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Electric Books of 1747: Franklin's Luminous Gilt

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Object Lessons

Electric Books of 1747

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It's an autumn night in Philadelphia in 1747, and I'm standing in a room lit with candles, waiting for Benjamin Franklin. There is a table in the middle of the room, and on the table stands an empty wine glass. This is Franklin's workshop; its shelves are heaped with junk: quires of paper, rags, hammers, tongs, bottles, wires, books, old shoes, rolls of leather, bones, feathers.

Franklin enters with a book in his hand. He squints. He has lost his glasses and the light is dim. He waves his book at me, steps up to the table, and places the volume flat, on top of the wine glass.

The book is Cicero's *Cato Major, or De Senectute*, bound in calfskin. It is Franklin's aim to electrify the *Cato* or, rather, to electrify the gilt design on its cover. Franklin has tooled the design himself: a rectangle within a rectangle within a rectangle of gold, the inner and the middle joined at the corners with floral rolls (fig. 1). Some variation of this simple design is used across the British colonies, whenever books are gilt, which is rarely.

"Instantly there is a strong spark and stroke, and the whole line of gold, which completes the communication, between the top and bottom of the bottle, [appears] a vivid flame, like the sharpest lightning"

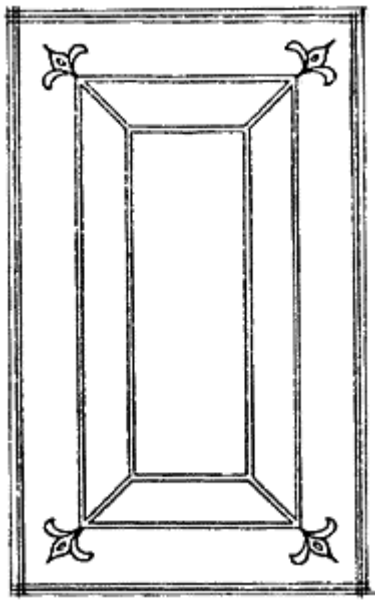

Fig. 1. The "Cambridge" design for the cover of Cicero's *Cato Major*, bound and gilt in Philadelphia and presented by Franklin to Yale president Thomas Clap in 1747

(author's sketch).

"Gold is like silver," says Franklin, "a fine conductor of the electrical fire."

"And is that," I ask, "why all the covers of the ledgers and account books in Philly are decorated with gold?--so bankers and merchants can perform electrical experiments?"

"No," he answers. "Pay attention."

As a printer, Franklin knows a lot about bookbinding. Recently, he has turned his binder's press to electrical purposes, using it as a vice for melting strips of gold or silver pressed tightly between plates of glass (223). The electrical and chemical properties of silver and gold are of considerable interest to Franklin and his colleagues in England: Peter Collinson, John Fothergill, and Matthew Boulton. In the 1760s Fothergill and Boulton (of steam-engine fame) will open a furniture gilding, or "ormolu," shop in Birmingham and, on off-hours, share the secrets of gold amalgams with the Lunar Society, a club of British scientists and manufacturers such as Joseph Priestley, Erasmus Darwin, Josiah Wedgewood--and, on occasion, Franklin himself. But there's not much gold in North America. In Pennsylvania, you can see it occasionally on the bindings of books: sermons, Masonic lore, Ciceronian favorites like the *Cato*, or, most often, on blank account or ledger books--a kind of bestseller in the American business.

"Even now," I inform Franklin, "down at OfficeMax, the account books and appointment books are gilt with lines of fake gold."

"Hmm," grunts Franklin. "Gold supports the money system."

"I don't think that's true anymore," I tell him.

"Oh. Well. Paper is my preferred medium, anyway--in all matters. But look: I will transform the King of Metals into a medium of electrical conduction."

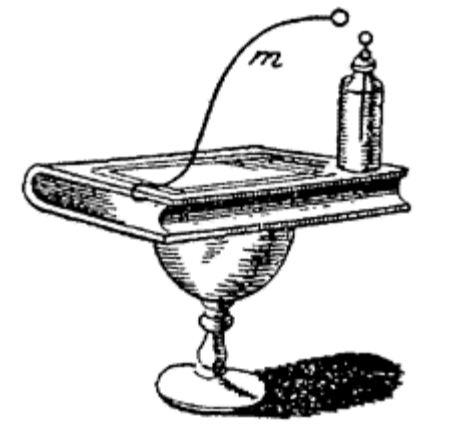

Fig. 2. The Book on the Wine Glass. From the frontispiece of the fifth English edition of Franklin's *Experiments and Observations on Electricity, Made at Philadelphia in America* (London, 1774).

Franklin scrounges a wire from his shelves. Holding it up to the candlelight, he bends it into the shape of a long, cursive M. He presses one end of the M around the edge of the book, so that it crosses the gilt like a paper clip. The other end curves awkwardly up into the air (fig. 2). He reaches for his "phial": a Leyden jar, a device for creating an electrical charge. He positions the Leyden jar carefully on the other end of the book, snuffs out the candles, and leans over his arrangement. In the darkness, Franklin lifts a stick of wax about the size of his index finger, and uses it to push the elevated end of the wire M slowly over towards the mouth of the Leyden jar, from which another wire obtrudes . . . The two wires touch, and ZAP!

"Instantly there is a strong spark and stroke, and the whole line of gold, which completes the communication, between the top and bottom of the bottle, [appears] a vivid flame, like the sharpest lightning" (186).

Wow. You knew he killed turkeys and chickens with jolts of sharpest lightening; but you'd never heard of his electric books.

"Sometimes, in the dark," Franklin says, "we electrify a book that has a double line of gold round upon the covers, and then apply a knuckle to the gilding; the fire appears every where upon the gold like a flash of lightning; but not upon the leather, nor, if you touch the leather instead of the gold. Neither calfskin, nor goatskin, nor softest buckskin will glow like the King of Metals" (177).

"This matter of electricity," he continues, "is an extreme subtle fluid, a kind of *aether* that penetrates all bodies

equally, and subsists in them diffused. Whenever it is unevenly distributed--collected in one place, or evacuated from another--it creates a positive versus a negative charge: plus (+) or minus (-). Whenever there is a greater proportion of this fluid in one body than another the body which has the most will communicate to that which has the least, till the proportion becomes equal. Thus, if its communication with the common stock (in the floor or table, or walls) is cut off, you may circulate it; you may also accumulate or subtract it, upon, or from any body . . . (175-76). But let me demonstrate, this time without the gold."

He goes to the shelf to find more books and pulls out Samuel Richardson's *Pamela, or Virtue Rewarded*, in two volumes. He sets out a second wine glass and, then, carefully balances one volume flat upon each.

I decide to ask a scientific question: "But these bindings are made of animal skin. How do you know that such bodies will conduct the lightning?"

"Because the electrical flow is simply invisible in denser bodies, such as these gilt-less books. In fact, my dear, *any* body can be charged, or discharged by the subtle flying fluid. As in the electrical kiss." Franklin smiles, his jowls twitching slightly. "For example, if *you* stand on the floor, while I stand on wax, and *you* hold the electrised phial in your hand, while I take hold of the wire, then, when our lips approach, they will be struck and shock'd . . . Thus we vastly increase the force of the electrical kiss" (177).

I glance at the door. "But won't this fluid just dissolve in the air?"

"The electrical fluid," sighs Franklin, "does not seem to mix or incorporate willingly with meer air . . . Now, I have placed my *Pamela* on two wine glasses, back towards back, two or three inches distant. I will set the electrified phial on one, and then touch the wire with my hand. That book will be electrified minus, the electrical fire being drawn out of it by the bottom of the bottle. I now take off the bottle, and then, while holding it in my hand, I touch the other book with the wire. That book will be electrified plus, the fire passing into it from the wire, while the bottle is, at the same time supplied from my hand."

He scrounges, this time retrieving a small, round cork on a string. He dangles the cork between the two books, where it immediately begins to swing rhythmically back and forth between them. "Thus," he says, "the small

cork-ball will play between the books until equilibrium is restored" (184-85).

"It seems," I observe, politely, "that electricity ebbs and flows like the tides, but that its motion is controlled, as in a canal. You are an electrical engineer, Dr. Franklin."

"Well, yes . . . " he answers. "Although, strictly speaking, electricity subsists quite calmly in all particulate objects, prior to any operation. In its original state it is better described, in fact, as kind of *aether*-net" (208-09).

Franklin gestures again to the *Cato*, devoid of charge. "The leaf-gold used in bookbinding is porous. When you hold it to the light, it appears like a net, and, when it is electrified, the fire is seen in its leaping over the vacancies, from body to body, or from particle to particle through the air. For the fire is visible only when it is in motion, as when it passes through the links of a chain" (208).

"Your explanations are all metaphors." I observe. "*Aether*net, canal, fluids, channels, chains."

"Well, yes!" he says. "In fact, you might say that metaphor itself is a very powerful electrical device! Ultimately, indeed, there are no bounds (but what expense and labour give) to the force man may raise and use in the electrical way. For bottle may be added to bottle *in infinitum*, and all united and discharged together as one (246). Such a force could never be sustained by the leaf-gold, however. One strong shock breaks the continuity of . . . the filleting, and makes it look rather like dust of gold . . . " (225).

Franklin is fascinated by the gold leaf used in book-gilding because, thin as paper, it makes electricity visible. He walks over to the shelves to find some, and returns carrying a tiny book. He opens it. Between the covers are several hundred squares of pounded gold carefully stacked between equally small sheets of paper. The largest sheets in the book are only two or three inches square. Franklin picks out one of the fragile pages of gold and holds it up to a candle. Then he hands it to me.

"Where does it come from?" I ask.

"Probably from Brazil, the *Minas Gerais* region--or the province of General Mines" (fig. 3).

Fig. 3. The *Minas Gerais* of Brazil (author's sketch).

I know about this place. The mines west of Rio de Janeiro are famous for their wealth. Brazilian gold fuels English industrial expansion. It is said that, in good years, nearly £50,000 of gold from Brazil arrives in London every week.

While Franklin restacks his leaves, I silently track the flow of bullion from Brazil, making a map of its capillary branches:

Brazilian gold is mined by African slaves, imported from Angola by the Portuguese; from the mines of *Minas Gerais*, it is conveyed to Rio, and shipped to Lisbon. Since the early years of the eighteenth century, gold has been pouring into Portugal where it stimulates an endless flood of British manufactures into Lisbon. Portuguese merchants use Brazilian gold to pay for British imports. As a result, the flow of gold into Portugal is immediately redirected to London--and from London to northern Europe and around the world. Through Portugal, the British receive enough Brazilian gold to pay for their own essential imports, mostly raw materials arriving from the Baltic countries, India, China, and North America. Because it uses Portuguese gold to pay for raw materials, Britain can concentrate fully upon its own domestic, industrial development. In the process, British manufacturing produces more and more British trade goods--which continue to flood consumer markets around the world, such as Portugal and Brazil.

Unable to develop its own manufacturing base, Portugal copes with British imports by re-exporting them to

Brazil (in return, of course, for remittances of Brazilian gold entering Lisbon's Tagus River, only to be dispatched to London or Amsterdam to pay for British goods). While Franklin experiments with the conducting power of leaf-gold, then, the gold from *Minas Gerais* has reduced Portugal to the status of an entrepôt--a middle ground of exchange, a suture point for flows of gold and commodities whose circulation supercharges British manufacturing. Portugal tries to staunch the hemorrhaging of Brazilian gold from Lisbon; but this proves impossible. Whenever the Brazilian fleets arrive on the Tagus, British navy vessels and merchantmen already lie in wait, a continual irritant to Portuguese port authorities. By 1755, Portugal's prime minister will declare that the English have conquered Portugal without the trouble of a conquest, that they are supplying two-thirds of its needs, and that British agents control the whole of Portuguese trade. Portugal is producing almost nothing, and, as Eduardo Galeano puts it in *Open Veins of Latin America* (1973), "The wealth brought by gold [is] so illusory that even the black slaves who [mine it are] clothed by the British" (68).

By now, in the mid-eighteenth century, the production of Brazilian gold has exceeded the total volume of gold extracted by Spain from its colonies in the two previous centuries. Portuguese emigrants and some ten million black slaves swell the mining towns of the Brazilian interior: Sabara, Mariana, and, the biggest of all, the Vila Rica de Oura Preto, the "Rich Town of Black Gold." The slaves eat, sleep, and work in the gold-washing installations: weighed, and shipped from Angola, they are called the "coins of the Indies." In Brazil, those who survive the voyage become "the hands and feet" of the white master. At Ouro Preto, the *capitaes do mato* collect rewards in gold for the heads of slaves who try to escape. Many of these are Bantu, sold to the Portuguese in exchange for clothing, liquor, and guns. But, as Galeano points out, Brazilian miners actually "prefer blacks shipped from the little beach of Ouidah on the Gulf of Guinea because they are more vigorous and [last] somewhat longer. And every miner needs a black mistress from Ouidah to bring him luck . . . " (66).

Franklin's voice intrudes insistently.

He is telling me how to gild a book with leaf-gold. "We call the adhesive 'glaire.' You make a hole in the shell of an egg, run the white into a cup, and then froth it with a quill. Skim off the froth and add a little vinegar or wine to preserve it. Let it sit for several hours and then apply the glaire to the empty design tooled in the leather. Place

a sheet of leaf-gold over the design, and press against it with the hot gilding tool, filling the lines with gold . . . "

"I am beginning to see," I inform him, "that your electric books are just one component in a remarkable *aether*net-of-work, a Net-of-Work which elevates some bodies (as particulate, free, illuminated), while relegating others to invisibility. You exhibit your American electricity as a universal medium that penetrates all things; but it is an artifact of Anglo-American accounting, managed by operators and middlemen in the temperate zone, the middling zone, where matters are technically brought into equilibrium, through exchange, interchange, electrical commerce."

"And your commerce skips over a lot of things, doesn't it? When the plusses and minuses are added up, certain objects, certain bodies just fall away--because they don't register as costs, and for that reason they don't exist. For example, if something isn't either obviously dark or light (+ or -), it can't really be included in the procedure. Am I right? Unbalanceable bodies are nonthings; because they cannot be assimilated to the binary grid of the extractive enterprise, they cannot be seen in the enlightenment of your lightening, of your superprocessing *aether*net."

"And there is another circuitry at work, a linguistic one. The function of metaphor in conducting the power of American electricity suggests that the resources of language too have come to constitute a kind of exploitable cognitive energy that functions exactly like the electrical mechanisms they are supposed to comprehend, leaping over differences (via similarity) and dissolving similarity (via difference). Within the world of electric commerce, analogy and metaphor are just one more device in a diffused synaptic system! And yet you claim that it is the virtue of your science to make sense of things! I can see, Dr. Franklin, that it is *you* who have already invented the Internet--and the *aether*net--as a set of dynamically constellated work sites."

Franklin smiles. "I must confess," he says charmingly, "to being a little in the dark about the light. But, might not all these phenomena be conveniently resolved by supposing universal space filled with a subtle elastic fluid, which, when at rest, is not visible, but whose vibrations affect the eye, as the vibrations of the air do the ear . . . ?" (325-26).

I stand up, and, slipping the little leaf of gold into my pocket, I walk out the door.

Sitting on the stoop outside, chin in hand, the wind feels cool--ah, the temperate zone . . . But Franklin sticks his head out behind me, with one more lesson: "If you ever," he warns, "find yourself sleeping in a house that lacks a lightening rod, and a storm arises, here is what you must do. Suspend a hammock or swinging bed, by silk cords equally distant from the walls on every side, and from the ceiling and floor above and below. This affords the safest situation a person can have in any room whatever; and what indeed may be deemed quite free from danger" (392).

"Exactly," I think. "Suspended. Particulate. Floating, like a fish of gold."

I get up and leave him there, then, a figure in the doorframe. It is windy and, as I walk down the street, with nothing in my hands, the dry leaves spin down from the trees, turning over themselves: back to front, back to front.

Further Reading:

Franklin's dialogue is drawn directly, or paraphrased from his electrical papers of 1747, 1769, and 1774, as published in I. Bernard Cohen's, *Benjamin Franklin's Experiments: A New Edition of Franklin's Experiments and Observations on Electricity* (Cambridge, Mass., 1941). Quotations, paraphrases, and key terms from Cohen's edition are referenced throughout the dialogue by page numbers in parentheses.

Franklin's binding of *Cato Major, or de Senectute* is discussed by Hannah Dustin French, "Early American Bookbinding by Hand," in *Bookbinding in America: Three Essays*, ed. Hellmut Lehmann-Haupt (New York and London, 1967): 18-39. This discussion includes a black-and-white photograph of the cover of Franklin's *Cato* (134, fig. 6). For a discussion of the English panel style of decoration, known as the "Cambridge style" used by colonial binders "throughout the seventeenth century and part of the eighteenth centuries," see Edith Diehl, *Bookbinding, Its Background and Technique*, vol. 1, (Port Washington, N.Y., 1946). Edith Diehl offers a detailed description of the specialized process used by goldbeaters for pounding gold into leaf for use by bookbinders, in *Bookbinding*, 188-89. Bernard C. Middleton describes the use of glaire in gilding in *A History of English Craft Bookbinding Technique* (New York and London, 1963), 176.

For an overview of orders for bookbinding that Franklin received between 1728 and 1737, see G. S. Eddy, *Account Books Kept by Benjamin Franklin*, 2 vols. (New York, 1928-29). These volumes also document Franklin's role in supplying far-flung colonial bookbinders with gold leaf and other materials. C. Clement Samford surveys the numerous kinds of account books ("blank books," "legers," "alphabets," "journals," "account books," "day books," "wastebooks") bound and gilt by a contemporary Virginia printer in *The Bookbinder in Eighteenth-century Williamsburg, and Account of his Life and Times and of his Craft* (Williamsburg, 1964), 17.

For Boulton's and Fothergill's Birmingham ormolu business, and Franklin's attendance at the Lunar Society see Nicholas Goodison, *Ormolu, The Work of Matthew Boulton* (London, 1974), 8. Ormolu is the art of gilding that used an alloy of gold and mercury, creating ornamental metal objects, clocks, candelabra, doorknockers, and mounts; many of Fothergill and Boulton's designs were based on the neoclassical patterns illustrated in books such as Robert and James Adam, *Works in Architecture* (1773-79); see vol. 2, no. 4, plate 8 (277, fig. 46).

There are many studies of the discovery and circulation of Brazilian gold and its role in industrialization in Britain. My account draws primarily upon Artur Attman, *American Bullion in the European World Trade, 1600-1800* (Goeteborgs Kungl. Vetenskaps-Och Vitterhets Samhaelle. Acta: Humaniora, No. 26, 1986), 64-67; Eduardo Galeano, "Ouro Preto, the Potosi of Gold" in *Open Veins of Latin America*, trans. Cedric Belfrage (New York, 1973), 62-70; James Lydon, "Fish and Flour for Gold: Southern Europe and the Colonial American Balance of Payments," *Business History Review*, 39 (1965): 171-83; Pierre Vilar, *A History of Gold and Money, 1450-1920*, trans. Judith White (London, 1976), 222-3l; A. J. R. Russell-Wood, "Colonial Brazil: The Gold Cycle, c. 1690-1750," in *The Cambridge History of Latin America*, vol. 2, ed. Leslie Bethell, (Cambridge, 1984): 547-600.

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