

# Antony van Leeuwenhoek

—The First Periodontist

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THE HISTORY of the California Academy of Periodontology is adorned by the names of some of the foremost scientists in the field. It was, I am informed, the first Academy of Periodontology in the United States. This association of age, brilliance and noteworthy accomplishment which has characterized Academy activities throughout its existence is responsible for the choice of subject matter.

It is always gratifying to share unique and pleasurable experiences with others. 'Twas just about the time the California Dental Association complimented me with an invitation to address its members that I saw an advertisement of a paperbound book written by Clifford Dobell about Antony van Leeuwenhoek and his little animals. It was published by the Dover Press, New York City and sells for \$2.25. The truth is I purchased the book because it was inexpensive and the advertisement said "Antony van Leeuwenhoek (pronounced Lay-when-hook) has in his debt every man who has ever used a microscope to view animal organisms. He was the first man to see blood corpuscles, protozoa, and spermatozoa; he discovered parthenogenesis (in aphids) and budding in an animal (hydra); and

he outstripped all other microbiologists for over a century. He was, in short, the first microbiologist, bacteriologist, and micrologist."

The book is fascinating. It is of special interest to all those concerned with the art and science of periodontology as Leeuwenhoek was the first to enter, by means of his microscope, that little world of adherent microbial matter on the teeth and to describe the inhabitants seen therein. It will be my purpose to attempt to share with you some of the pleasures, the surprises, the discoveries, the knowledge and the humor I found within the pages of this "paperback." It did not turn out to be a "cheap" purchase, by the way, for it was so interesting and enlightening that I have bought additional copies as gifts for friends.

Before proceeding to the story of Leeuwenhoek and his life, an introduction to the author of this extraordinary work is in order. Clifford Dobell was born in 1886. He was Protistologist to the Medical Research Council, London until his death in 1949. As a young man he began to study the microscopic creatures in organic infusions; and while so doing, learned that they had been seen by Leeuwenhoek 200 years before. This stimulated his curiosity about the man and he soon learned that Leeuwenhoek was a well-known figure in the history of biology. It also came to his attention that Leeuwenhoek's observations were

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published in English in the Philosophical Transactions and that the Hollander was actually a Fellow of the Royal Society of London. This circumstance led eventually to the publication of the book.

Dobell continued his studies in the fields of protozoology and bacteriology. He says "To make a long story short, I continually found that whatever protozoa or bacteria I worked at, I was always forestalled and led back to the same mysterious and elusive individual who had somehow succeeded in registering the first observations on almost every kind of microbe I attempted to investigate." It was more than 25 years later that Dobell began to find, decipher and copy Leeuwenhoek's original letters. The task was monumental as they were written in his own hand in seventeenth century Dutch. After encountering and surmounting seemingly insuperable difficulties and obstacles, Dobell made the acquaintance (through his letters) of Mynheer Antony van Leeuwenhoek himself.

It was learned that he knew no language but Dutch, nor did he know science; he was an ordinary shopkeeper, who held a few minor municipal appointments in the little town of Delft where he was born on the 24th of October, 1632. Dobell continued his studies until an enormous body of records was amassed. Most of the work was done between 12 midnight and 3 a.m. after a long hard day in the laboratory and with another of the same soon to begin. The end result was the book. The following quotation is from the preface, "Therefore, dear Reader, meet Mr. Van Leeuwenhoek (a simple and ordinary dead Dutchman) and shake him by the hand and hearken to what

he has to say. When you have done that, you will not only know the true meaning of that misused term 'scientific research,' but you will also realize (I hope) that you have already gone further along the path of peace and progress than some of the more sophisticated people now sitting solemnly at Geneva or at the meetings of the most learned and modern and Royal and Scientific societies (God bless and prosper them all!)."

Leeuwenhoek did not discover the microscope. He never published a single "scientific" article. His observations are recorded in letters to the Royal Society of London. The first was written in April, 1673. He wrote them all himself in his old fashioned Dutch. They were made using a microscope of simple pattern with biconvex lenses he had taught himself to grind. It is not known when he made his first microscope, but he started working with them before 1668.

More important than the skill with which he performed his experiments was the philosophy with which he recorded his observations, exactly and precisely; and the manner in which he separated observation, theory, fact and fancy while analyzing and interpreting the data. When recording facts he invariably said, "I have observed . . ."; his interpretations are preceded by phrases such as, "I imagine . . ." or "I figure to myself. . ."

Certain of his recorded observations are of great importance to this very day and especially so as they are not known, generally, by present day dental scientists. As early as 1678 he had written that he could make out no animalcules in spit. It was on September 17, 1683 that he wrote the famous letter describing bacteria



from the human mouth. These are excerpts from Dobell's translation that follow:

"Tis my wont of a morning to rub my teeth with salt, and then swill my mouth out with water: and often, after eating, to clean my back teeth with a toothpick, as well as rubbing them hard with a cloth: Wherefore my teeth, back and front, remain as clean and white as falleth to the lot of few men of my years (he was about 51) and my gums, no matter how hard the salt be that I rub them with never start bleeding. Yet notwithstanding, my teeth are not so cleaned thereby, but what there sticketh or groweth between some of my front ones and my grinders (when-ever I inspected them with a magnifying mirror), a little white matter, which is as thick as if 'twere batter. On examining this, I judged (albeit I could discern nought a-moving in it) that there yet were living animalcules therein. I have therefore mixed it, at divers times, with clear rain-water (in which there were no animalcules) and also with spittle, that I took out of my mouth, after ridding it of air bubbles (lest the bubbles should make any motion in the spittle): and I then almost always saw, with great wonder, that in the said matter there were many very little living animalcules, very prettily a-moving. The biggest sort had the shape of Fig. A: these had a very strong and swift motion, and shot through the water (or spittle) like a pike does through water. These were most always few in number."

Leeuwenhoek goes on to describe other forms seen within this little microscopic world which is still found on the teeth today just as it was 300 years ago. There is one major differ-

ence, he knew what was in the white material resembling batter. Today the exact nature of the inhabitants of the microcosms of the mouth and their communal behavior is yet generally unknown and although the term *materia alba* is used to refer to the "little animals" few dentists have actually seen them in the living state.

Leeuwenhoek confirmed his suspicions regarding the ubiquity and multiplicity of these organisms by examining the teeth of a child and two women with "clean" mouths and by removing some of the material, "... that was lodged upon and betwixt the teeth, from an old man who makes a practice of drinking brandy every morning, and wine and tobacco in the afternoon; wondering whether the animalcules, with such continual boozing, could e'en remain alive. I judged that this man, because his teeth were so uncommon foul, never washed his mouth. So I asked him, and got for answer 'Never in my life with water, but it gets a good swill with wine or brandy every day.' Yet I couldn't find anything beyond the ordinary in his spittle. I also mixed his spit with the stuff that coated his front teeth, but could make out nothing in it save very few of the least sort of living animalcules hereinbefore described again and again. But in the stuff I had hauled out from between his front teeth (for the old chap hadn't a back tooth in his head), I made out many more little animalcules, comprising two of the littlest sort." The foregoing quotation reveals Leeuwenhoek's interest in the effect of various agents on mouth organisms. He noted that when spit was mixed with the material from between the teeth he saw only a few living animalcules. This



interest on his part is revealed further by the next quotation.

"Furthermore, I put some strong wine-vinegar in my own mouth, and then set my teeth, and let the vinegar run betwixt 'em time after time: and after doing so I rinsed my mouth out thrice with fair water. Afterwards I once more fetched out some of the foresaid stuff from between my front teeth, as well as from between my grinders; and I mixed it divers times both with spittle and the clear rain-water: and most always I discovered in it an unbelievable number of living animalcules, though most of 'em were in the matter I got from between my back teeth, and only a few had the appearance of Fig. A.

"I have also put a little wine-vinegar to this stuff mixed with spittle, or with water: whereupon the animalcules fell dead forthwith. And from this I drew the conclusion that the vinegar, when I filled my mouth with it, didn't penetrate through all the matter that is firmly lodged between the front teeth, or the grinders, and killed only those animalcules that were in the outermost parts of the white matter."

The significance of the foregoing observations as they relate to dental research and practice has been overlooked. They are important in two ways: first they are a model for all researchers in that Leeuwenhoek presents his results with a charming simplicity, honesty and sincerity. Facts are never confused with speculations. Secondly, the observations provide exact information concerning the very nature of mouth organisms, their immediate environment and their role in dental disease. Leeuwenhoek learned from his experiment with the vinegar that what happens in vivo may not necessarily occur in vitro.

The presence of the little animals was related to mouth odors in later studies as the following quotation reveals: "I have had several gentlewomen in my house, who were keen on seeing the little eels in vinegar: but some of 'em were so disgusted at the spectacle, that they vowed they'd ne'er use vinegar again. But what if one should tell such people in future that there are more animals living in the scum on the teeth in a man's mouth, than there are men in a whole kingdom? especially in those who don't ever clean their teeth, whereby such a stench comes from the mouth of many of 'em, that you can scarce bear to talk to them; which is called by many people 'having a stinking breath,' though in sooth 'tis most always a stinking mouth. For my part I judge, from myself (howbeit I clean my mouth like I've already said) that all the people living in our United Netherlands are not as many as the living animals that I carry in my own mouth this very day: . . ."

Some present day dentists have found Leeuwenhoek's prophesy of value now that phase microscopy has a place in dental practice. Patients are motivated to clean their mouths more thoroughly and to acquire a much better understanding of the reasons why oral hygiene practices are necessary when they actually see, with their own eyes, the enormous numbers of living animals they carry in the scum on their teeth every day.

Nine years after writing the 1683 letter Leeuwenhoek writes again, "In my letter of the 12th of September, 1683, I spake among other things, of the living creatures that are in the white matter which lieth, or groweth, betwixt or upon one's front teeth or one's grinders. Since that time, and



especially in the last two or three years, I have examined this stuff divers times; but to my surprise, I could discern no living creatures in it.

"Being unable to satisfy myself about this, I made up my mind to put my back into the job, and to look into the question as carefully as I could. But because I keep my teeth uncommon clean, rubbing them with salt every morning, and after meals generally picking them with a fowl's quill, or pen; I therefore found very little of the said stuff stuck on the outside of my front teeth: and in what I got out from between them, I could find nothing with life in it. Thereupon I took a little of the stuff that was on the front most grinders; but though I had two or three shots at these observations, 'twas not till the third attempt that I saw one or two live animalcules. Yet I could well make out some particles lying about that I felt sure must have been animalcules. This put me in a quandary again, seeing that at and about the time when I wrote to you concerning these animalcules, I never failed to see there was life in them: but though now I used just the very same magnifying glass and apparatus (which I judged to be that best suited to the purpose), yet I couldn't make out any living creatures at all.

"Having allowed my speculations to run on this subject for some time, me thinks I have now got to the bottom of the dying off of these animalcules. The reason is, I mostly or pretty near always of a morning drink coffee, as hot as I can, so hot that it puts me into a sweat: beyond this I seldom drink anything save at meal-times in the middle of the day and in the evening; and by doing so, I find myself in the best of health. Now

the animalcules that are in the white matter on the front teeth, and on the foremost of the back-teeth, being unable to bear the hotness of the coffee, are thereby killed: like I've often shown that the animalcules which are in water are made to die by a slight heating.

"Accordingly, I took (with the help of a magnifying mirror) the stuff from off and from between the teeth further back in my mouth, where the heat of the coffee couldn't get at it. This stuff I mixt with a little spit out of my mouth (in which there were no air-bubbles), and I did all this in the way I've always done: and then I saw, with as great a wonderment as ever before, an unconceivably great number of living animalcules, and in so unbelievably small a quantity of the foresaid stuff, that those who didn't see it with their own eyes could scarce credit it. These animalcules, or most all of them, moved so nimbly among one another, that the whole stuff seemed alive and a-moving."

It is to be noted that Leeuwenhoek associated motility of bacteria with life. He lost a carious tooth about 1697 that must have been affected by periodontal disease as he extracted it by pressing it hard on the side with his thumb. He found large numbers of the same microorganisms in the root canals of this tooth. In April 1708 he writes that he scraped a coating of whitish matter from his tongue with a small pen knife or silver tongue scraper and on examination saw nought but what he had described previously. This is the last reference Leeuwenhoek makes to mouth organisms in his letters. He continued to make observations and to report them in his letters right up until the time



of his death on the 26th of August, 1723.

In summary it has been my purpose to share with you a prized possession, an acquaintanceship through his writings with Antony van Leeuwenhoek. He told us in September, 1683, two hundred and seventy-nine years ago that his teeth remained clean and white as befell the lot of few men his age (about 51) because he was wont to cleanse them daily with cloth, salt, toothpicks and a swill of water. He saw, nevertheless, some white matter sticking to them in which he recognized with the aid of his simple microscope, living bacteria which probably were bacilli, selenomonas sputigena, micrococci, leptotrichia and spirochetes. In addition, he drew our attention to the inability of a mouthwash made of vinegar to pene-

trate and kill the microorganisms in the scum on his teeth. This is the first recorded observation indicating the presence and protective nature of the gel within which the microcosms of the mouth thrive. He also related mouth odor to mouth bacteria. May I suggest that now, in 1962, when microscopes with phase optics can be purchased for much less than some dental handpieces that we also gaze into this tiny world inhabited by Leeuwenhoek's little animals and share with him great wonder and delight as we view the microbes moving nimbly back and forth. Perhaps if we record our observations as accurately, simply and honestly as he did, and speculate thereon as wisely, new discoveries will be made of great value for the prevention of dental disease and the preservation of oral health.