Oedipal revolt present in Homer produced the creative tensions in Greek, and especially Athenian culture. "Both tragedy and democracy are impossible when all authority is seen as good and blind obedience to authority is considered a high virtue." In the end, Plato joined Homer's condemnation of the revolt by proposing an ideal system that would produce fathers so virtuous that revolt would be unnecessary. And the old ambiguous stories, such as Cronus' castration of his father, need not even be told any longer. What had happened in the archaic and classical periods was "not the transformation of a shame and glory culture into a guilt and conscience culture," rather transformation "into one in which shame and guilt, glory and conscience, would coexist and struggle against each other. In cultural terms, the final resolution of that conflict has yet to be accomplished." In this way Sagan addresses the current discussions that derive from E. R. Dodds.

Sagan offers readings of tragedy which emphasize tyranny and justice within the family as the prototype for political values. He finds that the tragic poets do write scenes of reconciliation, but fail to convince in the way that, e.g., those of Lear and Cordelia or Joseph and his brothers do. "Something in the Greek mind seemed to withdraw when faced with the problem of making people love each other after they had held each other in hatred. The hatred in these plays is always believable, the love which is supposed to conquer the hatred is vague or spoiled." He finds a series of negative pronouncements about human nature in Thucydides, and finds that Euripides feebly objects to the attitudes that Thucydides exhibits. I find Sagan's readings compelling.

As a student of Classical history and literature Sagan is not scholarly, in the sense that he does not acknowledge and discuss authoritative interpretations that differ from his own, but in the end that is of little moment. He has used good sources and has gone beyond them in ways that should be of use even to those who dispute his readings of individual works, so long as they admit the validity of the general approach. Is there an Oedipal complex which is collective, societal, as a result of shared values? Can the Hebrew-Christian God-the-Father compete with the Greek pantheon for parenting, and is it meaningful so to discuss civilizations? I recommend the book as an interpretive manifesto. I hope that its methodology and interpretations of ancient documents will receive serious attention.

We read the past in order to learn. Sagan finds a parable for us, "The western civilization which now doubts its credentials is capitalist civilization, built upon economic inequality, imperialist wars and that subtle form of human aggression called "competition" which insists that those who suffer in society somehow deserve that suffering" (p. 216). It is a long stretch, and I think that one Oedipal theory does not have to cover everything, but the attempt is worthy.

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J. L. HEILBRON, *Electricity in the seventeenth and eighteenth centuries. A study of early modern physics*, Berkeley, Los Angeles, and London, University of California Press, 1979, 8vo, pp. xiv, 606, illus., £24.00.

The title is prosaic, but the content is anything but a pedestrian account of a science that has been a sleeping partner in the "Scientific Revolution" industry. Heilbron presents an engaging and marvellously detailed exploration of almost every facet of the history of electricity in the period, surveying the experimental and theoretical labours of a large army of "electricians", from Gilbert, the founder of the science, to Volta, Cavendish, Coulomb, and Poisson, whose quantifications of newly-emerged fundamental concepts and their relations, together with parallel developments in magnetic theory and with Volta's invention of the electric pile, led to the establishment of the links between electricity and magnetism detailed in classical electromagnetic theory. Philosophically, Heilbron writes in instrumentalist mode (Poisson is his *terminus ad quem* and on the last page he invokes Dirac's famous 1930 dictum), and his history chronicles the struggle of experimentally-vindicated quantitative laws to win recognition in the face of tough opposition from conceptual eccentricity, explanatory blind-alleys, fanciful

theorizing, retrograde wanderings, and other assorted obstacles that history has inconsiderately created for onward-marching science. These attitudes no doubt account for some strange assertions. For example, in his Introduction Heilbron claims that "at a level of [financial and institutional] support comparable to today's, early modern physicists no doubt could have brought knowledge of electrical phenomena from its very beginnings with Gilbert to the order given it by Dufay in a few years. It took a century and a third." (p. 2). How does Heilbron know? And how could such a proposition possibly be proved or disproved?

Nevertheless, Heilbron does take note of the ideas and arguments "that didn't make it", so his history is a rich and comprehensive source for those interested not merely in the history of electricity, but indeed of early modern physics in general. He shows with painstaking care the great difficulties the early physicists encountered in accounting for (and reproducing) electrical phenomena, in comparison with which the mechanics of solid bodies (say) must have been child's play. As Heilbron shrewdly notes, apropos a Newtonian editor's criticism of the master for failing to Newtonianize the wayward motions of electrified paper bits he described to the Royal Society in 1675, "to have discerned the laws of plus and minus electricity, of superposed central forces, of insulators and conductors, in the whirling and skipping of the bits would have been a feat more remarkable than the invention of the gravitational theory" (p. 5). Part Two deals with 'Electricity in the Seventeenth Century': Gilbert, the Jesuit physicists, the Accademia del Cimento, Boyle, von Guericke and other immaterialists, and the Cartesians, notably Huygens. Part Three with 'The Great Discoveries': Hauksbee's experiments and Gray's demonstrations of communication, Dufay's methodological rigour and his major discoveries, including the crucial "attraction-communication-repulsion" sequence, the scene in Germany, and in France and England after Dufay and Gray. Part Four with 'The Age of Franklin': relatively little on Franklin himself, but a delightful account of the invention of the Leyden jar (independently in Holland and Germany), the reception of Franklin's ideas in Europe. Part Five with 'Quantification': the invention of the electrophore, the debate over whether contrary electricities corresponded to two fluids or one, the emergence of the concepts of charge, capacity, and "tension".

There is one omission that will interest readers of this journal. Heilbron gives no extended treatment of the applications of electricity to medicine. He does no more than mention the pioneering work of Krüger and Kratzenstein (1743–44) and Nollet's attempts (1746) to cure paralytics by applying the Leyden jar. Yet according to his own Table 20.1 (p. 491), during 1752–61 articles on medical electricity made up 45 per cent of those published on electricity, during 1762–74 they made up 35 per cent of the total, during 1769 30 per cent, during 1775–1788 30 per cent, and during 1789–97 a surprising 70 per cent, though Heilbron suspects a "bias towards medical electricity in the 1790s" in his source for these statistics!

What of Part One, missing from the above synopsis? As a monograph-length bonus, Heilbron prefaces his history of electricity with a 166-page account of 'Early Modern Physics and its Cultivators', which turns out to be the only serious treatment of the subject in or out of print. Even if it were not the only acceptable introduction to early modern physics, it would surely rank as one of the best. Heilbron distinguishes and traces the relations between "physics" (scholastic sense), *magia naturalis* (which in the seventeenth century included experimental investigation of uncommon phenomena), and mixed mathematics (which included quantified physical science). It was the latter which led to the experimental physics that was to change the nature of post-Newtonian physics, especially in the domain of electrical phenomena, which, though more difficult to quantify than other branches of "physical mathematics", had become the major and most popular branch of experimental physics by the mid-eighteenth century. He surveys the variety of explanation in the seventeenth century for all (not only electrical) phenomena: occult causation, corpuscularism, Newtonian attraction, the Newton of the *Opticks*, Leibnizian causation. In the eighteenth century there were the Newtonian-Cartesian arguments over the nature of gravitational force, and, later in the century, the "reification" (tempered by an instrumental epistemology), in the form of fluids or other carriers, of the diverse physical forces associated with magnetism, electricity, heat, light, and fire. Then there was finally the extension of quantification from mechanics, geometrical optics, and hydrostatics

to electrostatics and magnetism during the second half of the eighteenth century, accompanied by the increasing employment of sophisticated instruments.

Even within such a dense account of early modern physics, Heilbron manages to include an extensive examination of the "boundary conditions" (my term, not his) on the scientific activity he explores: the social, financial, educational, and institutional contexts in which the work was done. Thus we have accounts of the Jesuits, many European academies and societies, of the working conditions, courses, and salaries of European university and college teachers, and of independent operators of all sorts and conditions whose main aim was the popularization of science. However, although very useful in itself, this account of the extra-scientific boundary conditions illuminates very little of what goes on in Parts II-V, since Heilbron does not tell us exactly how these boundary conditions shaped the science that developed within them.

Heilbron makes one striking claim, for which his book constitutes a sizeable body of evidence: "the single most important contributor to the support of the study of experimental physics in the seventeenth century was the Catholic Church, and, within it, the Society of Jesus" (p. 2). This is a view not often met with in the pages of *Past and Present*, and should be set as an interpretative test-piece for the supporters of the Merton-Hill-Webster thesis. More precisely, and more constructively, we should ask ourselves what it was that seventeenth-century Jesuits and Puritans had in common.

There is a full index, and a superb 69-page bibliography.

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FRED GETTINGS, *Dictionary of occult, hermetic and alchemical sigils*, London, Routledge & Kegan Paul, 1981, 4to, pp. 410, £15.95.

Alchemical, astrological, and medical-chemical (chemiatric) texts are notoriously difficult and often made completely inaccessible through interlarding with "occult" ciphers. These are "sigils" that are neither abbreviations nor hieroglyphic symbols, but belong to a category of their own. They were probably meant to exclude the profane reader or else to place on record an imagined discovery or new recipe for transmutation without giving the secret away. Some of the sigils are consistent and what they stand for has been known for a long time in a well-established tradition. However, there are innumerable variants and problems of deciphering that remain. A historical and graphical basis of the sigils can be found in various archetypal alphabets, notably those related to ancient Hebrew scripts and the extant "secret" alphabets that are derived from them. The need for a comprehensive and annotated inventory of the sigils has long been felt. Alchemy has so far been covered by the magisterial work of G. W. Gessmann (1899–1922) with its 120 excellent lithographic impressions and good indices. However, though purporting to give the "occult symbols of alchemy, medicine and astrology of the Middle Ages", it is restricted to alchemy. Nor does it indicate the source for any let alone each individual sigil. This is perhaps the most prominent feature by which the work under notice is distinguished and in advance of anything that has gone before in this field. Moreover, its net is cast wide – not only astrology, but also occult and "hermetic" topics in all their ramifications are as comprehensively dealt with as is possible today. To give an example of the richness of entries, there are no less than eighty for capricorn as against a single one in an extant modern glossary – they include the variants and their common modifications and the rare forms each with its source, manuscript, incunabula, and papyri, among them (Thurnheisser's *Hermeneia*. 1583, (its first part, 1574, is quoted under *Onomasticum*) and the "celestial alphabeth" of Gaffarel, 1629, being strangely omitted). Interesting sidelights fall on such marginal items as John Dee's famous Hieroglyphic Monad (1564). This is entered under Monad (p. 175), Omega (p. 187), and Immortal Adam (p. 144). The problem in this composite sigil lies in its bottom-line. This consists of two curved lines like an omega, but inverted, closed above and open below. Under "monad" it is given as "alchemical fire, a sigil related to the form used for Aries" (p. 175). Under "omega" (p. 187) the reader is referred to "Immortal Adam" (p. 144) where the sigil is