

The monument is set in an arched niche, doubly recessed, the pilasters of the inner arch bearing two stone lamps and its apex the veiled head of a woman. The whole is protected by a decorative¹ iron railing. On the floor, in front of the railing, is a stone slab covering the tomb. Upon this is cut:

HIER RUST

ANTHONY VAN LEEUWENHOEK,

OUTSTE LIT VAN DE KOONINCKLIJKE SOSYTEYT IN LONDE.
GEBOOREN BINNEN DE STADT DELFT OP DEN 24STEN OCTOBER 1632.
EN OVERLEEDEN OP DEN 26STEN AUGUSTY 1723.
OUT SYNDE 90 JAAR, 10 MAANDE EN 2 DAGEN.²

This is followed by some verses "to the reader" composed by Leeuwenhoek's young friend and fellow-townsmen Hubert Poot (1689-1733)—the rustic poet who has been called the "Bobbie Burns of Holland" (see Plate XVI)—which run thus:

HEEFT ELK, O WANDELAER, ALOM
ONTZAGH VOOR HOOGEN OUDERDOM
EN WONDERBARE GAVEN,
SOO SET EERBIEDIGH HIER UW' STAP:
HIER LEGT DE GRYSE WEETENSCHAP
IN LEEUWENHOEK BEGRAVEN.³

highest approbation of the whole world. Born at Delft 24 October 1632, and died in the same place 26 August 1723."—The final words "*de toto . . . meruit*" are curiously mistranslated "by which he astonished the whole world" by Wildeman (1903, p. 48).

¹ Morre (1912), following Wildeman (1903), describes this as "elegant"; but Harris (1921) regards it as particularly nasty. I call it "decorative" in a descriptive sense: the reader can form his own estimate of its artistic merits from the illustration.

² "Here lieth Anthony van Leeuwenhoek, oldest Fellow of the Royal Society in London, born within the town of Delft on the 24th of October 1632, and deceased on the 26th of August 1723, being aged 90 years, 10 months, and 2 days." Note the spelling of L.'s name and the rest of the inscription—which has been "corrected" by every previous transcriber.

³ "Since everyone, O traveller,
Great age respecteth, everywhere,
And gifts of wondrous merit:
So here all reverently tread,
Where Science old and gray of head
In LEEUWENHOEK lies buried."



ANTHONI van LEEUWENHOEK
KERK TE DELFT.

OMB IN THE OLD CHURCH

(1740) after a drawing by the designer,

facing p. 101

CHAPTER 1

THE FIRST OBSERVATIONS ON "LITTLE ANIMALS"
(PROTOZOA AND BACTERIA) IN WATERS

(LETTERS 6, 13, 13a, 18, 18b)

LEEUWENHOEK'S observations on the free-living Protozoa probably began with his discovery of certain "very little animalcules" which he saw in fresh water in the year 1674. He described his findings in a letter addressed to Mr. Oldenburg,¹ and dated from Delft, 7 September 1674. This letter deals with other matters also, and the passage in which the Protozoa are mentioned is quite short. (See Plate XVII.) Here it is, in its entirety²:

About two hours distant³ from this Town there lies an inland lake, called the Berkelse Mere, whose bottom in

¹ Henry Oldenburg, Secretary of the Royal Society. See p. 38.

² From *Letter 6*. 7 September 1674. MS.Roy.Soc. [Not in Dutch or Latin collected works.] Part of this letter was translated and printed in *Phil. Trans.*, Vol. IX, No. 108, pp. 178—182 [misprinted 821], 23 Nov. 1674. It is numbered "[10] Brief Tr. 7" by Vandevelde (1922, p. 344), who gives an abstract of it in Flemish (from the *Phil. Trans.* version—not from the MS.). The important passage given above has been generally overlooked by protozoologists—possibly because the letter was omitted, apparently by an oversight, from the table of contents at the beginning of the number in which it was printed. The passage here given begins on p. 181; and I have followed the original translation pretty closely, because it is so lively and faithful. I have a strong feeling—but no direct evidence—that it was not the work of Oldenburg himself: but I do not know who the translator was. The English MS. has not been preserved.—I find since writing the above that attention was directed to this passage—as fixing the date of L.'s earliest observations—by Schill (1887), who reprinted the original English version. His note has seemingly been overlooked by all later writers.

³ John Ray, in his *Journey through the Low-countries*, notes (anno 1663) as a peculiarity that "they reckon or measure their way in these Countreys, by the time they spend in passing it" (Ray, 1673; p. 23).

many places is very marshy, or boggy. Its water is in winter very clear, but at the beginning or in the middle of summer it becomes whitish, and there are then little green clouds floating through it; which, according to the saying of the country folk dwelling thereabout, is caused by the dew, which happens to fall at that time, and which they call honey-dew. This water is abounding in fish, which is very good and savoury. Passing just lately¹ over this lake, at a time when the wind blew pretty hard, and seeing the water as above described, I took up a little of it in a glass phial; and examining this water next day, I found floating therein divers earthy particles, and some green streaks, spirally wound serpent-wise, and orderly arranged,² after the manner of the copper or tin worms, which distillers use to cool their liquors as they distil over. The whole circumference of each of these streaks was about the thickness of a hair of one's head. Other particles had but the beginning of the foresaid streak; but all consisted of very small green globules joined together: and there were very many small green globules as well. Among these there were, besides, very many little animalcules,³ whereof some were roundish, while others, a bit bigger, consisted of an oval. On these last I saw two little legs near the head, and two little fins at the hindmost end of the body.⁴ Others were somewhat longer than an oval, and these were very slow a-moving, and few in number.⁵ These animalcules had divers colours, some being whitish and transparent; others

¹ *nu laest* MS. The date of the observation is not more precisely stated, but it seems clear that the discoveries must have been made in the late summer (end of August or beginning of September?) of 1674.

² The common green alga *Spirogyra*: the earliest recorded observations on this organism. The size of the filament negatives the suggestion that L. could have been referring to *Arthrospira* or *Spirulina*.

³ It can hardly be doubted that some, at least, of these animalcules were Protozoa.

⁴ Probably Rotifers—seen under a low magnification.

⁵ Probably Ciliates.

[illegible]

EXTRACT (REDUCED FACSIMILE) FROM LEEUWENHOEK'S LETTER NO. 6

(7 Sept. 1674: leaf 3 *recto* = p. 5), showing the original of the passage here translated. Holograph MS. The concluding words are on the *verso* of the page, and read: ". . . *int tarwen meel, in schimmel, en etc. heb gesien.*" Apart from this unavoidable omission, the passage is complete.

with green and very glittering little scales; others again were green in the middle, and before and behind white¹; others yet were ashen grey. And the motion of most of these animalcules in the water was so swift, and so various, upwards, downwards, and round about, that 'twas wonderful to see: and I judge that some of these little creatures were above a thousand times smaller² than the smallest ones I have ever yet seen,³ upon the rind of cheese, in wheaten flour, mould, and the like.

No further observations on these "little animals" appear to have been reported until more than a year later. But in a letter written in December, 1675, Leeuwenhoek again alludes to them briefly, in the following words:⁴

In the past summer I have made many observations upon various waters, and in almost all discovered an abundance of very little and odd animalcules, whereof some were incredibly small, less even than the animalcules which others have discovered in water, and which have been called⁵ by the name of Water-flea, or Water-louse.

This passage is important as establishing the date when some of Leeuwenhoek's earliest observations were made—the summer of 1675. At this time, however, he gave no more detailed account of his discoveries: but he kept a careful record, and a month later the following passage occurs in a further note to Oldenburg:⁶

¹ Probably *Euglena viridis*. The peculiar arrangement of the chromatophores in this species gives the flagellate this appearance under a low magnification. The identification seems to me almost certain; and, if correct, this is the first mention of *Euglena*, whose discovery is usually attributed to Harris (1696).

² i.e., in volume—not in linear dimensions.

³ i.e., mites.

⁴ From *Letter 13*. 20 December 1675. MS.Roy.Soc. Unpublished. Original in Dutch.

⁵ By Swammerdam. See note 1 on p. 118.

⁶ From *Letter 13a*. 22 January 1676. MS.Roy.Soc. Unpublished. Original in Dutch.

The living creatures discovered by me in water, were in ordinary rain-water, that was caught from a pantile roof¹ in stone troughs under the ground, or in tubs; also in well or spring water, coming up through well-sand; likewise in the canal water, that runneth through this Town and through the country. Upon these I have made divers notes, concerning their colour, figure, the parts whereof their body is composed, their motion, and the sudden bursting of their whole body; of which notes I keep a copy by me, which I shall send you at the earliest opportunity.

The promised "notes" were sent in due course: they form the celebrated letter (*Letter 18*) which protozoologists have long regarded as the first paper ever written upon the objects of their special study. Moreover, this letter also contains the first account ever written of the Bacteria, as well as many other original observations. In view of its unique interest, therefore, I must say a few further words of introduction at this point.

Leeuwenhoek's 18th Letter.

The famous "Letter on the Protozoa" is a truly amazing document. According to my reckoning it is Leeuwenhoek's eighteenth scientific epistle to the Royal Society, and I shall therefore refer to it henceforward simply as *Letter 18*. The original Letter itself is preserved among the Royal Society's manuscripts, and is still—except for a few slight mutilations—intact. It is in Dutch, and covers 17½ folio pages, closely written in a neat small hand which is not Leeuwenhoek's own, though the manuscript has been carefully corrected by him throughout (in a different ink), and bears his autograph signature at the end. It seems likely that he wrote the letter himself, with his notebook before him, and then caused his

¹ The water so collected was probably very clean water: for Dutch houses then—as now—were wont to be kept clean both inside and out. John Ray, in the diary of his *Travels*—writing in 1663—notes that, in the Netherlands, "all things both within and without" were "marvellously clean, bright, and handsomely kept: nay some are so extraordinarily curious as to take down the very Tiles of their Pent-houses and cleanse them." *Vide Ray* (1673), p. 52.

rough draft to be copied out in a fair hand before sending it to the Society. The letter is dated from "Delft in Holland, 9th October, 1676" [New Style], and is addressed to Henry Oldenburg in person. From an endorsement which it bears¹ it appears that he received it 10 days later, and sent back an acknowledgement of its receipt through Leibniz. The letter was read at the meetings of the Royal Society held on 1, 15, and 22 February 1677 [O.S.].²

A part of this letter was published (in English) in the *Philosophical Transactions* in March, 1677,³ under the heading "*Observations, communicated to the Publisher⁴ by Mr. Antony van Leewenhoeck, in a Dutch Letter of the 9th of Octob. 1676. here English'd: Concerning little Animals by him observed in Rain- Well- Sea- and Snow-water; as also in water wherein Pepper had lain infused*". (See Plate XVIII.) This English version was the work of Oldenburg himself, as is evident from the manuscript translation—in his hand—still preserved with its Dutch original.

Oldenburg's English rendering is the only version of *Letter 18* which has hitherto been printed. It is, on the whole, good: but it is not perfect, and most people will be surprised to learn that it is a condensed translation of less than half of the original, and that the part which Oldenburg did not print has never yet been published in any language. Why the letter has never been published, in its entirety, I do not know. I can only suppose that no protozoologist or bacteriologist has ever yet seen the original manuscript; or, having seen it, has had the courage and diligence to decipher

¹ The endorsement—in Oldenburg's hand—is as follows: "*receu le 9. Octob. st. v. [=style vieux] 1676. resp[ondu]. le 16 Oct. d'avoir receu cette lettre, par M. Leibnitz, mais non pas encor considéré*".—It was in the autumn of 1676 that Leibniz paid his now well-known (but formerly hushed-up) visit to Spinoza at The Hague (cf. Pollock, 1899; p. 37). Perhaps Oldenburg, knowing this interview to be imminent, requested Leibniz to send word to L.—only a few miles distant at Delft—of the safe receipt of his letter. I can find no evidence to show that Leibniz visited Leeuwenhoek on this occasion.—The well-known correspondence between L. and Leibniz took place, of course, at a much later date, and has been already reviewed by Ehrenberg (1845).

² Cf. Birch, Vol. III, pp. 332, 333, 334.

³ *Phil. Trans.* (1677), Vol. XII, No. 133, pp. 821-831.

⁴ "Publisher" = Editor (*i.e.* Oldenburg).

it. It certainly is not very easy to read; but considering its supreme interest and importance, I am astonished that nobody hitherto appears to have made the attempt—nobody, that is, since Oldenburg: for Oldenburg evidently read the whole letter, and, though he published but a part, translated most of it—after a fashion. I have been through his manuscript translation carefully, but I have made no use of it in the preparation of my own: for it is much too abbreviated and confused for my purpose, and it is not free from errors. Oldenburg seems to have had a fair knowledge of Dutch, but the objects which Leeuwenhoek was endeavouring to describe were, of course, at that time entirely outside the experience of everybody but himself: and to understand his words, and to appreciate his efforts at description, it is necessary to be familiar with the things that he was studying as well as with his way of writing.

Many protozoologists have, no doubt, read Oldenburg's curtailed English version of *Letter 18* in the *Philosophical Transactions*, but probably many more are acquainted with it through the work of Saville Kent. This author copied a considerable part of the letter into his well-known book on the "Infusoria"¹; but I must remark that his quotations from Oldenburg's translation do not altogether bear out his own statement that they were transcribed "with a faithful reproduction of their original quaint style of diction". Kent's version is, indeed, by no means faithful to its prototype, and even contains several bad mistakes. For example, in one place Leeuwenhoek says that he put some water in a glass "*op mijn comptoir*"—meaning "in my closet," i.e. the office or study² in which he worked and wrote (probably the counting-house in his shop). This frequently recurring phrase is usually rendered "*in musaeo meo*" by the Latin translators, and appears—concordantly—as "*dans mon cabinet*" in the

¹ *Manual of the Infusoria* (1880). Vol. I, pp. 3-7.—I may also note here that what purports to be another reproduction of the same letter, published recently by Knickerbocker (1927), is nothing more than a reprint of the garbled and condensed version printed in 1809 by Hutton, Shaw, and Pearson in their *Abridgement of the Phil. Trans.* It has no value either as a historical document or as an illustration of L.'s work.

² *Comptoir* = *rekenkamer*, *schrijfkamer*, etc. (Meijer, *Woordenschat* p. 56). Some particulars regarding L.'s "*comptoir*" are given in *Letter 18* (p. 125 *infra*).

short French version of Chr. Huygens.¹ Oldenburg rightly translated it "in my Counter² or Study"—evidently being at a loss for the exact English equivalent of the Franco-Dutch word. But Kent, by "copying" Oldenburg, ultimately gives us "on my counter of study"—an unintelligible expression which he perhaps imagined to mean "on my laboratory bench".³

On 7 November 1676, a month after he had sent his long letter to the Royal Society, Leeuwenhoek wrote a much shorter account of the same observations to his old friend Sir Constantijn Huygens—the statesman-poet father of Christiaan, the famous astronomer and mathematician. This letter⁴ is preserved at Leyden, and has recently been published by Vandeveld and van Seters (1925). At Leeuwenhoek's request it was translated into French by Christiaan Huygens—then at Paris—whose MS. translation is also now in the Leyden University Library along with its Dutch original. This French version was evidently intended for presentation to the Paris Academy: but another French abstract or summary of Leeuwenhoek's observations was printed in the *Journal des Sçavans* some two years later,⁵ and the translation made by Huygens has only recently been published in Holland.⁶ These various abstracts give but a poor idea of

¹ See note 6 below.

² i.e. Counting-house (*rekenkamer*).

³ I regret to say that at least one modern Dutch translator and one Flemish commentator have fallen into the same error. They should both have known better.

⁴ *Letter 18b*, according to my numeration. Referred to by Haaxman (1875), p. 135. Snelleman (1874) has printed a part of this letter, in the original Dutch, but his version contains several manifest misreadings which Vandeveld and van Seters have rectified. I have carefully compared the (published) letter of 7 Nov. 1676 with *Letter 18*, and it is obvious that it is merely a very condensed account (not half the length) of the latter. It contains nothing that is not more fully given in the original (*Letter 18*, 9 Oct. 1676) addressed to the Royal Society. The comparison instituted by Vandeveld and van Seters between the French and Dutch abstracts and Oldenburg's short English version seems somewhat unprofitable, since they never consulted the Dutch original *in extenso* (*Letter 18*).

⁵ *Journ. d. Sçav.*, Vol. IX. 1678 (pp. 55 and 68 of *nouv. éd.*, 1724).

⁶ *Œuvres Complètes de Chr. Huygens* (1899), Vol. VIII, pp. 22-27 (No. 2100).

the extensive investigations described in the original Dutch epistle (*Letter 18*).¹

The greater part of this very long letter—one of the longest Leeuwenhoek ever wrote—is in an unusual form. At the very end of it he remarks that "these my observations" are "taken from the diary which I keep from time to time;" and accordingly we find that he generally gives, in order, the observations as he made them from day to day—without making any attempt to summarize or correlate them. In his letter to Constantijn Huygens (7 Nov. 1676) he explains that he sent these details from his notebook "merely so as to make my observations more credible in England and elsewhere; and especially because Mr Secretary Oldenburg had formerly written to me that there are a number of philosophers at Paris and elsewhere who don't allow of the truth of what I describe"². The subject-matter falls naturally, as will be seen, into various sections, dealing with the divers creatures found in the several sorts of water or infusions which he examined. Some of these sections are provided, by himself, with appropriate headings, while others are not: and I have therefore, for the sake of uniformity, interpolated such headings where they are lacking in the original.³

Leeuwenhoek's 18th Letter opens (cf. Plate XIX) with a few personal remarks, of no particular interest in the present connexion, and then drops abruptly into the description of his discoveries: and at this point I have begun my translation, which now follows.⁴

¹ Another French translation (or a copy of one of the two mentioned above?) was published later in a work called *Collection Académique de Dijon*, Vol. II, pp. 454-461, 1755: but this I have not been able to consult. Cf. Konarski (1895, p. 251 note) and Vandeveld (1922, p. 349).—No account of these observations appears to have been published in the *Acta Eruditorum*, which only began publication in 1682: but a reference to L., and the discovery of animalcules in infusions (attributed ambiguously to Butterfield), will be found in the note by Elsholz (1679) in *Miscellanea Curiosa*, Vol. IX.

² See Vandeveld and van Seters (1925), p. 20: and *Œuvres Compl. de Chr. Huygens* (1899), Vol. VIII, p. 22, footnote 3.

³ These additions, wherever they occur, are indicated by being inclosed between square brackets.

⁴ *Letter 18*. 9 October 1676. To Oldenburg. MS. Roy. Soc. I have not thought it necessary to mark all the places where my translation differs