

Sample Translation

Dangerous Knowledge

(Gevaarlijke kennis)

by Luuc Kooijmans

(Amsterdam: Bert Bakker, 2007)

Translated by Diane Webb

III IN SEARCH OF A REPUTATION

Niels Stensen and Jan Swammerdam faced an uncertain future. There were no paid positions for research scientists, and those wishing to indulge in observation and experimentation were forced to do so in their free time. To earn a living, Stensen and Swammerdam would have had to become practising physicians, but the idea did not appeal to them. Not only had almost all current medical theories been called into question – owing in no small part to their own work – but they also believed that the foundations of medical science were too shaky to sustain any serious practice. A great many anatomical and physiological issues had first to be resolved, and as physicians they would have far too little time for this. Even as university lecturers they could not be certain of continuing their research, for empirical study was not a generally accepted approach in academic medicine. Universities were primarily institutions for the dissemination of classical learning, with little attention being paid to new findings. The lack of any convincing alternative had led most European universities to cling to outmoded teaching material, and the spirit of Aristotle still prevailed. Students were given Galen and Hippocrates to read, and were instructed in the doctrine of the four humours.

There were, however, outside the universities, various forms of private seminars, in which more widely ranging and controversial material could be handled than in university lectures, and where fresh insights therefore made faster inroads. New viewpoints often took shape at informal gatherings, at which experiments were carried out and observations exchanged. Such societies were considered rather subversive, because their conclusions sometimes ran counter to established ideas, but the more their findings proved to be based on verifiable facts, the more their prestige grew, and generous patrons were increasingly inclined to offer them financial support.

The most prestigious research society was a group of scholars at the court of Florence, who were protégés of the Grand Duke Ferdinando de' Medici and his brother Leopoldo. The Tuscan sovereigns paid their scientists a salary, and provided them with research facilities and accommodation. Researchers in other parts of the world had to rely on sponsors with considerably less power and wealth. In England, the society that had grown up around Robert Boyle had become an official institution, the Royal Society of

London for the Improving of Natural Knowledge, but its princely patronage was purely nominal as it lacked the means to pay for research.

Research scientists were dependent on wealthy individuals, and ambitious young men like Niels Stensen and Jan Swammerdam could not be certain of having the means to continue their research after finishing their studies. That time was fast approaching, but the availability of money for foreign travel and study allowed them to postpone any decisions about their future, at least for a while. Studying abroad enabled young scientists to establish a reputation as scholars and to make the acquaintance of people who might one day be of use to them. How long and how far they travelled was mainly a question of money. Those with ample funds could afford a trip to Italy, the cradle of civilization, but Jan Swammerdam set out to conquer the world from the nearest metropolis.

Paris, 1664

In September 1664, Swammerdam paid a visit to Ole Borch at his flat in the Rue de Vaugirard. The two had not seen each other since Borch had left Leiden eighteen months before. Borch had been living in Paris for a year, as the guardian of three young men who had been his private pupils in Copenhagen. In the spring of 1663, he had travelled with them to Calais, where they had crossed the Channel and spent the summer in England before settling down in Paris.

Swammerdam told Borch how he had spent the past few months. He had left Holland before finishing his studies in Leiden in order to attend the Protestant university in Saumur, a not uncommon destination for Dutch students. Johannes Hudde had preceded him, and Henry Oldenburg (future secretary of the Royal Society in London) had spent a year in Saumur as the companion of the Earl of Cork's grandson. Oldenburg found the surroundings beautiful and the people friendly, but had not noticed any exciting scientific research. There was, however, an ongoing debate as to whether professors should be allowed to deviate from Aristotelian philosophy, but after careful consideration that idea had been rejected, in view of the problems it had caused in the Netherlands.

Since Oldenburg's time at Saumur, a lively exchange of philosophical ideas had arisen outside the academic community, largely owing to the arrival of the physician Louis de la Forge, who was working on a book about the connection between mind and body, wholly in the spirit of Descartes. Moreover, a debate was raging about the

possibility of uniting the Protestant and Catholic churches. These discussions, which were followed with interest in the Netherlands, not only produced few concrete results, but even led to increased discord within Saumur's Reformed community, whose two ministers had long disagreed on this point. Swammerdam became acquainted with one of them, Isaac d'Huisseau, who suggested that theological issues could be clarified by taking Descartes's philosophy as a starting point, dismissing all existing opinions and preconceived notions, and using reason to arrive at some measure of agreement on a number of basic principles. He was thus seen as attempting to jettison the whole of theological tradition, and this made him a controversial figure.

Although in both France and the Netherlands Descartes's philosophy was clearly a burning issue, Jan Swammerdam did not find these discussions between the adherents of Aristotle and Descartes particularly interesting, because in Leiden he had already made up his mind about the value of both philosophers. While it was obvious that Descartes had not sufficiently tested his derivations, Swammerdam was nonetheless convinced of the correctness of his idea that all natural phenomena were based on immutable laws of nature, and he had set himself the task of discovering how those laws manifested themselves. To his mind, the hierarchic distinctions that Aristotle had applied to nature were meaningless, as was practically everything previously written about nature. Swammerdam believed that the only way to unravel the secrets of nature was to study nature itself, and in this he found a kindred spirit in D'Huisseau, who also proved to be an enthusiastic natural scientist. D'Huisseau told Swammerdam that he had seen mosquitoes emerging from a water-filled basin in his garden. That mosquitoes developed in water was new to Swammerdam, and he decided then and there to get to the bottom of the matter.

Swammerdam had lived in the house of D'Huisseau's friend Tanneguy Lefèvre, a man not unknown in the Netherlands, who had been educated by the Jesuits but had converted to Calvinism. Lefèvre, now a man of about fifty, had been offered the chair in Greek at the University of Leiden, but had turned it down. In addition to his passion for classical literature, he was a true lover of nature. He had bought a country estate near Saumur – complete with vineyard, orchard, gardens, meadows and woods – which he paid for by renting rooms in the big house to university students. He said he had chosen that spot because of its view over the valleys of the Thouet and the Loire, the two rivers that flowed together in Saumur.

The surroundings also appealed to Jan Swammerdam, who had observed all kinds of interesting insects on the verdant shores of the broad Loire, whose waters were low in the summer. On a stone wall in the river behind Lefèvre's house, he had spotted a small worm described in the literature as a 'water ear-worm' and, by chance, had seen it change into a dragonfly. It was rare to witness such a metamorphosis, he told Lefèvre, who was equally enthusiastic about Swammerdam's discovery. Apparently the worm, while shedding its skin on the stone wall, had become so soaked with splashing water that the process had temporarily come to a halt.

Swammerdam was most excited about his observations of mayflies. These insects exist for a long time at the bottom of the river as larvae, but in June they come to the surface in great numbers, emerging only to mate and then, soon afterwards, to die. One evening when Swammerdam was strolling across the bridge over the Loire, he saw huge swarms of flies, some of which still had the skin they had just shed clinging to their tails. He told Borch that in Saumur he had seen no fewer than seven species of mayfly. Not only were they difficult to catch, but they could be seen only for a few days each year. A new batch emerged from the water every day for three days. Starting in the late afternoon, they could be seen skimming across the water.

Swammerdam had observed the insects closely and seen that as soon as they emerged from the water, they moulted before spreading their wings and flying away. The females laid their eggs and the males released their sperm over the water. Milt and spawn merged on the water, after which the fertilized eggs sank to the bottom and the adult insects died. Swammerdam thought it a miraculous process and resolved to record the details.

Having continued his anatomical research, Swammerdam had finally found the solution to the problem Niels Stensen had been tackling in Leiden. After Stensen had demonstrated experimentally which direction lymph flowed through the body, he had added that his findings could be proved conclusively if the valves that he was sure must exist in the lymph vessels could be made visible. So far all attempts to do this had failed, but Swammerdam, applying the method Malpighi had used to reveal the structure of the lungs, now succeeded in preparing lymph vessels in such a way as to demonstrate the existence of the valves, laying to rest once and for all the theories of Louis de Bils. It was high time someone did this, for even though Stensen had refuted all of De Bils's arguments, his lack of evidence had permitted De Bils to persist in his spurious standpoint. De Bils had declared that he would retract his assertions only if someone

could show him the valves. At the beginning of the summer, Jan Swammerdam did just that, demonstrating the existence of the valves to a group of physicians. As proof of his discovery, he sent drawings of his preparations to his father in Amsterdam, so that he could forward them to Niels Stensen, whose whereabouts were unknown to him.

Swammerdam and Borch talked shop that September. An acquaintance of Swammerdam in Amsterdam, Catharina Questiers, had written to tell him that she had fused two pieces of polished crystal by heating them and compressing them in an iron press. He had also heard that a diamond cutter had split a diamond belonging to the Grand Duke of Tuscany and seamlessly rejoined the two pieces. Borch had delved into the origins of heat and cold, asking himself why cracking sounds were heard in the woods in extremely cold weather, and why geraniums sometimes bloomed on cold nights.

The day after Swammerdam had seen Borch, Borch returned the visit. Swammerdam showed him the insects he had caught in and around Saumur. He said that butterflies could be kept for years if pierced with a needle, but that grasshoppers could not be preserved without being eviscerated. They talked about chemistry and about the structure of the penis, which Swammerdam had studied in dogs. Swammerdam told Borch about his experiments with a hypodermic needle, which had been invented by a fellow student in Leiden. He had used it in experiments aimed at inducing blood to clot in the vessels, so that he could dissect unhindered by bleeding. This would be another point scored off De Bils, who claimed that he was the only one who had mastered the art of bloodless dissection. Swammerdam had tried injecting diluted sulphuric acid or ammonium sulphate into the jugular vein, and had observed that ammonia made the blood very thin, whereas sulphuric acid induced coagulation, making it possible to dissect with little loss of blood.

Shortly after this Niels Stensen showed up in Paris. He had gone to Copenhagen the previous year after the death of his stepfather, to decide what to do about the family's goldsmithery. Then his mother had died, and he had stayed in Copenhagen until the end of the summer, when her estate was finally settled. Instead of returning to Leiden, where the plague was raging, he had come directly to France via the Rhineland, with the intention of asking the University of Leiden to grant him his doctorate in absentia.

In Copenhagen, Stensen had been greatly admired for his demonstrations of his anatomical discoveries. The elderly Simon Paulli had come to watch him, as had Thomas

Bartholin, who now lived in the countryside, but had made a special trip to the city to see him. Bartholin, who had complained in recent years about the lack of activity in the anatomical theatre, had been particularly enthusiastic about Stensen's demonstration of the structure of the heart. The old men acknowledged that Stensen had far surpassed them, but their praise did not secure him an appointment at the university.

It had been this hope of a university appointment that had led Stensen to publish in Copenhagen a book describing the anatomical discoveries he had made in Holland concerning the workings of the glands, the heart and the muscles. He had dedicated his book to the Danish king, Fredrik III, but to no avail. The book was noticed by many, but applauded by few, for it gave short shrift not only to all classical knowledge of the heart, muscles and glands, but also to Descartes's ideas on the subject. Stensen maintained that the heart was not the seat of natural warmth and that no blood, or *spiritus vitalis*, was made there. Not everyone was prepared to accept this: the heart could not be a muscle, some objected, because its contraction was involuntary. But Stensen replied that this was true of other muscles too, and demonstrated convincingly that the structure of the heart did not differ from that of other muscles.

In his book, Stensen could not refrain from sneering once more at Blaes: the ductus Blasianus would never be found, he assured his readers, except perhaps by those living on the moon. The case was closed, since Hoboken, the principal witness for Blaes, had withdrawn from the arena.

Thévenot

In Paris, Jan Swammerdam and Niels Stensen could observe medical practices in the large hospitals and make the acquaintance of famous scholars and wealthy benefactors, but they could not automatically expect recognition for their own work, for the scientific climate could not be compared with that of Leiden. Aristotle and Galen held undisputed sway at the Roman Catholic university of the Sorbonne. The chances for young research scientists therefore lay elsewhere: in the cercles, the informal societies that met for the purpose of discussion and experimentation. The problem in Paris, though, was that more often than not, Descartes was considered unassailable.

The Paris cercles had a long history. Among the most talked-about were the gatherings organized by the mathematician Marin Mersenne, who corresponded with many foreign scholars. Like Comenius and his English friends, Mersenne, too, had

hatched grand schemes to improve the world and civilize humanity through the advances of modern science, especially the method of Descartes. After Mersenne's death, his circle was more or less taken over by his friend Henri-Louis Habert, seigneur of Montmor, a man of sixty-five who had managed to secure the lucrative position of maître des requêtes. Though rather inarticulate, Habert was highly respected as a patron of writers and scholars. He received men of learning at his home in the Rue du Temple in the Marais district, and had once offered Descartes the use of his country house. Indeed, it was sometimes claimed that his gatherings were intended mainly to disseminate Descartes's philosophy.

In France, the philosophy of Descartes was the most powerful weapon deployed against the teachings of the established order, and it was therefore hotly debated. The Sorbonne had condemned Descartes's first publication as soon as it appeared, and his work had been banned by the Pope. This had not stopped its dissemination, however, for Cartesianism was emphatically sectarian in character: in fact, it was no less than a belief. The way Descartes had presented his philosophy had, in fact, encouraged divisiveness: it was a question of being either for him or against him, and many of his followers were actively engaged in trying to produce evidence in his favour. There were countless debates between advocates and adversaries, which led Habert de Montmor to formalize his gatherings, to prevent them from deteriorating into discussions constantly punctuated by quotations from the work of Descartes or Aristotle. Each time he held a meeting, he asked two participants to write down their thoughts on a subject, without reference to any authority. Yet despite these rules, the gatherings were overwhelmed by vehement debate between representatives of the established order and doctrinal Cartesians, as well as by protracted orations delivered by people chiefly interested in themselves – to the frustration of those interested in experimental science, who would have preferred to exchange findings and conduct joint experiments. The scientists among them, who had come to the conclusion that such collective research could be undertaken only in another setting, had already started to organize separate meetings. Their goal was to set up a government-sponsored organization under the auspices of the king to finance their experiments.

They drew up a plan for a French version of the organizations that existed in Florence and London, a Compagnie des Sciences et des Arts, to be devoted to the acquisition of practical knowledge. Inventors and explorers would also be welcome to join. Like the

Royal Society in London, the company would promote science mainly by observing nature, while making use of such instruments as telescopes and microscopes. Knowledge of the human body would be sought from dissections rather than textbooks, use would be made of the latest findings in the field of chemistry, and new inventions would be fostered.

To solicit support for the plan, the promoters emphasized its many benefits to humanity as a whole and to the citizens of France in particular. They approached the most influential minister, Jean-Baptiste Colbert, to suggest the foundation of a permanent society with royal assent, at the same time giving him a list of names and a programme. The plan was in keeping with Colbert's ambition to strengthen the monarchy of the young Louis XIV by presenting him as a generous patron, who rewarded artists and scientists both at home and abroad for their contributions to culture. Colbert was sympathetic to the idea of a scientific academy, and to make sure that the plan was worthwhile, he sent a relative of his, Vincent Hotman de Fontenay, to a few of the scientists' meetings. After receiving assurances that the undertaking would undoubtedly do him credit, Colbert suggested that the king grant the society official status, arguing that the monarchy and France would not only derive much glory from the undertaking but also benefit from it. It was doubtful whether the initiative would succeed, however, because the plan immediately encountered resistance from the established order: the Jesuits, the Sorbonne, the medical faculty and the guilds.

In this situation, contributions from foreigners who could enhance the prestige of experimental science were extremely welcome, and Niels Stensen and Jan Swammerdam profited accordingly. They soon attracted the attention of Melchisédec Thévenot, one of the driving forces behind the plan for an academy of science. Thévenot, a wealthy man in his forties, was, above all, a bibliophile. As a young man he had been encouraged by Isaac Vossius, with whom he had become acquainted in Padua. Both Thévenot and Vossius could get very excited about the discovery of a rare manuscript or an exceptional library, and continued to exchange letters about their finds long after they had gone their separate ways. Vossius had ended up in Stockholm, at the Swedish court; Thévenot had served the French court, secretly fulfilling what he claimed were dangerous government missions, some undertaken in Italy, where he had lived for many years. Latterly he had returned to Paris. He knew Colbert well, and was on friendly terms with two of his

influential advisers, Jean Chapelain and Valentin Conrart, Protestant luminaries in the field of literature.

In Paris, Thévenot spread the fame of Isaac Vossius, whose book about the age of the world had caused a stir in France as well. Like Vossius, he was particularly interested in the history and geography of remote parts of the world. It was his ambition to document uncharted areas, and to this end he collected books and manuscripts of travellers' accounts, including some written by Dutchmen. Having undertaken to translate and publish these reports, he had enlisted the help of Colbert by convincing him that geographical knowledge would benefit French shipping and trade. The first volume, which had appeared the previous year, was a folio edition containing articles about the Cossacks and the Tartars, the Caspian Sea, Egyptian pyramids, the court of the Great Mogul of India, and China's recent capture of Formosa from the Dutch. The volume also included an excerpt from the work of the Arab geographer Abu el Fida, which Thévenot intended to have translated in its entirety, as well as the *Relation du voyage de Bontekoe aux Indes orientales*, which he claimed to have translated himself from the Dutch.

Thévenot had discovered ancient manuscripts in the royal library, and hoped to acquire Oriental manuscripts through Vossius, whom he had asked to be on the look-out for interesting travel accounts. Thévenot had commissioned the translation of a Persian manuscript on the life of Genghis Khan, and was working on an account of a journey undertaken by Dutch envoys to the emperor of the Tartars seven years before. He had also published pieces on the Philippines and Japan, for which he had translated a number of Dutch sources on such subjects as the persecution of Christians, claiming that he preferred the sober accounts of Calvinists to the biased reports of Catholic missionaries, since reliability was of paramount importance. He therefore corresponded with a number of trustworthy physicians and envoys in far-off lands, and had even sent off a traveller of his own: his younger cousin Jean Thévenot. This cousin had previously journeyed as far as Egypt and now, at the beginning of the year, had embarked on an odyssey that would take him to Isfahan and Surat. Thévenot hoped that his cousin would bring back new treasures in the form of books and manuscripts. In the meantime, he set about publishing the account of Jean's first journey, which had lasted more than six years.

Geography was his great love, but Thévenot took an interest in all branches of learning, from astronomy and anatomy to chemistry and engineering. He was convinced that advances in knowledge did not stem from explanatory treatises on the work of

Aristotle, but from the exchange of observations and experimental results. He therefore corresponded with like-minded individuals, such as Vossius's friend Coenraad van Beuningen and the young Christiaan Huygens, whom he had met at one of Habert de Montmor's gatherings. Thévenot also kept in touch with the secretary of the research society at the Tuscan court, Lorenzo Magalotti, and with Henry Oldenburg, secretary of the Royal Society in London.

Though Thévenot did not represent a formal society, as did Magalotti and Oldenburg, his goals were the same as theirs. Like Boyle in England, he had formed a society on his own initiative, in the hope that he would eventually find a patron. He sent reports of observations made in Paris to London and Florence, and looked forward to receiving news of English and Italian research. Oldenburg, who likewise saw such connections as a means of gathering information from abroad and of spreading the news of discoveries made in England, asked Robert Boyle to send his latest book to Thévenot, one of the few Frenchmen with a thorough command of English.

Thévenot was also actively engaged in research. He had designed a level and was working on a number of other technical projects, together with Pierre Petit, who specialized in research instruments. The two had often taken instruments along to Habert's gatherings, but had never had the opportunity there to explore what they considered the central issues. Thévenot had therefore invited the scientists to meet at his home in the Rue de la Tannerie, near the Capuchin Convent in the Marais district. Moreover, he put his country house in Issy, just outside Paris, at their disposal as a venue for scientific inquiry. It was there that Petit spent night after night studying Saturn, sharing his telescope and his observations with Thévenot.

Jan Swammerdam in Paris

Their aversion to dogma and devotion to research made the company that gathered at Thévenot's different from the others, such as those who assembled at the home of the physician Pierre Bourdelot. Like Vossius, Bourdelot had served Queen Christina at the Swedish court. Though certainly not known for his piety, upon returning to France he had been appointed Abbot of Macé, which assured him an ample income. Every Monday he received scholars and interested individuals, who discussed a wide range of scientific topics and were free to level criticism at Aristotle and Galen, but preferably not too much at Descartes. Every week Bourdelot produced a spectacular demonstration of some kind

to amuse the merchants, courtiers, physicians and lawyers who made up a large part of the audience. Among the visitors was Ole Borch, who had also been invited to attend the Tuesday meetings at Thévenot's, which gave him the opportunity to introduce Niels Stensen and Jan Swammerdam to this society.

Swammerdam, whose father had given him a travel allowance to further his medical studies, visited Paris hospitals where physicians and surgeons graphically illustrated their lessons. At the large Hôtel-Dieu hospital, Swammerdam watched with interest as a surgeon demonstrated a technique to stop arterial bleeding. For the most part, however, he was occupied, even in Paris, with his study of insects. Swammerdam told Borch about an amazing discovery he had made, namely that snails did not spring forth from mud, as almost everyone thought, but mated with each other in the most curious manner. Snails possessed both male and female reproductive organs, and when they mated, each fertilized the other. Swammerdam had observed snails seeking one another out several days before mating, at which time they began to show signs of rutting, as in dogs and chickens. He described how snails, evidently driven by violent passion, approached each other and pressed their bodies together like the palms of two hands. Thus upright, they began to jab their heads and horns at each other. Being touched by its partner's horn caused a snail to withdraw into its shell, only to come out at once and seek renewed contact. This playful behaviour sometimes lasted as long as three days, during which time they tried so hard to unite their reproductive organs that the penis and the womb could often be seen dangling completely outside their bodies. It all seemed a bit clumsy. Swammerdam had seen them frequently 'firing' their male organs at each other, like slightly sluggish arrows, yet they succeeded in coupling in only one out of three attempts. He had also observed both partners, during the act, moving the penis and the opening to the womb. Even when coitus had taken place a dozen times, the snails continued their frolicking with unbridled passion. Swammerdam thought it strange that a hermaphroditic animal would need a partner to reproduce. He also told his fellow scientists about the coupling of frogs, about a larva that turned into a fly after spending two weeks without food in a glass, about the large number of newts he had seen in a marsh near Saumur, and about his dissection of a snake, whose lung resembled that of a frog.

In November a physician – an acquaintance of Ole Borch – exhibited Swammerdam's lymph-vessel preparations during the dissection of a dog in Hôtel-Dieu. Shortly

thereafter, Swammerdam himself showed the company assembled at Thévenot's one of the experiments on live animals he had told Borch about, an experiment connected with his search for a method of bloodless dissection. He intended to demonstrate what happened to a dog when hydrochloric acid was injected into its bloodstream. The audience included not only various French celebrities, but also Isaac Vossius and the elderly Constantijn Huygens, who had come to Paris to dissuade the young king from annexing the Principality of Orange. They were rather disappointed, however, because the experiment did not go exactly as planned: the blood did not clot to the extent Swammerdam had hoped, presumably because of the way the hydrochloric acid had been distilled. Two weeks later he showed the assembled company the other experiment he had told Borch about. This time he injected ammonia into a dog, which died almost instantly, but not before suffering violent convulsions, with blood frothing from its mouth.