Henry Power's Microscopical Observations

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It is probably true that Doctor Henry Power's Experimental Philosophy in Three Books, Containing New Experiments Microscopical, Mercurial, Magnetical, which was published at the end of 1663, elicits no enlightened response, or even faint recognition, from microbiologists in general. Yet, although almost completely unknown, this is an important work, since it was the first book written in English on microscopic observations. Unfortunately, it was totally eclipsed a year later with the appearance of the justly renowned Micrographia by that undoubted polymath Robert Hooke.

Book I of Power's opus is the longest of its three sections (the other two need not concern us), and it stands as the most comprehensive work on microscopic observations of living materials prior to Hooke's treatise. There were, of course, earlier 17th century writings on microscopy, for example, the Apiarium (1625) by Francesco Stelluti and Federigo Cesi, the 34 observations on insect eyes by the Sicilian Giambattista Holdierna (1644), Francesco Fontana's New Observations of the Things of Heaven and Earth (Novae Caelstium Terrestriumque Rerum Observationes... 1646), and Pierre Borel's Century of Microscopical Observations (Observationum Microscoparum Centuria, 1656).

These works consisted mainly of casual descriptions of magnified insects, and it may be noted that they were generally written by Italians. This comes as no great surprise because the early 17th century Italian instrument makers were producing the best sliding-tube compound microscopes available in Europe. It has been pointed out, on many occasions, that the origin and development of the microscope is shrouded in controversy and contradiction. Nationalistic interests have further muddied the historical aspects of the subject. Furthermore, only a few specimens of early 17th century microscopes have survived to the present day for study, but undoubtedly the sliding-tube type was developed and improved by Italian instrument makers during the period 1645 to 1670.

As the name implies, sliding-tube compound microscopes consisted of a series of paper-covered cardboard tubes, usually three or four, which were either slightly larger or smaller than the next (maximum diameter, ca. 2.5 to 4 cm) so that they could slide over one another. The ocular lens or lens system was at the topmost tube situated in a metal or wood diaphragm. The objective lens or lens system was contained in a wooden holder that was screwed into the nose-piece. This could be rotated until the object was brought into focus and thereafter enlarged by extending the various draw tubes. The bottom tube was placed in a tightly fitted ring to which three flat feet were attached, thus holding the microscope upright on a tripod. These instruments had a maximum magnifying power of about \( \times 145 \).

We know from Hooke's description of his microscope in Micrographia that it was of the sliding-tube type. It is probable that Henry Power's instrument was of similar construction. Hooke also used an instrument made for him by Christopher Cock. Power purchased his microscope from Richard Reeves of Long Acre, London. Cock and Reeves were the best known of 17th century English microscope makers. Although predominantly a telescope virtuoso, Reeves was making various other optical instruments from 1640 to 1679, and he was widely regarded as one of the most versatile and skillful practitioners of the art. It is likely that Reeve's microscopes were modeled from instruments of Italian or Dutch design. Eustachio Divini and Giuseppe Campani, both excellent microscope makers, sold lenses of all sizes to astronomers shortly after 1625, and the Huygens brothers, Christian and Constantijn, made compound microscopes before 1654. By 1660 Reeves was selling his microscopes at prices from £3 to £6. Samuel Pepys noted in his diary for 13 August 1664: "There comes also Mr. Reeves, with a microscope and a scotoscope. For the first I did give him £5.10\( \times \), a great price, but a most curious bauble it is, and he says, as good may the best he knows in England and he makes the best in the world."

Even so, these early compound microscopes were beset with technical problems. A magnification of \( \times 150 \) was sufficient to give confused images, and aberrations, both spherical and chromatic, abounded, especially when coupled with the flaws and irregularities of the glass lenses.

The publication of works based upon the use of scientific instruments in the 17th century reflected the ascendance of the new learning or "experimental philosophy" in England centering around the Royal Society. It was Henry Power's report on microscopical observations at the 1 July 1663 meeting of this group that brought them to the attention of Robert Hooke, who was himself keenly interested in such matters.

Power had finished Book I in 1661, and it is
likely that Hooke would never have published *Micrographia* except that the former supplied only three drawings for the entire series of observations. Power was no mere dilettante, however, as we learn from a letter written to Reeves in 1662 in which he suggests that the latter construct his microscopes without a field-lens and that he should supply objectives with a graduated set of powers. The field-lens served to enlarge the field of view, but as Hooke pointed out, when one wished to see fine details, this lens was superfluous.

Power's microscopical observations were made mostly on commonly found insects. We are given descriptions of the magnified flea, bee, fly, ant, butterfly, louse, spider, mite, firefly, grasshopper, spittle bug, lady bug, water spider, and wasps. Additionally, he described magnified vinegar eels, seeds of strawberries, moon wort, wall rue, corn poppies, and lilies. Other objects described were horse hair, sand, sugar, salt, mercury droplets, ribbons, snails, eels, leaves, and nettles. Samuel Pepys used Power's book as a guide to his own microscopical interests and wrote in his diary that it was "very fine and to my content."

We may obtain a clue as to the magnification of Power's microscope from what he writes about the objects under study. For example, it is noted that the flea "seems as big as a little Prawn or Shrimp"; a louse "appears the bignesse of a large Crecket"; cheese mites "appeared equal to a Nutmeg"; and vinegar eels were "as long as my little finger."

The style of Power's writing is delightfully literate, and his descriptions contain numerous and learned philosophical and historical digressions. In Observation II, The Bee, he writes, "I have seen more in one hour than the famous Bee-master Aristomachus did in his fifty years contemplation of these Laborious Insects"; and in Observation III, The Common Fly: "Had Domitian thus busied himself in the Contemplation of this Animal, it has been an employment, not sometimes unworthy of Caesar." Viewing the house spider, Power noted, "Since they wanting a neck cannot move their head, it is requisite that defect should be supplied by the multiplicity of eyes. Secondly: Since they were to live by catching so nimble a prey as a Fly is, they ought to see her every way, and to take her per saltum (as they do) without any motion of their head to discover her..."

The only observation on liquids dealt with vinegar and the presence therein of the vinegar eel. For examining transparent materials, the base of the microscope was placed on a glass plate over a hole in a flat surface. Below the hole a candle was situated, and the light was shown through this aperture and thence through the glass plate, on which drops of the liquid to be examined were placed. Such observations were difficult, due to the sphericity of the drops, evaporation, and reflections; hence, liquids were rarely examined. Even the *Micrographia* contains only a few observations on liquids, and consequently it fell to Leeuwenhoek to discover microorganisms when he hit upon a method for studying fluids by using a single-lens microscope.

The three drawings in Power's book depict the eight eyes of the white field spider, the enlarged thread of a silk "ribbon," and corn poppy seeds. None of these add anything to the text description. One reason for the enormous success of the *Micrographia* was the fact that there were more than 75 drawings illustrating 57 observations; of these, the fly's head, the blue fly, the gnat, the moth, the ant, the flea, and the louse are spectacular.

A few facts of Henry Power's life may be desirable since he is so little known to microbiologists. He was born in 1623 and graduated from Christ's College, Cambridge, in 1644. He obtained an M.D. in 1655 and practiced in Halifax for some time. In 1663 he was elected to the Royal Society. He died on 23 December 1668 at the early age of 45 and was buried at All Saints Church, Wakefield. His only published work was the book we have reviewed, but there exist three other short works on microscopy (one a poem on the microscope) in the British Museum Library (Sloan MSS 1380, art. 15; art. 16; and 4022, art. 11, 1661). Thus passed the brief fame of Doctor Henry Power, FRS, the author of the first English book on microscopy.