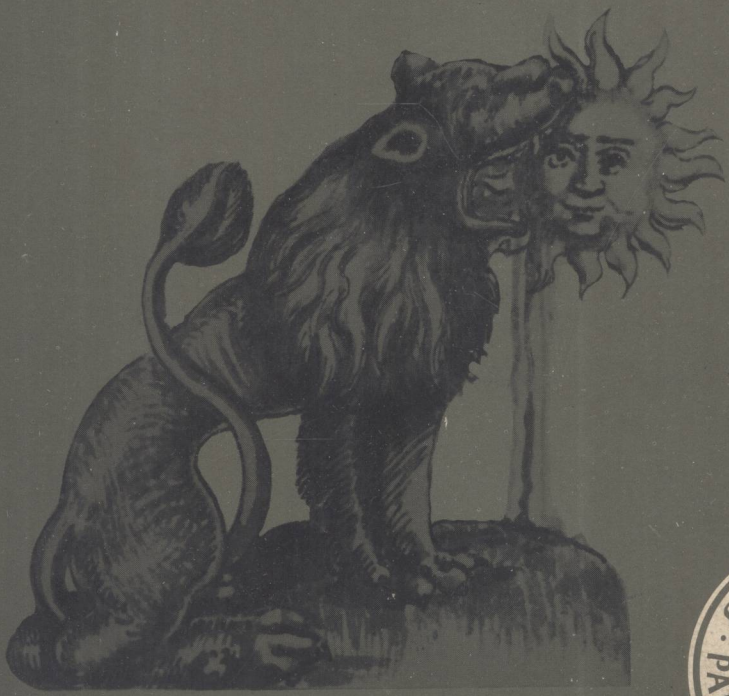
The Foundations of Newton's Alchemy

or, The Hunting of the Greene Lyon

B. J. T. Dobbs



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or

"The Hunting of the Greene Lyon"

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Sir Isaac Newton left at his death a large collection of papers on alchemy, mostly in his own handwriting; the importance of this legacy has been debated ever since. When it first appeared, Professor Dobb's detailed analysis of the foundations of Newton's alchemical pursuits further stimulated interest in the subject by firmly establishing the importance of alchemy in Newton's thought.

This book sets the foundations of Newton's alchemy in their historical context in Restoration England. It is shown that alchemical modes of thought, and particularly those of a Neoplatonic kind, were quite strong in many of those who provided the dynamism for the scientific revolution of the seventeenth century, and that these modes of thought had important relationships with general movements for reform in the same period: reform of religion, philosophy, learning, society, and of man himself. Against this background, Professor Dobbs establishes the scholarly and experimental bases Newton provided for himself during his early alchemical studies, analysing in detail his surviving papers and notes. Newton indeed believed himself to have achieved experimental success in preparing a true "philosophical mercury", and left a remarkably complete account of this work: this fascinating manuscript is reproduced in full. Finally, the alchemical thought patterns evident in Newton's later scientific publications are discussed, and their role in his development of the concept of "active principles", notably the attractive force of gravity, is outlined. Newton's alchemy is thus seen as a crucial link between Renaissance Hermeticism and the rational chemistry and mechanics of the eighteenth century.

"Not every first book suffices to establish a reputation. Mrs Dobbs's superb achievement does just that . . . No one interested in seventeenth century science should allow himself to miss the work."

Journal of the History of Medicine

"Dobbs's book should be read not only by scholars of Newton: it should be basic reading for students of the Enlightenment as well as for historians interested in the connection between Renaissance Neoplatonism, broadly interpreted, and the origins of modern thought."

The Eighteenth Century

The Foundations of Newton's Alchemy

TO MARY GLADYS GREER TEETER, MY MOTHER, WHO, FROM HER VANTAGE POINT IN THE SMALL TOWNS OF ARKANSAS, ALWAYS RECOGNIZED THAT THERE WAS MORE TO BE LEARNED

Preface

This study, since its original conception, has contracted in its projected coverage of Newton's own alchemy as it has expanded in its coverage of the tidal waves of the Hermetic modes of thought that engulfed his period. Only a tiny fraction of Newton's own alchemical experiments have been explored in the event, but it is hoped that they have been made more comprehensible by placing them in their matrix in the intellectual currents of the seventeenth century. What has resulted here is a composite, and the word "foundations" in the title may be taken in three separate ways. One sense in which the word is used in this work is that of origins, and the origins of Newton's alchemy in Restoration England are emphasized. Another sense is that of the experimental and scholarly bases Newton provided for himself in his alchemical studies, and those foundations are examined also for the earliest period of his work. The last sense in which the word is to be taken is that of supports, and alchemy is seen finally as comprising one of the pillars which supported the structure of Newton's mature science.

This book is, in a small way, a work of both intellectual history and the history of science. Perhaps that is appropriate, even necessary, in studies dealing with scientific thought in the seventeenth century. For modern science in its nascence surely bore the marks of the ancient womb of human thought in which it had had its long period of gestation. Not all of those antique thought patterns are acceptable today as valid approaches to the world of phenomena or as genuine and honest efforts at making that world comprehensible. Modern science, like an adolescent, denies its parentage.

But the rich complexities of the seventeenth century produced a "century of genius," and it will perhaps do no harm to recapture what we can of its intellectual atmosphere. Newton is the century's epitome: his great synthetic mind wove its multiple strands together to make a brilliant new tapestry. In methodology he integrated the empiricism of Bacon and the mathematics of the ancients; in physics he integrated Kepler's planetary motions with Galileo's terrestrial ones. In both cases he added his own inimitable flourishes, making his productions something wholly new. In his chemical studies the same pattern may be detected, for Newton strove to integrate alchemical and Hermetic ideas with the mechanical philosophies of his day. The result was somewhat less successful in the realm of chemistry proper than were the results in

some of his other undertakings. But in fact his efforts to integrate alchemy and mechanism seem to have produced one of his best virtuoso performances: the creation of a new concept of force. Newton's alchemy is the historical link between Renaissance Hermeticism and the rational chemistry and mechanics of the eighteenth century.

Two research tools which have been invaluable in this study are Maurice P. Crosland, *Historical Studies in the Language of Chemistry* (Cambridge, Mass.: Harvard University Press, 1962) and J. W. Mellor, *A Comprehensive Treatise on Inorganic and Theoretical Chemistry* (16 vols.; New York: John Wiley & Sons, 1960). They have been used freely throughout for innumerable problems in the translation and interpretation of seventeenth-century chemistry and alchemy and no further citation will be made to them. The symbols and names in Tables 1–5, drawn in part from those works, in part from various dictionaries and lexicons cited in the Bibliography, and in part from primary sources cited in the text, may be of some use to the reader.

TABLE 1 *Metals*

Symbol	Metal	Celestial analogue
☿	Mercury	Mercury
♄ or ♅	Lead	Saturn
♃	Tin	Jupiter, Jove
♀	Copper	Venus
♂	Iron	Mars
☽	Silver	*Luna*, Moon
☉	Gold	*Sol*, Sun

TABLE 2 *Antimony*

Symbol	Name and modern symbol
♁	Antimony ore, stibnite, Sb_2S_3
Regulus of ♁, ♉, and [in Keynes MS 55] ℞	Metallic antimony, Sb
✳ [in Keynes MS 55]	Star, star regulus, Sb
R ♂, Regulus of iron	Metallic antimony prepared by the use of iron, Sb

TABLE 3 *Other chemicals*

Symbol	Seventeenth-century name	Modern name and symbol
	Sulphur	Sulfur, S
Æ	*Aqua fortis*	Nitric acid, HNO_3
	Vitriol	Any sulfate but probably usually that of iron or copper, $FeSO_4$ or $CuSO_4$
✳ [usually]	Sal ammoniac	Ammonium chloride, NH_4Cl
	Salt peter, nitre	Potassium nitrate, KNO_3
	Tartar	Potassium hydrogen tartrate, $KH(C_2H_2O_3)_2$
	Salt	Sodium chloride, NaCl, or other salt
	Mercury sublimate	Mercuric chloride, $HgCl_2$
---	Sal alkali	Probably sodium or potassium hydroxide, NaOH or KOH

TABLE 4 *Measures, apparatus, and processes*

Symbol	Name
$\overline{3}$	Ounce
β, ss	$\frac{1}{2}$
+	*Crucibulum*, crucible
	Tigillum, crucible, cupel
$\overline{aaa}$	Amalgam, amalgamate
℞ [usually]	Take or prepare

TABLE 5 *Miscellaneous*

Symbol	Name
♆, q̄. ē.	Quintessence
♌	*Leo*, lion

Where square brackets occur in quotations from Newton's manuscripts, they are Newton's own. The arrows up and down set off Newton's interlineations; the carets indicate probable readings supplied by the present investigator where the manuscript is damaged or otherwise illegible and where it has been necessary to interject an explanatory remark.

References are cited in full when they are introduced for the first time. Subsequent citations to the same work will utilize a shortened form but will include also a parenthetical direction to the full title, such as (1, n. 5), to direct the reader to Chapter 1, note 5, if he desires the fuller form.

Many libraries and their staffs have assisted with books, manuscripts, microfilms, and Xeroxes: the several branches of the library of the University of North Carolina at Chapel Hill; University Library, Cambridge; the libraries of Trinity College, King's College, Queens' College, and Gonville and Caius College, Cambridge; The Fitzwilliam Museum, Cambridge; The Bodleian Library, Oxford; The British Museum; Babson College; the libraries of Stanford University, Cornell University, Harvard University, Duke University, the University of Wisconsin, and the Yale Medical School; Burndy Library, Norwalk, Conn.; Mercantile Library, St. Louis, Mo.; and the Jewish National and University Library, Jerusalem. Special thanks are due to the University of Wisconsin for a copy of Newton's copy of Eirenaeus Philalethes' *Secrets Reveal'd* and for the use of a copy of the 1650 edition of Sendivogius' *New Light of Alchemy*, and to the Syndics of University Library, Cambridge, to the Provost and Fellows of King's College, Cambridge, to the Master and Fellows of Trinity College, Cambridge, to The Frederick E. Brasch Collection of Sir Isaac Newton and the History of Scientific Thought of Stanford University, to Babson College, the Bodleian Library, the Fitzwilliam Museum, the Burndy Library, and the Yale Medical School for permission to quote from or describe manuscript material in their possession, and to the editors of *Ambix* for permission to use material previously published in that journal, which comprises parts of Chapters 2 and 3.

The inclusion of the illustrations was made possible through the courtesy of the Syndics of the Fitzwilliam Museum, Cambridge; the Provost

and Fellows of King's College, Cambridge; the Science Museum, London; and the Stadtbibliothek Vadiana, St. Gallen.

Grateful acknowledgment for support is made to the National Science Foundation, the Danforth Foundation, the North Atlantic Treaty Organization, and to my husband and children. Katherine Roan Dobbs has assisted with the study of the Newton Collection, Trinity College, Cambridge, Gladys Rebecca Dobbs with the preparation of the index, George Byron Dobbs II and Jean Frances Dobbs with more personal sacrifices and contributions than they perhaps realize, and Dan Byron Dobbs with that good base *sine qua non*. Michael R. McVaugh and Frederick O. Behrends have assisted with translations from the Latin. Michael McVaugh, Robert Siegfried, Henry Guerlac, Ronald Sterne Wilkinson, Richard S. Westfall, John M. Headley, Seymour H. Mauskopf, and William H. Brock have given much valuable advice and encouragement along the way: Professors McVaugh, Guerlac, Westfall, Headley, and Mauskopf, in particular, having read part or all of the work in manuscript, have eliminated many errors which would otherwise appear. Unfortunately, none of them may be given credit for the ones which remain. But a very special debt of gratitude is owing to Michael McVaugh, without whom this project could never have been conceived, much less completed.

B. J. T. DOBBS

30 September 1974

Note to the paperback edition

In her review of this work in 1977 Karin Figala quite correctly pointed to certain problems in my interpretation in Keynes MS 18 of the antimony regulus as the "regulus of leo," offering instead an interpretation of it as the "regulus of Aries." Though the change in no way modifies the basic thrust of my argument regarding Keynes MS 18, at this writing her interpretation seems both more accurate and more plausible, and I should like to call the interested reader's attention to it. Cf. Karin Figala, "Newton as Alchemist," *History of Science 15* (1977), 102–38, esp. 108–10.

B. J. T. DOBBS

4 October 1982

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1. "The Hunting of the Greene Lyon"

Introduction

In the late 1670's or early 1680's, a Fellow of Trinity College, Cambridge, made extensive abstracts from an alchemical poem entitled "The Hunting of the Greene Lyon." At the end of his abstract he made some notes.

> The ↗ script ↙ conteins ye Regimen of ye work in common gold after ye ~~Pher~~ ☿ is made. Jn ye following notes you have the consent of it with other authors & elucidation thereby.[1]

The "work" referred to was the Great Work of alchemy and the man writing was Isaac Newton. How he came to be engaged in that peculiar activity has been the subject of considerable wonder and no little controversy. It is the purpose of the present work to attempt a relief of both wonder and controversy by establishing the historical context and foundations of Newton's alchemy.

Although alchemy is now considered a delusion, a mystical pursuit, or at best a pseudo-science, that was not always necessarily the case. In the seventeenth century quite different attitudes towards it were possible. In this study, after a brief biographical sketch of Newton's life and achievements, an historiographical survey of writings on Newton's alchemy, and a preliminary examination of his alchemical papers, some of the larger questions concerning alchemy in general will be undertaken. In succeeding chapters alchemy will be discussed from the viewpoint of analytical psychology, and a survey of its little-understood developments in the seventeenth century will be made.

With something of the broad currents of seventeenth-century alchemy in hand and with some background information on the flood of alchemical literature of the period, it will then be possible to turn to events in Cambridge as Newton came upon them and to approach the questions involved in the more immediate historical context of his work. It is hoped that a glimpse of that concrete setting Newton encountered in Cambridge will make his alchemical studies seem not only reasonable and natural but indeed almost inevitable.

Then Newton's own earliest alchemical studies and experiments will be considered. It will be seen that Newton attacked alchemical questions

[1] King's College, Cambridge, Keynes MS 20, f. 5r, hereinafter referred to as Keynes MS 20. Techniques utilized in the dating of the Newtonian manuscripts used in this study are discussed in Appendix D. For an explanation of transcription notation on manuscript materials and of alchemical symbols used, see the Preface.

with quite definite chemical processes, working within a fairly widespread alchemical tradition of the period. In the event, Newton achieved some alchemical success, preparing a "philosophical mercury" which he took to be preliminary to "ye Regimen of ye work in common gold."

That success, about 1675 or perhaps a little after, colored a great many of his later scientific ideas. Although it is beyond the scope of the present study to attempt a detailed analysis of Newton's alchemical studies after 1675, some places in his later scientific writings in which alchemical ideas are reflected will be indicated.

Biographical sketch

Isaac Newton was born on Christmas Day, 1642, the premature, posthumous, and only child of an illiterate yeoman farmer of Lincolnshire.[2] Not really expected at first to live – he was later to remark that at his birth he was so small that he might have been put into a quart mug – he survived war, revolution, plague, and the seventeenth-century pharmacopoeia to the age of eighty-four, to be buried in Westminster Abbey, idolized by his countrymen and admired by the world.

His genius appeared more mechanical than intellectual at first: as a boy he constructed water clocks, windmills, kites, and sundials, and cleverly used the force of the wind to enable himself to outjump the other boys. But nurtured by neighboring village schools and the King's School at Grantham his intellectual prowess and his enormous power of concentration slowly became apparent. Recalled from school by his mother to learn the art of farming, he spent his time under the hedges with his books and his calculations, to the utter neglect of the life of his ancestors. Eventually a maternal uncle, a Cambridge man himself, intervened to have him returned to the school at Grantham to be prepared for Cambridge, and Isaac went up to that venerable seat of learning in 1661, entering Trinity College. He was aged eighteen, a little older than most entering students and probably less well prepared than many, but evidently with all his faculties ready to flower. Stimulated by the new Cartesian ferment in physics, philosophy, and mathematics, by Kepler's optics and laws of planetary motion, by Galileo's mechanics, and by the work in mathematics and optics of his own teacher Isaac Barrow, the young Newton

[2] Lesser biographies of Newton are legion; a number are noted in the Bibliography. The three fullest and most serious biographical studies of Newton in English are: (1) David Brewster, *Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton* (2 vols.; Edinburgh: Thomas Constable and Co.; Boston: Little, Brown, and Co., 1855), hereinafter referred to as Brewster, *Memoirs*; (2) Louis Trenchard More, *Isaac Newton. A Biography* (London: Constable and Co.; 1934; New York: Charles Scribner's Sons, 1934; New York: Dover Publications, 1962), hereinafter referred to as More, *Newton*; (3) Frank E. Manuel, *A Portrait of Isaac Newton* (Cambridge, Mass.: The Belknap Press of Harvard University Press, 1968), hereinafter referred to as Manuel, *Portrait*. The following sketch is indebted to all but especially to More, *Newton*.

was soon to tackle – and solve – many of the physical and mathematical questions which engaged his contemporaries. And through all his subsequent work the niceness of his mechanical aptitude and the fine-grained quality of his physical comprehension, that early mechanical genius of his childhood, kept steady pace with his developing intellectual genius and strengthened it.

In January 1664/65 Newton took his Bachelor of Arts degree but in the summer of 1665 was forced to retire to his home at Woolsthorpe as the University was closed because of an outbreak of the plague. It remained closed most of the time until the spring of 1667 and Newton spent the period at his mother's manor, a fact which would hardly bear notice in this summary biography had that period not proved to be his *annus mirabilis*, the marvelous year in which he invented his "fluxions" (later to be developed into the calculus), discovered white light to be compounded of all the distinctly colored rays of the spectrum, and found out a mathematical law of gravity. The gradual development and unfolding to the world, throughout subsequent years, of the productions of that brief period were to establish his reputation upon the granite foundation it still enjoys.

In 1667, however, he merely returned to Cambridge, quietly proceeded Master of Arts, was elected to a Trinity Fellowship, and settled down. Only Isaac Barrow seems to have had an inkling of what was going on in Newton's mind, as Newton had shown him one of the mathematical papers from the Woolsthorpe period. Barrow immediately put it into circulation among interested mathematicians and in 1669 resigned his Lucasian Chair of Mathematics in Newton's favor.

In 1672 Newton disclosed some of the optical discoveries of the Woolsthorpe period to the Royal Society and was in consequence elected Fellow of that group. But it was not until 1684 that the full extent of his gravitational studies came to light. By that time a number of Fellows of the Royal Society had come to the conclusion that the centripetal force of the sun which acted upon the planets must be inversely proportional to the square of the intervening distance, but they could not prove it. Edmund Halley, later Astronomer-Royal, knowing from earlier exchanges that Newton had some ideas on the subject, made the journey to Cambridge to ask him about it. Halley

> at once indicated the object of his visit by asking Newton what would be the curve described by the planets on the supposition that gravity diminished as the square of the distance. Newton immediately answered, *an ellipse*. Struck with joy and amazement, Halley asked him how he knew it? Why, replied he, I have calculated it. . . .[3]

[3] From a manuscript by John Conduitt, who married Newton's niece and lived in Newton's London residence for many years, quoted in More, *Newton*, p. 299. Conduitt prepared the manuscript with a view to writing a "Life" of Newton, but never did so: