27. 11. 46.	46.	91024.	70117.	12163.	28500.	9030.	3751.	4901.	4961.	4961.
27. 11. 47.	47.	94378.	71817.	12654.	29866.	9350.	3801.	4991.	5061.	5061.
27. 11. 48.	48.	97790.	73517.	13155.	31266.	9674.	3851.	5081.	5161.	5161.
27. 11. 49.	49.	101260.	75217.	13666.	32700.	10002.	3901.	5171.	5261.	5261.
27. 11. 50.	50.	104790.	76917.	14187.	34166.	10334.	3951.	5261.	5361.	5361.
27. 11. 51.	51.	108380.	78617.	14718.	35666.	10670.	4001.	5351.	5461.	5461.
27. 11. 52.	52.	111930.	80317.	15259.	37200.	11010.	4051.	5441.	5561.	5561.
27. 11. 53.	53.	115540.	82017.	15810.	38766.	11354.	4101.	5531.	5661.	5661.
27. 11. 54.	54.	119210.	83717.	16371.	40366.	11702.	4151.	5621.	5761.	5761.
27. 11. 55.	55.	122940.	85417.	16942.	42000.	12054.	4201.	5711.	5861.	5861.
27. 11. 56.	56.	126730.	87117.	17523.	43666.	12410.	4251.	5801.	5961.	5961.
27. 11. 57.	57.	130580.	88817.	18114.	45366.	12770.	4301.	5891.	6061.	6061.
27. 11. 58.	58.	134490.	90517.	18715.	47100.	13134.	4351.	5981.	6161.	6161.
27. 11. 59.	59.	138460.	92217.	19326.	48866.	13502.	4401.	6071.	6261.	6261.
27. 11. 60.	60.	142490.	93917.	19947.	50666.	13874.	4451.	6161.	6361.	6361.

Fig. 2. Comparison of the heights of mountains according to various hypsometric rules. Same source as figure 1.

craftsmanship, but also as “one of the most elegant of applications of the physico-mathematical sciences.” Deluc’s devotion to minutiae showed what physics could and should be; his barometer marked an epoch not only in natural science, but also – echoing the *Gentleman’s magazine* — in the “history of the human mind.”⁵

⁴ *Gentleman’s magazine*, 43 (1773), 113. *LPM*, 1, 352-4, and J.A. Deluc, *Recherches sur les modifications de l’atmosphère* (2 vols., Geneva, n.p., 1772), 1, ii, give 1762 as the date of his election as correspondent; Académie des sciences, Paris, *Index biographique des membres et correspondants* (Paris: Gauthier-Villars, 1968), 159, gives 6 Aug 1768. The contradiction resolved: In 1762 the Academy accepted the dedication of the *Recherches* and promised Deluc the next vacancy as correspondent; La Condamine to Deluc, 18 Jan 1768, BPU 2461: 171-2.

⁵ M.A. Pictet, “Notice sur la mesure des hauteurs par le baromètre,” *Bibliothèque britannique, sciences et arts*, 43 (1810), 19-42, 91-119, 299-335, on 21 (quote); Pictet to Deluc, 19 Feb 1779, BPU 2465:157. Cf. T.S. Feldman, “Applied mathematics and the quantification of experimental physics: The example of barometric hypsometry,” *Historical studies in the physical and biological sciences*, 15:2 (1985), 127-95, on 153-4.

⁶ Michel Grenon, “Les observations météorologiques et climatiques de Saussure,” in René Sigrist, ed., *H.B. de Saussure* (Geneva: Georg, 2001), 141-57, on 142-3.

⁷ Rousseau to J.F. Deluc, 17 Oct 1754, 10 Oct 1762, and answers, 23 June 1755, 24 Sep 1762, in J.J. Rousseau, *Correspondance complète*, ed. R.A. Leigh (52 vols., Geneva: Institut et musée Voltaire, 1965-98), 3, 45, 13, 191-3, and 3, 137-8, 13, 101-6, resp.

Deluc and his brother indulged a second hobby in Geneva: politics. Later Jean-André would make an intimate connection between his politics and his science via his religion. For the moment the two activities had only a habitual association, as in the journal in which Guillaume-Antoine wrote down the pressure, temperature, state of the atmosphere, and political climate in Geneva every day for 33 years.⁶ The brothers’ political activity had a trigger in the person of Jean-Jacques Rousseau, whom their father, the fiery Calvinist and democrat Jacques-François Deluc, befriended; although, being a believer in the literal word of scripture and a providential God, the elder Deluc disagreed with most of what Rousseau thought or wrote. When in 1754 Rousseau returned to Geneva to reclaim his citizenship and his religion, the Delucs celebrated with him during a week’s excursion along the shores of Lac Léman. They cemented a friendship strong enough to withstand the tempest called up by the publication of *Emile* and the *Contrat social* in 1762.⁷

The ruling body in Geneva, the Petit Conseil, condemned both books. The Delucs joined with forty or so fellow citizens in submitting a formal remonstrance to the Conseil, which rejected it. The stakes escalated. Deluc père fed Rousseau material for a grand slam at the governing bodies of Geneva – the *Lettres écrites de la montagne* (1764) – that helped to mobilize the Représentants (the remonstrators) and Natifs (disenfranchised citizens) to

CH. V. OBSERVAT. DU BAROM. A SALEVE. 213

Ire. STATION. 216 Pieds 2 pouces de hauteur.

Cette Station & les deux suivantes, sont à la partie Occidentale de la Montagne, dans un talus dominé par un Rocher aride, fort élevé & coupé à pic. La chaleur que ce Rocher communique à l'air voisin, fait que les observations du Baromètre, donnent trop de hauteur dans ces trois premières Stations (621).

Dates & Heures.	Etat de l'air.	Barom. infér.	Barom. supér.	Diff. des B.	Résultat par Log.	Th. sup. & inf.	Sommes.	haut. par la règle.
1760. 25 ^e . Mars. 5 h. soir	sud — pluie	5154 — 6 5160	5101 — 9 5110	50	253	—30 —33	} —63	237
		5164	5116					
20 ^e . dit 5 h. soir	calme vapeurs	— 7 5171	— 5 5121	50	253	—23 —21	} —44	242
		5202	5156					
3 ^e . Avril 5 h. soir	petit N.E. ferein	— 5 5207	— 1 5157	50	251	—16 —14	} —30	243
		5165	5124					
12. Mars 4 h. $\frac{1}{2}$ soir	petit S. couvert	— 4 5169	+ 1 5123	46	233	—13 —11 $\frac{1}{2}$	} —24 $\frac{1}{2}$	227
		5207	5164					
8. Avril 5 h. $\frac{1}{4}$ soir	med. N. nuages	— 1 5208	+ 4 5160	48	241	— 5 $\frac{1}{4}$ — 6 $\frac{1}{4}$	} —11 $\frac{1}{2}$	238
		5208	5162					
7 ^e . Aout 7 h. $\frac{3}{4}$ matin	zephire ferein	+ 4 5204	+ 3 5159	45	226	— 6 — 5 $\frac{1}{2}$	} —11 $\frac{1}{2}$	223
		5161	5120					
22 ^e . Juin 8 h. $\frac{1}{4}$ matin	calme & couvert	+ 5 5156	+ 8 5112	44	223	— 3 + 4	} + 1	223
		5182	5141					
12 ^e . Avril 4 h. $\frac{1}{2}$ soir	fort N. E. ferein	+ 3 5179	+ 8 5133	46	232	+ 1 $\frac{1}{2}$ + 2	} + 3 $\frac{1}{2}$	233
		5185	5138					
20 ^e . Juillet 6 h. $\frac{3}{4}$ matin	calme & ferein	+ 8 5177	+ 7 5131	46	232	+ 1 $\frac{1}{4}$ + 4 $\frac{3}{4}$	} + 6	234
		5175	5133					
dit jour 5 h. soir	S. pluie	+12 5163	+12 5121	42	213	+ 7 + 9 $\frac{1}{2}$	} +17	216
		5192	5154					
7 ^e . Août 5 h. $\frac{1}{2}$ soir	zephire ferein	+ 8 5184	+14 5140	44	222	+14 $\frac{1}{2}$ +10 $\frac{1}{2}$	} +25	227
		5198	5162					
1759. 14 ^e . Juillet 5 h. soir	calme & ferein	+12 5186	+19 5143	43	217	+20 $\frac{1}{2}$ —22 $\frac{1}{2}$	} +43	226
Somme des 12 Observations 2769								

Fig. 3. Protocol for recording and correcting barometrical data to determine the difference in height between two stations. Same source as figure 1.

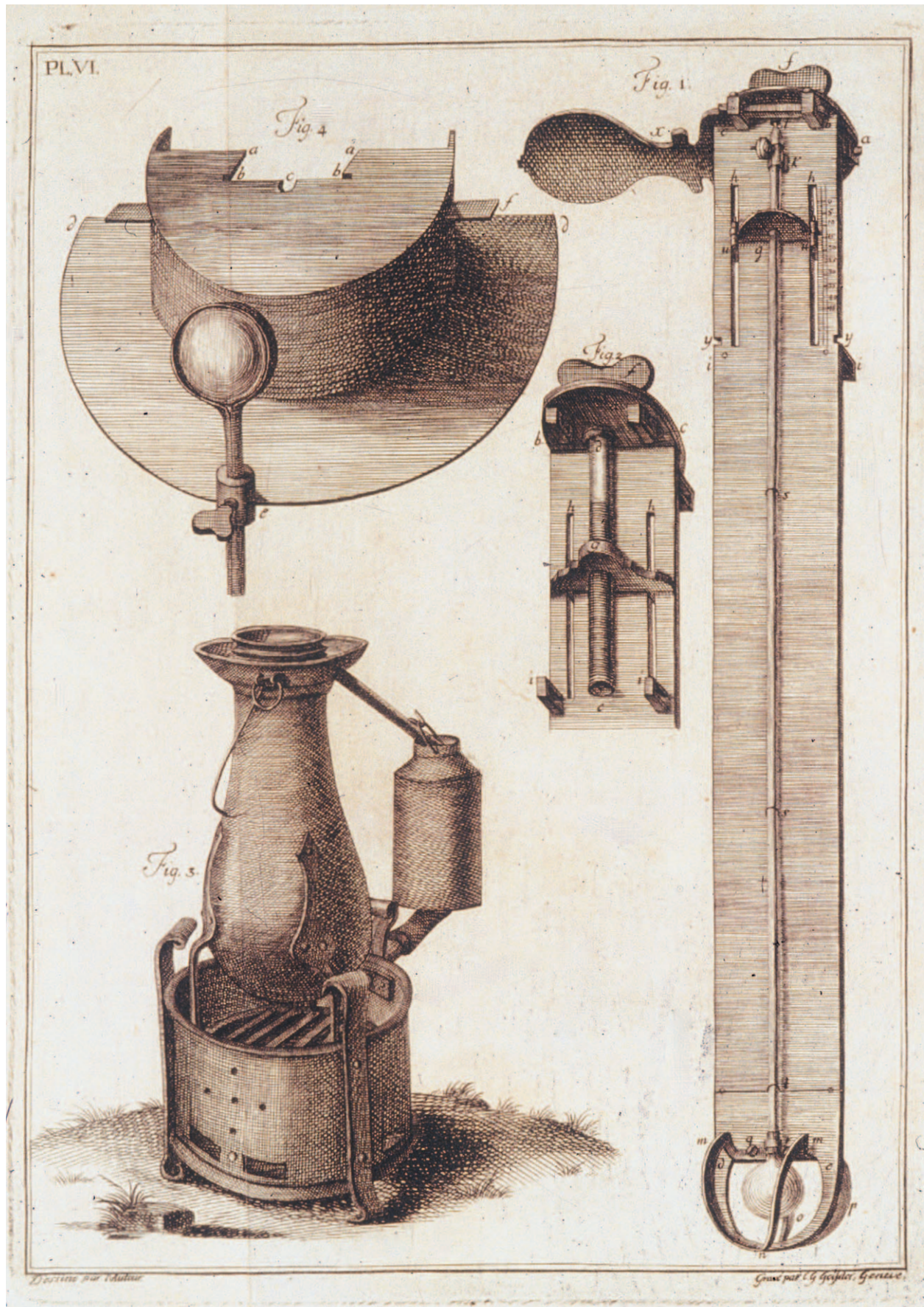


Fig. 4. Apparatus for determining the boiling point of water at different pressures, with details of the thermometer and fixtures required. Same source as figure 1.

demand a larger share in the governance of the city.⁸ The elder Deluc, though depreciated as a semi-literate tradesman by the patricians, was an effective demagogue. “He was a sort of fanatic in politics, the more dangerous the simpler and more disinterested he appeared.” Jean-André proved to be much more flexible than his father⁹. He had a talent for negotiation. It was largely owing to his advice that the Représentants and their aristocratic opponents, the Négatifs, reached a fleeting compromise in 1768. Deluc’s fire-eating father accused him of conceding too much to the other side. Jean-André replied that nothing can be accomplished in the world of men without concessions and mutual tolerance; a goodly doctrine, no doubt, which he ignored in later life, when he became no less inflexible, though he remained more polite, than his father.¹⁰

Another reason – apart from his willingness to compromise — for Deluc’s effectiveness was his devotion to the serious pursuits respected in Geneva. Even in the thick of battle Charles Bonnet, a leader of the patrician Négatifs, could discern the wider merits of the man “who is...constantly at the head of the force that toppled us.” He was instrumental in securing Deluc’s election to the Paris Academy. Noblesse oblige: “abstracting from the activist to consider only

the *physicien*,” Bonnet subscribed for three copies of Deluc’s big book on barometers, which, despite its merits, no publishing house wished to bring out at its own expense.¹¹ “This work is to me not only, as the Paris Academy says, ‘one of the best books that has enriched physics in a long time,’ it is also an excellent application of logic to physics.”¹²

Deluc’s textile business foundered in the trade slump during the city’s troubles.¹³ He had no desire to rebuild the business and no obvious alternative. What market existed for a longwinded mountaineer, bankrupt cloth merchant, conservative revolutionary, and barometrical enthusiast? Deluc ranked as his main asset knowledge of French, for which people were willing to pay something outside Francophonia. Genevan tutors then enjoyed a seller’s market, since they offered instruction in French without the temptations of Paris or the dangers of Catholicism. So Deluc thought to set up as tutor to a “pupil with rich and generous parents.” He pinned his hopes on Britain, where he had some valuable connections through Englishmen who studied or vacationed in Switzerland. He limited his opportunities, however, by refusing to teach young children, or mathematics or history. He said that his memory was too weak for history, his mind unsuited to mathematics, and his interest in children exhausted by the experience of bringing up three of his own.¹⁴

Instead of mathematics and history, Deluc promised moral guidance. He was indeed a perfect preceptor, scholarly, gaunt, abstemious, sober, humorless, religious (fig. 5). Though in the forefront of physics and a liberal in politics from a Genevan point of view, he rejected the Enlightenment as represented by Voltaire and Diderot. Once Rousseau asked the Deluc brothers to write an article on glaciers for the *Encyclopédie*. Their father replied for them: They had better use for their knowledge than to give it to the ungodly encyclopedists. The editors tried again: would Jean-André condescend to write on “Hauteur des Montagnes”? Or, if that rushed him too much, “Montagnes, Hauteur de”?¹⁵ To no avail. The Delucs saved their Alpine data for the work of a lifetime. During their alpine tramps they had formed the grand project of confirming scripture from the constitution of mountains. It took Jean-André fifty years of constant thought, observation, and travel to find the evidence that guaranteed Genesis. As he wrote half way through the arduous enterprise, he published his contributions to natural philosophy “only with religion in mind.”¹⁶

In 1796, just yesterday in geological time, Guillaume-Antoine lectured in this place about the latest evidence acquired by the Deluc brothers in support of the Mosaic account of the Flood. He took the oppor-

⁸ Jean Guéhenno, *Jean Jacques Rousseau* (2 vols., New York: Columbia U.P., 1967), 2, 87-135; R.G. Mazzoleni and Shirley Roe, *Science against the unbelievers: The correspondence of Bonnet and Needham* (Oxford: Voltaire Foundation, 1986), 133-41; André Gur, “La négociation de l’édit du 11 mars 1768 d’après le journal de Jean André Deluc,” *Revue suisse d’histoire*, 17 (1967), 166-217, on 172-5. Pictet’s politics appear from his letters to Deluc of 19 and 26 Feb 1782, in M.A. Pictet, *Correspondance. Sciences et techniques*, ed. David Bickerton and René Sigrist (4 vols., Geneva: Slatkine, 1996-2004), 3, 231-4.

⁹ Bonnet to Haller, 8 Mar 1766 and 6 May 1772 (quote), and reply, 23 Sep 1762, in Otto Sonntag, ed., *The correspondence between Albrecht von Haller and Charles Bonnet* (Bern: Huber, 1983), 284-5, 525.

¹⁰ Deluc to his father, 12 Nov 1769, BPU 2641: 9.

¹¹ Bonnet to Haller, 8 Mar 1766 and 6 May 1772 (quote), in Sonntag (ref. 9), 482, 1018.

¹² Bonnet to G.L. Le Sage (“mon cher Euclide”), 1 May 1772, BPU 2463:27.

¹³ Deluc’s business dealings are detailed in BPU 2461: 53-132.

¹⁴ Letters of 1770-72 in BPU 2461: 47-52, 77 (letter to d’Invernois [Deluc’s business partner], 19 Sep 1772, quote); Claire-Elaine Engel, “Genève et l’Angleterre: Les De Luc, 1727-1817,” *Revue d’histoire suisse*, 26 (1946), 479-504, on 481-2, 488-90.

¹⁵ Rousseau to J.F. Deluc, 28 Dec 1754, and reply, 20 Jan 1755, in Rousseau (ref. 7), 3, 28-9, 94; Fortuné-Barthelemy de Felise to J.A. Deluc, 5 Nov 1773, BPU 2465:25.

¹⁶ LPM, 1, 24-5.

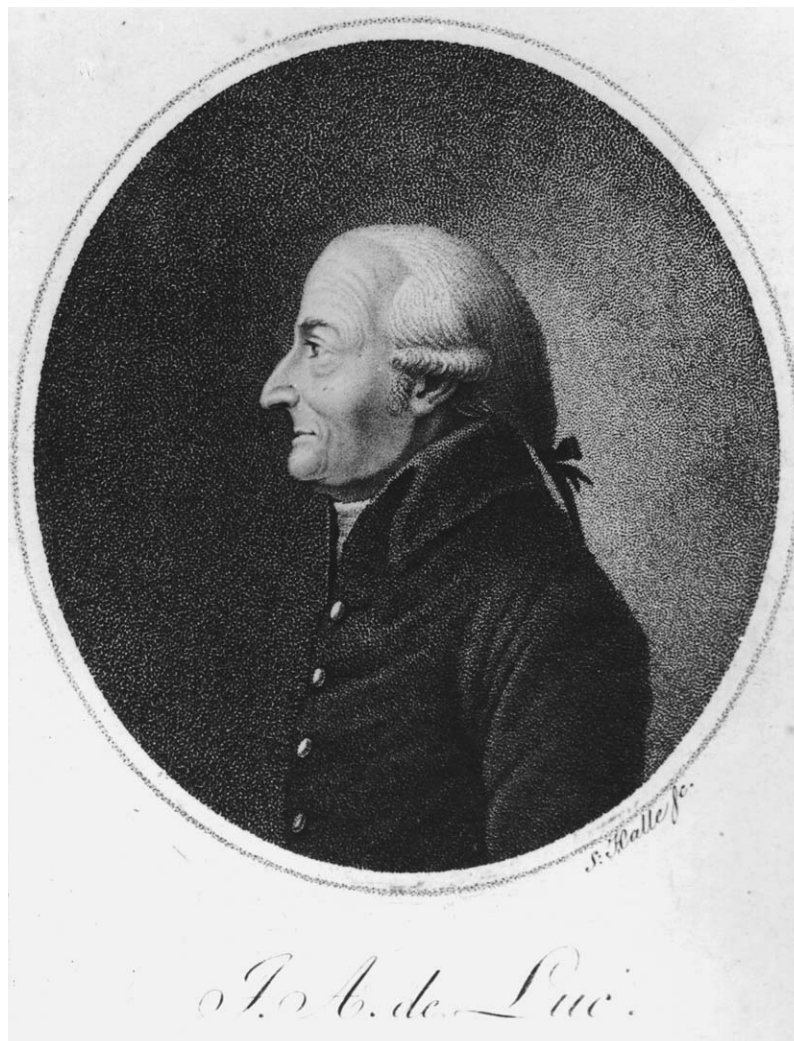


Fig. 5. J.A. Deluc, etching by S. Halle From Sammlung Voit, courtesy of the Niedersächsische Staats- und Universitätsbibliothek, Göttingen.

tunity to condemn mechanistic cosmologies like the system of the Comte de Buffon, which, besides being wrong, destroyed "the confidence we should repose in the account of Moses, in his history of the

Deluge."¹⁷ Marc-Auguste Pictet, who might well have been in attendance, would not have approved the sentiment. He disliked the mixing of scripture and physics, which was a guiding theme for the generation of the Delucs and the Bonnets.¹⁸ He had good reason to be especially annoyed with Deluc's miscegenation of the barometer and the bible. Deluc had made use of Pictet's unpublished measurements, without permission, in his pious work. Pictet remonstrated. Despite Deluc's assurances that he regarded him as a son and disciple, Pictet moved closer to Deluc's rival in mountaineering and measurement, Horace Bénédict de Saussure.¹⁹ With Pictet's technical help, Saussure mounted an incisive criticism of the details of Deluc's instruments and measurements. Saussure also was a loud voice in the chorus of opponents of Deluc's inspired earth history.²⁰

During the 1790s these hot spots of academic friction were reheated by Lavoisier's chemistry and Hutton's geology, both of which Pictet championed and Deluc rejected; unluckily, since both soon won almost universal approbation.²¹ And to complete the opposition between the former master and disciple, Deluc regarded Lavoisier's revolutionary chemistry as a stalking horse for the French

Revolution, whereas Pictet bowed to the inevitable and represented his fellow citizens in arranging the terms of the annexation of Geneva to France in 1798. While Deluc, on commission from the King of

¹⁷ Quoted in A.V. Carozzi, *Histoire des sciences de la terre entre 1790 et 1815, à travers les documents inédits de la Société de physique et d'histoire naturelle de Genève* (Geneva: SPHN, 1990), 73.

¹⁸ Jean Senebier, *Histoire littéraire de Genève* (3 vols., Geneva: Barde et al., 1786), 3, 61; Mazzoleni and Roe (ref. 8), 62-95; René Sigris, "Science et société à Genève au xviii^e siècle: l'exemple de Charles Bonnet," in *Charles Bonnet savant et philosophe* (1720-1793) (Geneva: Passé Présent, 1994), 19-39, on 30.

¹⁹ Pictet to Deluc, 1 Feb 1780, and Deluc to Pictet, 18 Jan and 15 Feb 1780, in Pictet (ref. 6), 3, 196-201; Deluc to Pictet, 7 Sep 1784, complaining about the treatment of his *Recherches* in Saussure's *Essai sur l'hygromètre* (1783), *ibid.*, 245.

²⁰ Pictet to Deluc, 15 Apr 1790, and reply (the last letter in their correspondence), 23 Apr 1791 in Pictet (ref. 8), 3, 252-5; René Sigris, "Les Essais sur l'hygromètre (1783) ou l'art de la mesure précise," in Sigris, *Saussure* (ref. 6), 109-40, on 113, 117, 133; A.V. Carozzi, "La géologie: De l'histoire de la terre selon le récit de Moïse aux premiers essais sur la structure des Alpes et à la géologie expérimentale, 1778-1878," in Jacques Trembley, ed., *Les savants genevois dans l'Europe intellectuelle du xviii^e au xix^e siècle* (Geneva: Journal de Genève, 1987), 203-65, on 213-14, 223-5. Cf. Pictet (ref. 5), 108, 110, 321-2 (on Pictet's experiments on temperature dependence in 1779-83).

²¹ Carozzi (ref. 20), 192; J. Deshusses, "Le physicien Marc-Auguste Pictet et l'adoption de la doctrine chimique de Lavoisier par les savants genevois," *Institut national genevois, Bulletin*, 61 (1961), 100-12.

England, sought to rally help in Germany against French expansion, Pictet was often in Paris, respected by Napoleon and on intimate terms with his leading savants.²²

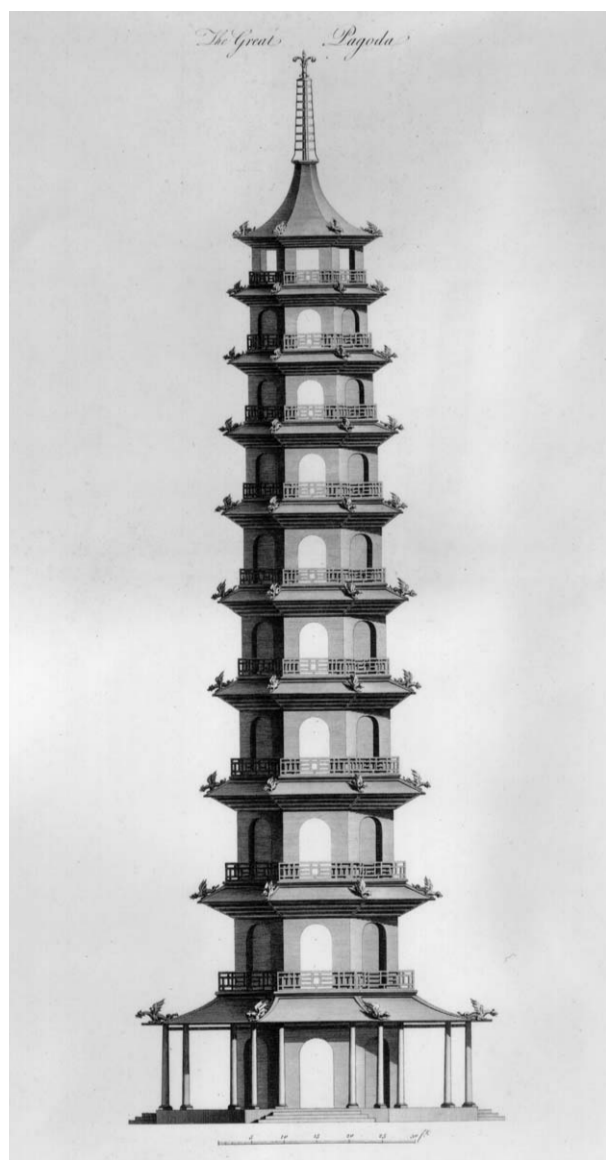
George and Charlotte

Jacques Prevost, a Genevan patrician with whom Deluc had collaborated to settle the uprising of 1768, was a general in the British army. When he returned to England in the fall of 1772, he generously offered to take his impecunious collaborator with him. He paid Deluc's expenses and introduced him into émigré circles around the court.²³ Just before Deluc's arrival the Royal Society of London, following the lead of the Académie royale des sciences of Paris, and with the strong support of Bonnet and other members with Genevan connections, had elected him a fellow; and shortly after he landed, a very long and appreciative review of his huge book on barometers appeared in the leading English monthly.²⁴ The purveyor of scientific news and instruments, Jean-Hyacinth Magellan, who lived in London, advised his network that Deluc had "met with ye greatest reception in England." The reason? "[H]e is very clever in ye barometrical way: and must have a very extraordinary patience to go thro' 2 large volumes on ye subject."²⁵

In the late spring of 1773 Deluc's friends obtained a brief interview for him with the king, who had a fine taste for barometers and other scientific instruments.²⁶ Guillaume-Antoine knew what was to fol-

low. "I do not doubt that after this first introduction you will have an opportunity of presenting your instruments to the king and I cannot believe that this will be as fruitless as you appeared to think." Jean-André's pessimism must have been born of experience in England, for before he left Geneva he had conceived the plan to exchange a barometer for a pension. He may have had in mind Galileo's use of the telescope to promote himself from professor to courtier, although Deluc could scarcely have expected to score a similar success himself. Guillaume-Antoine, a fountain of good advice, counseled hope and perseverance. Friends – the émigré

Fig. 6. *The pagoda in Kew Gardens*. From William Chambers, *Plans, elevations, sections and perspective views of the gardens and buildings at Kew* (London, 1763). Courtesy of the Research Library, The Getty Research Institute, Los Angeles.



²² Pierre Speziali, *Physica genevensis. La vie et l'oeuvre de 33 physiciens genevois*, 1546-1953, ed. C.P. Enz (Geneva: Georg, 1997), 93; J.L. Heilbron, "Physics and its history at Göttingen around 1800," in Nicolaas Rupke, ed., *Göttingen and the development of the natural sciences* (Göttingen: Wallstein, 2002), 50-71, on 63-5.

²³ For their collaboration, BPU 2465:161-170 (letters of 1767); Prevost to Deluc, 7 Jul 1772 (invitation to England), BPU 2465:177; Deluc to d'Ivernois, 19 Oct 1772, BPU 2461:76.

²⁴ *Gentleman's magazine*, 43 (1772), 113-16, 169-72; P.A. Turnbridge, "Jean André Deluc, F.R.S. (1727-1817)," *Royal Society of London, Notes and records*, 26 (1971), 15-33, on 17-19; M. Maty to Deluc, n.d., BPU 2465:56; Bonnet to Deluc, 5 Feb 1773, BPU 2463: 28, acknowledging Deluc's thanks and wishing him well in England, "cette terre fortunée, toute peuplée d'êtres pensans."

²⁵ Magellan to Nathaniel Pigott, 12 Oct 1773, reference courtesy of R.W. Home, who is preparing an edition of Magellan's correspondence.

²⁶ Jane Roberts, ed., *George III and Queen Charlotte. Patronage, collecting, and court taste* (London: Royal Collections Publications, 2004), 298-9; Alan Q. Morton and Jane Wiss, *Public and private science. The King George III collection* (Oxford: Oxford U.P., 1993), 17-37, 226, 22, 466-7, 469.

crowd around the court – would manage it. They will say: “Sire, this man Your Majesty has favored [by granting an interview] and esteems does not have a fortune, and that is to say everything to a king....The link to which a pension must be attached is the presentation of your instrument.”²⁷

The friends managed. The great affair took place in Kew Gardens, where there stood and stands a tall pagoda (fig. 6). Deluc climbed it, measured, calculated, and announced its barometric height. Measurement by line gave the same value. The press extolled the extravaganza, the instrument, and the performer – although the pagoda’s architect had published its dimensions several years earlier.²⁸ Deluc gave the marvelous barometer to the king, to take the heights of his palaces, and thoughtfully added a hygrometer for the queen, an enthusiastic botanist, to regulate the moisture in her greenhouses. On hearing about the barometer’s perform-

ance and the royal acceptance of the gifts, Guillaume-Antoine wrote from Geneva: “Nothing is more singularly happy than this agreement in the height... I imagine myself there at the time; I feel the pleasure that you must have felt and I see the pleasant surprise of the spectators.” “Finally, my dear brother, Providence has opened a path....Surely it will finish the work it has begun.”²⁹

Providence took its time. The royal couple said nothing and gave nothing; the king and queen were engaged in research. They examined their émigré courtiers about Deluc’s habits, politics, religion, reputation, and knowledge. George may also have consulted the military, in the person of General William Roy, a surveyor and geodesist, about the reputation and reliability of Deluc’s instruments, which Roy subjected to minute scrutiny.³⁰ While the king inquired, Deluc visited the famous spa at Bath. He liked it, its elegance and cleanliness, and the easy manners at the evening assemblies. What struck him particularly was that as many women over forty as under twenty attended, and as many ugly as attractive ones. The young and beautiful did not form courts nor were the old and ugly objects of ridicule.³¹ He was wonderfully observant.

In the fall of 1773, still without a position, Deluc returned to Geneva to buy himself clear of his business. It would take him many years to repay the debt. That did not dampen the spirits of his optimistic brother: “You are free, God be praised! Certainly He will finish His work.”³² In the late spring of 1774 He did. The king discovered that Deluc could be useful as a political consultant as well as as a measurer of mountains. The pious queen – Charlotte had been a canoness in a Protestant nunnery before her marriage – learned that although Deluc was a natural philosopher and spoke French, he was not a *philosophe*. She thus overcame a widespread prejudice. “People rather commonly believe that the names *Philosopher* and *Unbeliever* are synonymous, it is very important that true philosophers declare themselves openly for religion.”³³ Deluc had done so. “He is a proper philosopher [the queen wrote her brother], for religion does not repel him and all his work is filled with admiration for the Supreme Being.”³⁴ She decided to add him to her intellectual staff, which included the botanist James Edward Smith and Elizabeth de La Fite, a blue stocking who read to her in German. Queen Charlotte’s new philosopher had fallen into a congenial and well upholstered nest, in which, as its latest historian concludes, “the defense of Christian philosophy against Deism was a significant element.”³⁵ But he had not fallen into a sinecure. The queen was a serious student and a stickler for protocol. Deluc read to her standing, for three or four hours at a time; thus

²⁷ J.A. to G.A. Deluc, 13 Nov 1772, BPU 2461: 84; G.A. to J.A. Deluc, 14 May 1773, BPU 2469b: 13; Mario Biagioli, *Galileo courtier. The practice of science in the culture of absolutism* (Chicago: University of Chicago Press, 1993), 108-57.

²⁸ William Chambers, *Plans, elevations, sections and perspective views of the gardens and buildings at Kew in Surrey* (London: J. Haberkorn, 1763), plate 25. Begun in 1761, finished the following year, the pagoda was designed to be 126 feet to the highest balcony and 163 feet to the finial (*ibid.*, 5-6).

²⁹ G.A. to J.A. Deluc, 25 June and 12 Jul 1753, BPU 2469b: 15, 17; *George the Third, his court, and family* (2 vols., London: H. Colburn, 1820), 1, 365-6.

³⁰ William Roy, “Experiments and observations made in Britain, in order to obtain a rule for measuring heights with the barometer,” *Royal Society of London, Philosophical transactions*, 67 (1777), 653-770; George Shuckburgh, *Observations made in Savoy... being an examination of Mr De Luc’s rules* (London: W. Bowyer and J.N. Nichols, 1777), 2, 20, 43, 83; Feldman (ref. 5), 156, 162-3. Another likely source of information about Deluc was the tutor to the royal princes, who belonged to a Genevan family (de Solgas) with whom Deluc had some connection. Engel (ref. 14), 482-3.

³¹ Deluc to his daughter Franchette, 19 Nov 1773, BPU 2489:60v, reporting inquiries to the Comte de Bruhl, whom he claimed as his best friend in England; and 2 Jan 1774, BPU 2489: 64, on the ladies of Bath.

³² Letter of 24 Sep 1773, BPU 2461b: 19.

³³ Needham to Bonnet, 15 Nov 1760, in Mazzoleni and Roe (ref. 6), 189-90.

³⁴ Charlotte to Charles of Mecklenburg-Strelitz, 29 June 1774, in Turnbridge (ref. 22), 17-19; *George the Third* (ref. 24), 2, 385-6; George III, *The later correspondence* (5 vols., Cambridge: Cambridge University Press, 1962-70), 3, 8n.

³⁵ Clarissa Campbell Orr, “Queen Charlotte as patron,” *The court historian*, 6:3 (2001), 183-212, on 191, 192 (quote).

they got through many books on natural history, religion, travel, and philosophy, and Deluc kept in shape for mountain climbing.³⁶

The queen and her philosopher had a friend in common. He was Rousseau, with whom Charlotte and her entourage went botanizing during his sojourn in England in 1767-68. Before he left the country Rousseau had made a mess of things by accepting, rejecting, and accepting a pension from George III: which, with his republican politics and equivocal religion, not to mention his bohemian life style, gave Charlotte ample reason to drop him. Deluc was able to reassure her that Rousseau had a good heart but a head too easily muddled by *philosophes* who used natural science against revealed religion. Eventually she acquired copies of almost all of Rousseau's published books.³⁷ Deluc was also able to help Charlotte follow up Rousseau's botanical lead. When it came into her head to compare the plants of England with those of her native land, Deluc oversaw the collection of a herbarium of the flora of Hanover by a professor at Göttingen.³⁸

Deluc's sobriety, industry, and acumen soon won him Charlotte's complete confidence. She consulted him on the smallest details of her household, from

flower arrangements to chambermaids.³⁹ The king also consulted him. Deluc always advised tough measures against challenges to authority. He supported (though to his credit he deplored) the war against the American colonists, in which his friend General Prevost longed to serve.⁴⁰ In the mid 1790s George sent Deluc as a special agent to Berlin to help form a coalition against the new French Republic. The agent discharged his office creditably but ineffectually, and reported every step and maneuver with the same wealth of detail he lavished on his barometer.⁴¹ In 1797 George appointed him honorary professor of geology at the University of Göttingen without any obligation to teach or reside there. Under this transparent cover Deluc continued to inform the king about the political situation. He added warnings about the decline of religion throughout Germany — a drift that George had tried to stop by encouraging the Göttingen faculty to defend revealed religion against deism and the higher criticism. Deluc traveled widely in Northern Europe, combining his diplomatic assignment with geological excursions to collect more physical evidence in favor of scriptural history and with his self-imposed mission to save misguided mankind from *philosophes* and atheists.⁴²

Genesis and Geology

Deluc gave Charlotte good measure. He wrote her long letters about the history of the earth and its lessons, so many that in their published form they occupy five volumes. "I have found that brevity in demonstrations, that is, the shortest way from the distant principle to its remote consequence, only rarely pertains to physics, and still less to ethics." Deluc's *Lettres physiques et morales* (1779) set the foundations of what, in his introduction to them, he called "geology." Before attending to his own system, however, he had to clear the ground of others then in the limelight.⁴³ Chief among these was the account of the earth's formation given by the Comte de Buffon at the head of his immensely popular *Histoire naturelle* (1749+) and revised, just before the publication of Deluc's letters to Charlotte, as *Epoques de la nature* (1779). In both versions, Buffon attempted to reason only from physical causes; thus the fact that the planets rotate in the same sense in the same plane, which Newton had adduced as evidence of design, Buffon explained as the consequence of a collision in which a comet drove from the sun the matter that formed the solar system. Otherwise, in his theory of 1749, he had nothing to do with catastrophes or divine intervention; no Noachian deluge; only the forces that Buffon himself could observe could be invoked as causes for the development of the piece of old sun we call earth. Thus the marine fossils found

³⁶ Clarissa Campbell Orr, "Queen Charlotte, 'Scientific Queen,'" in Campbell Orr, ed., *Queenship in Britain, 1660-1837. Royal patronage, court culture and dynamic politics* (Manchester: Manchester U. P. 2002), 236-66, on 237, 244, 261n; Guéhenno (ref. 8), 2, 178-86.

³⁷ Campbell Orr (ref. 36), 246, 249-58, and (ref. 35), 190, 202, 211; Alexandra Cook, "Propagating botany: The case of Jean-Jacques Rousseau," in David Bickerton, ed., *The transmission of culture in Europe 1750-1850. Papers celebrating the foundation of the Bibliothèque britannique (1796-1815) in Geneva* (Bern: Lang, 1999), 63-94, on 71-9.

³⁸ Marita Hübner, "Jean-André Deluc (1727-1817), Professor, Reformer und Repräsentant des englischen Königshofes in Göttingen," in Elmar Mittler, ed., *"Eine Welt allein ist nicht genug": Grossbritannien, Hannover und Göttingen, 1714-1837* (Göttingen: SUB, 2005), 26-44, on 228-9; Campbell Orr (ref. 36), 253.

³⁹ Charlotte to Deluc, 15 Aug 1797, YUL 4:88.

⁴⁰ Prevost to Deluc, 23 June and 17 Jul 1775, BPU 2465: 231-2, 284-5; cf. *ibid.*, 244-7.

⁴¹ George III to various ministers, in *George III* (ref. 34), 2, 637, and 3, 8, 24, 28-9; J.A. Deluc, *Introduction à la physique par les fluides expansibles précédée de deux mémoires sur la nouvelle théorie chimique* (2 vols., Paris: Nyon, 1803), 1, iii-iv; Turnbridge (ref. 22), 22-5.

⁴² Hübner (ref. 38), 233, 237-40.

⁴³ *LPM*, 1, vii-viii (quote); D.R. Dean, "The word 'geology'," *Annals of science*, 36 (1979), 35-43; Henry de la Fite, "Introduction," in J.A. Deluc, *Letters on the physical theory of the earth, addressed to Professor Blumenbach, concerning geological and historical proofs of the divine mission of Moses* (London: Rivington, 1831), 1.

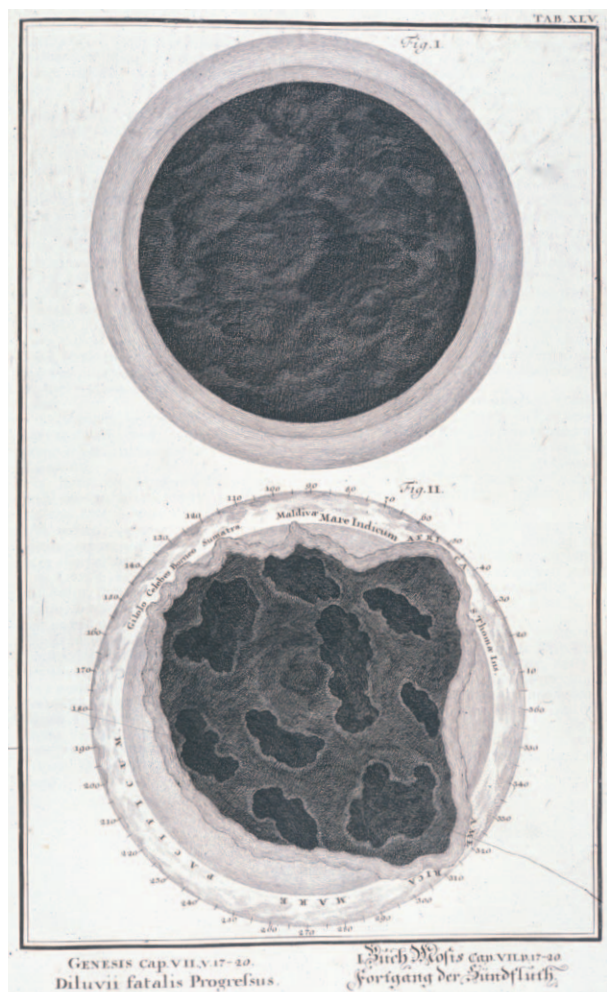


Fig. 7. "The fatal progress of the Flood," depicted by a rival Swiss diluvialist. From Johann Jacob Scheuchzer, *Physica sacra* (4 vols. Ulm, 1731-35), vol. 1. Courtesy of The Beinecke Library, Yale University.

far from the sea implied that the strata bearing them must have been deposited in an ancient ocean, which earthquakes or subsidence or some other natural cause subsequently elevated.⁴⁴ The naturalism of this account, which earned Buffon the condemnation of

the Sorbonne, and the clear separation of the origins of the universe, the earth, and mankind, shook the foundations of traditional cosmology.⁴⁵

Buffon's *Epoques* set out earth history within a misleadingly Mosaic account of six installments, from the creative comet to the appearance of man. The entire development required 75,000 years, or even longer. Buffon surveyed his work, and saw that it was good. Deluc looked, and saw the system of a "driveling old fool," grossly ignorant in physics.⁴⁶ This undiplomatic assessment was directed against Buffon's presumption to draw conclusions about matters of such importance in the moral as well as the physical realm without the thorough field work that Deluc and his brother had undertaken. Buffon's rejection of the Deluge, for which Deluc had collected a great mass of physical evidence, was an especially ignorant, arrogant, and consequential error.⁴⁷

Deluc taught Queen Charlotte that the keys to the accessible past are the nature and distribution of fossils, the current rates of erosion and sedimentation, and barometric measurements. From these we learn that a sea once covered fossiliferous rocks, that the length of time since the appearance of the present continents cannot have been long, and that the heights of the continents are roughly the same – a capital point overlooked in other systems. We also know, from measurements of the density of the earth then just completed by the astronomer royal of England, that our globe contains no large empty spaces.⁴⁸ Any caverns that might have existed had been filled by the collapse of part of the bed of an ancient sea; the old ocean had flowed into the depression thus created and exposed the part of the ancient seabed that now forms our continents. That explains at once why marine fossils are now found far from the sea and also, if the catastrophe took place a few thousand years ago, the Noachian flood (fig. 7). Deluc invested years in assembling the data to confirm this dating (fig. 8). The geochronometers he devised – the rate of erosion of land, deposit of peat, filling up of river deltas, and, a matter of immediate experience to

⁴⁴ Jacques Roger, *Buffon* (Paris: Fayard, 1989), 528-43.

⁴⁵ M.J.S. Rudwick, "The shape and meaning of earth's history," in D.E. Lindberg and R.L. Numbers, eds., *God and nature* (Berkeley: U. California P. 1986), 296-321, on 308-10.

⁴⁶ *LPM*, 5:2, 517-610 (against Bufon); Needham to Bonnet, 25 Nov 1779, quoting a letter from D.A. Gallitzin, in Mazzolini and Roe (ref. 8), 321 (quote).

⁴⁷ Cf. Rhoda Rappaport, *When geologists were historians, 1665-1750* (Ithaca: Cornell U. P. 1997), 258-61.

⁴⁸ *LPM*, 1, 352-4, 358-9, 365-6, the last referring to the famous measurement by Nevil Maskelyne, "An account of observations made on the Mountain Schehallian for finding its attraction," Royal Society of London, *Philosophical transactions*, 65 (1775), 500-42. Maskelyne had contributed to the resettlement of Deluc by Englishing his hypsometric formulas; Nevil Maskelyne, "M. de Luc's rule for measuring heights by the barometer, reduced to English measure and length and adapted to Fahrenheit's thermometer," *ibid.*, 64 (1774), 158-70.



Fig. 8. The Blocken in the Harz, a region Deluc favored, depicted by a rival geologist. From F.W.H. von Trebra, *Erfahrungen vom Innern der Gebirge* (Dessau and Leipzig, 1785). Courtesy of The Beinecke Library, Yale University.

him, the blocking of Alpine passages by glaciers – all confirmed the youthfulness of our continents. Buffon and others had deduced an age of millions of years from the rate of salification of lakes. “That is an example of the errors into which people who consider only a limited range of phenomena can fall.”⁴⁹

The strict observer cannot fail to notice that certain fossils have no known living descendents. That did not bother Deluc. He admitted the extinction and

even the transformation of species. Only extinction could explain why remains of elephants and molluscs buried in mountains differ from everything now alive. As for transformation, it appeared necessary to account for the existence of fresh-water fish. Fish altered their form as they lost their salt-water habitat owing to the collapse of the ancient seabed and the gradual sweetening of the rivers flowing through the new continents. “Disparities in the rate of change of the water in different lakes can conserve different species; which has given some lakes fish that others do not have. This manner of transformation has now ceased.” But all this was an aside. The essential point of his work, “entirely contrary to prevailing opinion,” so Deluc told Queen Charlotte, is the newness of the continents. “That, Madam, is the great result at which all my studies and the physical part of this long work has arrived.”⁵⁰

⁴⁹ LPM, 5:2, 496-7, 505, 510 (quote); M.J.S. Rudwick, “Jean André Deluc and nature’s chronology,” in C.L.E. Lewis and S.J. Knell, eds., *The age of the earth from 400 B.C. to A.D. 2002* (London: Geological Society, Special Publications 190, 2001), 51-60, on 58-9, and La Fite (ref. 43), 9, 13-19, on Deluc’s geochronometry.

⁵⁰ LPM, 1, 8, (first quote), 5:2, 515-16, 624-5 (second quote)

Although this result was hardly secure even when enunciated, the method by which Deluc reached it brought something of value to geology. He contributed a wide range of morphological observations together with their interpretations, which gave later geologists much material to refine and correct. Among them was Alexander von Humboldt, who sweetened his corrections with a compliment. "A man so meritorious as Deluc, who by his philosophical way of treating mineralogy inspired emulation everywhere, may certainly be excused some hasty conclusions."⁵¹ Another commanding geologist who did not disdain to praise Deluc was Georges Cuvier, who mentioned particularly Deluc's descriptions of the geology of Holland and Westphalia and his analysis of the orientations of secondary deposits.⁵² Deluc's most important legacy to geology, however, was his persistent hunt for quantitative geochronometers; for, as Martin Rudwick has remarked, Deluc's abbreviated time scale was the "direct progenitor of the long one, and facilitated its adoption."⁵³

Deluc claimed to have demonstrated the youth of the existing continents on physical principles alone. With this security, he identified the emergence of our continents and the subsidence of the ancient sea bed with the Deluge. That was not to prove the biblical account but to remove all objections to it based on physical science. "We Christians do not need to know how the Flood came about in order to believe in it; it is enough for us to know that it cannot be proved impossible." He had forced from physics, "the sole light that guides us with any certainty," a *nihil obstat*. This was a splendid achievement to be sure,

but only preparatory. Deluc thought that he could obtain much more from his corroboration of Moses' report of universal flooding. On the testimony of natural and human history he had established Moses as a reliable informant in one important matter. Why then not in all? Deluc did not mean that we should accept Genesis literally. He rejected the childish parts of the bible. With Swiss practicality he observed that all Noah needed to bring with him were animals, plants, seeds, and tools sufficient to resume farming when the waters subsided; other creatures had to save themselves by retreating to the highest mountains. The preposterous story of the arc, designed for people at a rudimentary stage of development, did not detract from the identification of the deluge with the emergence of the continents. As for the Garden of Eden, the longevity of the patriarchs, and even creation itself, Deluc declined to speculate. The collapse of the old seabed that caused the flood had buried all the pertinent facts.⁵⁴

The *philosophes* had appealed to the latest science to undermine religion and the state. That was to subvert not only the truth but also the truth-seeker. As we know, religion gave Deluc the direction of his life's labor and his joy in it. "Only religion made the sciences I cultivated a treasure for me."⁵⁵ The atheistic program of the *philosophes* – "their dogmatic incredulity, the flippancy with which they treat sacred dogmas that provide the basis for the happiness of individuals and the well being of society" – oppressed Deluc the concerned statesman as well as Deluc the convinced Calvinist.⁵⁶ "When we consider the terrible evil with which the abandonment of religious principles natural to ordinary people has been attended, we are attempted to believe with Rousseau that the sciences, whose abuse has brought about this situation, have so far been more harmful than useful to humanity." But Rousseau had been wrong. Deluc's painful studies had revealed how to use science victoriously in defense of religion. Previous paladins had failed because they did not have the patience to acquire and study all the facts.⁵⁷

Most people did not have the patience to read through all the facts scattered through the five volumes of Deluc's letters to his queen. Despite their prolixity, however, the *Lettres physiques et morales* were a success. The influential *Monthly review* observed that Deluc, "who has hitherto been only known as one of the first natural philosophers of our time, assumes here new aspects, still more interesting to humanity, namely those of the moralist, the citizen, the friend of man – who speaks the language of wisdom to the peasant, the artist, the legislator, and the sovereign, and appreciates with sensibility, truth and precision, the genuine source of human felicity."⁵⁸

⁵¹ Alexander von Humboldt, *Mineralogische Beobachtungen über einige Basalte am Rhein* (Braunschweig: Schulbuchhandlung, 1790), 100-05, 117, 121-2 (quote), and *Die Jugendbriefe, 1787-1799*, ed. Ilse Jahn and Fritz G. Lang (Berlin: Akademie Verlag, 1973), 83, 87, 100, 110-11. I owe these references to Petra Werner.

⁵² Georges Cuvier, *Histoire des progrès des sciences naturelles depuis 1789* (2 vols. Paris: Librairie internationale, 1864), 1, 80, 84. Cf. *ibid.*, 15, 82-3, 85-6; Roy Porter, *The making of geology. Earth science in Britain 1660-1815* (Cambridge: Cambridge U.P., 1977), 165-6, 199-200; and M.J.S. Rudwick, *Georges Cuvier, fossil bones, and geological catastrophes* (Chicago: U. Chicago P., 1997), 10-12.

⁵³ Rudwick (ref. 49), 52 (quote), 54.

⁵⁴ Quotes from *LPM*, 1, 241, and 5:2, 683, resp.; cf. *ibid.*, 5:2., 632, 637-45, and La Fite (ref. 43), 86-90, 112-17.

⁵⁵ *LPM*, 1, 24-5.

⁵⁶ *LPM*, 5:2, 733-4 (quote); cf. *ibid.*, 1, 26-34, 45-6.

⁵⁷ *LPM*, 1, 50 (quote), 51-2.

⁵⁸ Text of 1780, quoted by La Fite (ref. 43), 7.

Science and Values

Deluc first visited Göttingen during a geologizing trip to the Harz in 1777. His friend Georg Christof Lichtenberg, professor of mathematics and physics at the University of Göttingen, expert on Hogarth, satirist, and Anglophile, had talked up his visit. "He is one of the most pleasant and entertaining people I know, has seen and heard so much and has thought so much about it."⁵⁹ Deluc performed as advertised. He rattled on about English and German scholars, his hygrometer, barometer, and thermometer, refraction, the soul and its imperishability, Geneva and its constitution, spirit, industry, artists, and learned men, machines, research, evaporation and clouds, the world system, the history of the earth, friends, snow, George III, physiognomy, "and a hundred other things." His breadth, cosmopolitanism, and verbosity amazed a dinner party given by Lichtenberg; his abstemiousness was no less noteworthy at a German academic feast.⁶⁰

Twenty years later Deluc returned to Göttingen in his capacity of honorary professor of geology. Lichtenberg expressed delight at the prospect of the entertainment in store. But Deluc did not intend to bury himself in a small university town. "Oh no, monsieur," he wrote his would-be host, "I have too many ties elsewhere to think of such a thing." He would use his affiliation with the university as a guarantor of his scientific attainments and his presence in Germany as an opportunity to disseminate his demonstrations of the reliability of Genesis throughout Europe:

■ I felt that having produced these demonstrations, my duty to God and men required me to promulgate them in one of the seminaries of learning that has carped the least about

the bases of revelation and that enjoys the protection of the most virtuous, and therefore the most religious, of monarchs [George III!]. That is why I must be an honorary professor at Göttingen, affiliated with the philosophy faculty of our university. I intend to publish under this title the true bases of geology.⁶¹

Deluc had the gratifying idea that people pay attention to professors.

The Deluc of 1797 was not the entertaining cosmopolitan of 1777. A combination of circumstances had driven him far to the right. Everywhere innovators were destroying the world he had come to appreciate in Windsor. The French revolutionaries menaced the *ancien régime* supported by time-tested aristocratic rights and civic virtues inculcated by religion. Deists, free-thinkers, and atheists, whether revolutionaries or not, collaborated in undermining belief in revealed religion and its promise of salvation to citizens who behaved properly. Savants, philosophers, and men of science ran after novelties like French chemistry, exchanging their birthright for a mess of pottage. In all these domains Germany was still a battleground. Its leaders feared the revolution. Some of its respectable people, including pastors, opposed deism and the higher criticism.⁶² And a few of its prominent natural philosophers, like Lichtenberg and the professor of chemistry at Göttingen, Johann Friedrich Gmelin, teetered over the merits of French science.⁶³

In 1791 Deluc alerted George III to something rotten in his state of Hanover. The journals in Göttingen were supporting Adolph Franz Friedrich, Freiherr von Knigge, a graduate of its university, lawyer, writer, and freemason, whom Deluc ranked as the Paine of Germany, against Johann Georg, Ritter von Zimmermann, likewise a product of Göttingen, one of George's personal physicians, and in Deluc's estimation the German Burke, "a defender of religion and governments." The journals refused to publish rebuttals of Knigge. Zimmermann and other conservative notables read Deluc's rejected rejoinder and "rejoiced that [their opponents] would have in me an antagonist who knew their weak points and could combat them without giving them an opening." To obtain permission for the publication of the rejoinder in Hanover, however, the king would need to act. The situation was serious. "Your Majesty might judge...how triumphant the Unbelievers would be if they learned of a new rejection of the writer whom they fear the most because of his knowledge of nature, and whom they would say had been disgraced for daring to confront them. Finally, Your Majesty might imagine the distress that a new rejection would cause the friends of religion who have known my views for a long time"⁶⁴. More serious indications of decline then appeared: an

⁵⁹ Lichtenberg to Blumenbach, 17 Oct 1776, in G.C. Lichtenberg, Briefwechsel, ed. Ulrich Joost and Albrecht Schöne (4 vols., Munich: C.H. Beck, 1983-92), 1, 635.

⁶⁰ Lichtenberg to Schernhagen, 29 Oct, 4 Nov 1776, in Lichtenberg (ref. 59), 1, 637-8, 643.

⁶¹ Deluc to Lichtenberg, 13 Dec 1797, in Lichtenberg (ref. 59), 4, 794-5. Cf. C.C. Gillispie, *Genesis and geology* (New York: Harpers, 1959), 56-66, and François Ellenberger and Gabriel Gohau, "A l'aurore de la stratigraphie paléontologique: Jean-André De Luc, son influence sur Cuvier," *Revue d'histoire des sciences*, 34 (1981), 217-57, on 218, 220-1, 249.

⁶² Cf. John William Rogerson, *Old Testament criticism in the nineteenth century: England and Germany* (London: SPCK, 1984), 16-18.

⁶³ Karl Hufbauer, *The foundation of the German chemical community (1720-1795)* (Berkeley: U. California P., 1982), 100-02, 133-48.

⁶⁴ Deluc to George III, 24 and 23 Jul 1792, RA GEO/ 6983, 6982.



Fig. 9. The sign of God's covenant, as revealed in Genesis and calculated by Descartes. Same source as figure 7.

inclination toward enlightenment, a tendency to regard the Old Testament as a collection of myths, a desire to shop on Sundays. The king declared himself against it all, but to little lasting effect. According to Deluc's diagnosis, George's ministers in Hanover were too lax or ignorant to intervene; fortunately, fear of the French was awakening the people to the danger to their lives, as well as to their souls, of ignoring the true basis of the health of the state.⁶⁵

By 1799, Deluc had integrated his conservative politics fully with his "other great goal of bringing people back to Revelation by the voice of Nature." People who had arrived at the goal begged him to publish a "work that could be a foundation after my death by indicating and opening the various ways of Nature that lead to God Revealed; so that young people beginning their studies in science can have surer guides than those who have had the misfortune to be brought up in Disbelief." The task would be long and arduous; it would keep Deluc in Germany away from his family and the court; and it would tax the strength of a man in his seventies. But he had resources: the zealotry of his allies, the ignorance of his enemies, and his reputation as a "philosopher and a naturalist." His message would be the more effective because "it did not come from an ecclesiastic by profession." "God give me the grace to give myself the strength..."⁶⁶

The task would cost the king something too. Deluc needed money for traveling ("I have things to study to obtain fresh arms against the enemies of Revelation") and for publishing his works. George

gave what was asked, and more again, for translations and for sending copies of Deluc's books as gifts to the main academies and universities of Europe, and to their foremost members and professors.⁶⁷ The output from this collaboration was most impressive. In 1804 Deluc drew up a "Notice of the works I have published in six years in defense of revelation." It lists sixteen volumes: two on the history of the earth, three in defense of Bacon, seven against deistical philosophers, and four to correct the false science of France. These last volumes demonstrated that all worthwhile science could be integrated with Deluc's geology and thence with revelation, "the first source of all our knowledge of the universe and of man."⁶⁸

The most interesting of the controversies with deists concerned a community of Jews encouraged to convert to Christianity at the cost only of baptism. They would not need to accept the New Testament, that is, the revelation Deluc defended as the core of religion. He wrote open letters to the Jews, urging them not to abandon their heritage for a false Christianity, and to the Protestant minister, Abraham Teller, who tried to lead them astray. He attacked savants like his Göttingen colleague Johann Gottfried Eichhorn, who treated the Old Testament as a compilation of oriental tales, and bumbling fashionable pastors who assured their flocks that a Christian had only to believe in the "purest and most excellent truths of the understanding."⁶⁹ He thundered at deists (whom he ranked below atheists) that our reason comes into play in only one instance, in deciding whether Jesus was the Messiah. If we accept him, we must also accept everything he says and how he says it; he offers no proofs.⁷⁰ That does not mean that we lack strong corroborative evidence. "I have proved by evidence brought together from the universe, the earth, and human history that Genesis is a divine revelation [fig. 9] and that therefore [a shocking non-sequitur for a royal philosopher] the entire bible is so too."⁷¹

The most dangerous of the rationalists were the "new exegetes," the well-informed exponents of the higher criticism like Eichhorn. Deluc answered them in his counter-intuitive way: the exegetes could not understand the bible because they did not know enough physics. He had come at last to see natural science not only as helpful in understanding scripture but as essential. His love of religion and devotion to mankind demanded that he trumpet the truth. "I would have no internal peace...if I did not try with all my strength to disabuse those who have been led astray and if possible to redeem those who have caused this evil."⁷² Deluc believed that people who had come to see the big picture had an obligation to

⁶⁵ Deluc to George III, 19 Oct 1797, and Baron Georg von Steinberg to Deluc, 3 Oct 1797 (RA GEO/ 8646-7 and 8632-3, resp.); J.A. Deluc, *A letter to some Jews, authors of a memorial addressed to Dr Teller...with an historical introduction* (London: Goakman, 1812 [text of 1799]), iv-vii.

⁶⁶ Deluc to George III, 11 Jan and 3 Aug 1799 (RA GEO/ 9129-30, 9256-7).

⁶⁷ Deluc to George III, 3 and 13 Aug 1799, and 29 Nov 1804 (RA GEO/ 9256-7, 9268, and 11442, resp.).

⁶⁸ RA GEO/ 11443-4 (document dated 29 Nov 1804); Deluc to Guillaume-Antoine Deluc, 25 Dec 1797 (YUL), quote, in Hübner (ref. 38), 240-1. The total cost for the sixteen volumes was £ 174 exclusive of the cost of translation into German, for which Deluc raised donations from his aristocratic contacts in Berlin. For Deluc's defense of Bacon, see Heilbron (ref. 2).

⁶⁹ J.A. Deluc, *Lettre sur l'essence de la doctrine de Jésus-Christ* (Braunschweig: Imp. de la Maison des orphelins, 1803), 5-6, 10-11 (quote).

⁷⁰ Ibid., 11-12, 54-5 (quote).

⁷¹ Ibid., 58-60, 68 (quote); Deluc (ref. 65), xviii, xxi-xxvi.

⁷² Deluc (ref. 69), 82-4, 97-100, 118, 123 (quote). Cf. *LPM*, 5:2, 629.

share their enlightenment with the blinkered majority. He freely admitted that every physical phenomenon admitted of several interpretations. But all or all but one of competing interpretations could be ruled out by a person with large views and the necessary information. And by no one else. We know the reason. "Only with the aid of general theory can one fix ideas with some certainty."⁷³

Deluc's main impulse as a natural philosopher and human being was inclusiveness – up to a point. The Genevan constitution had to be altered to give a fair place to ordinary citizens, though not to the disenfranchised "natives." Theologians had to consult physics and natural history to understand the bible, though neither science nor reason can explain Christ's teachings, which must be accepted on faith. The *physicien* must develop the most general theories, and take into account the most detailed evidence, before deciding the nature of the secondary causes through which God acts; for only by breadth can we minimize the danger of premature decision and error in a realm where we cannot know for certain that we are right. Here Deluc echoed a standard theme among the conservative Genevan politicians and savants he had opposed: innovators destroy the status quo by following the dictates of a narrow system that covers only a fraction of received knowledge and leave a shambles behind.⁷⁴ But again, according to the same savants, only by the minutest study, say of the fossil record or the behavior of barometers, can we learn anything in physics. And yet again, proceeding from deep knowledge of molluscs or precise hypsometric formulas to the active forces of the universe, or to the relations between religion and reason, requires many a bold speculation. In practice, Deluc alternated between measuring and speculating, plodding and subliming, pebbles and mountains.

Deluc's breadth of vision, his exactness in observation, and his cosmopolitanism earned him a European reputation. Those who admired precision in measurement – the Parisian academicians who praised his barometers and the English adepts who tested them – esteemed him as a leader of the experimental physics that dominated the age. Natural historians followed him in historicizing the earth's development and in refining geochronometers. Traditional believers felt relief at his demonstration that natural science did not threaten scripture and more liberal ones agreed with him that the true principles of Christianity provided the basis of reconciliation among Protestants, Catholics, and, up to the divinity of Christ, Jews. Centrist statesmen admired his resolution of the Genevan crisis of 1768; conservative ones joined in his condemnation of the overturning of traditional values, seigneurial rights, received philosophy, and sound religion by the French Revolution. By 1800, however, his constituencies had narrowed to the far right and his self-importance had expanded to the heavens. "I was the only one who could resist this party [of revolutionaries, *philosophes*, and superficial savants] with any hope of success."⁷⁵ Alas! Even he could not avail.

Returning to England by ship in 1804, Deluc had a conversation with two of his fellow passengers, a deistical "theophilanthrope" eager to transfer French ideas to Britain and a materialistic Jew content to explain everything by natural law. Deluc silenced the philanthropist by pointing out where French ideas had landed France. He then asked the Jew whether he had studied nature and knew what natural law could do. "As well as you." Ah! "[M]y name is Deluc, and I beg you to tell me whether you have read any of my books." The devastating reply: "I know nothing about them."⁷⁶ Deluc had outlived his time. He continued to work. That did not slow his obsolescence. During his eighties, Lavoisier's chemistry triumphed, specialization ran rampant, Napoleon overran Europe, and the world sank ever deeper into deism and disbelief.

In 1810, the Royal Society of London, of which Deluc had been a member for almost forty years, declined to publish his description of an electrical instrument he had invented, probably because he had not brought it to his wonted perfection. Pictet stepped in and published the description in the *Bibliothèque britannique*, of which he was a founder and editor. By then the Deluc brothers had become honored ancestors in Geneva. As Pictet put it: "[Jean-André Deluc] takes us back to the time of the patriarchs; it might even be said that, like the evening star, his luster increases as he descends toward the horizon of life."⁷⁷ Soon he had reason to shine more brightly still despite a crippling disease that deprived the old

⁷³ LPM, 5:2, 564-5.

⁷⁴ Cf. Needham to Bonnet, in Mazzolini and Roe (ref. 6), 275; S.S.B. Taylor, "The Enlightenment in Switzerland," in Roy Porter and Mikulas Teisch, *The Enlightenment in national context* (Cambridge: Cambridge U.P., 1981), 72-89, on 76-80.

⁷⁵ Deluc (ref. 65), v. Cf. letters to Deluc from Baron Steinberg, 8 Jan and 4 Apr 1797, M. de Pape, 10 Jan 1797, and a Prof. Köster, 10 Dec 1796 (YUL 4:84, 86).

⁷⁶ Deluc (ref. 65), viii-xiii.

⁷⁷ Pictet (ref. 5), 40 (first quote), and editorial note in J.A. Deluc, "Analyse de la pile galvanique," *Bibliothèque britannique, sciences et arts*, 47 (1811), 3-34, 113-45, 213-33, 313-34, on 3-4; D.M. Bickerton, "A scientific and literary periodical, the Bibliothèque britannique (1796-1815)," *Revue de littérature comparée*, 4 (1972), 527-47. Cf. Speziali (ref. 20), 48-9, 96, and Trembley (ref. 20), 358, 423.

mountaineer of the use of his legs. What cheered him was the fall of Napoleon, the liberation of Geneva and Hanover, the return of conservatism, “the dawn of better days.”⁷⁸

The values of synthesis and comprehensiveness that Deluc championed in science and in his other activities remain with us and continue to attract integrators and synthesizers. However, as the example of his life makes only too clear, the closer a comprehensive thinker comes to his goal, the wider the territory from which a successful challenge can be mounted, and the less effective, and more stubborn, his defense may become. Eventually the great quest must fail. It

will be started anew, however, for the urge to create a complete system of knowledge and belief rests on the enduring values of consistency, wholeness, unity, and depth. But there are competing values, equally powerful and often more admirable: diversity, tolerance, and multiplicity. It is very fine and even necessary to try to integrate systems of beliefs and hierarchies of values into a big permanent consistent picture; but it is also good and even better to recognize that the endeavor must fail. An enduring, progressive, and humane world picture is inevitably more uncertain and amenable than the Grand Unified Theory built by the citizen of Geneva and royal philosopher of England, Jean-André Deluc.

⁷⁸ Deluc to J.G.H. Feder, April 1814, in J.G.H. Feders *Leben, Natur und Grundsätzen*, ed. K.A.L. Feder (Leipzig: Schwickert, 1825), 206, reference courtesy of Marita Hübner.