ACID SPIRITS AND ALKALINE SALTS

The iatrochemistry of Franciscus dele Boë, Sylvius.

Harm Beukers

The second half of the seventeenth century is generally considered as the flourishing-time of the Leiden medical faculty. The ideas prevailing there, are more or less illustrated in the seal of 1670, with which the faculty authenticated its documents (fig. 1).

Prominent in the picture stands a two-headed woman placed against a background with a radiant sun and a colonnade. The woman, wearing a cuirass, has in her left hand a heart with an eye and in her right hand a burning-lens lighting a fire. The colonnade referred to the ideal of the *constantia* or, in the words of the famous humanist Justus Lipsius, the proper and firm strength of mind which does not lead to over-boldness or dejection by external or accidental circumstances. *Constantia* certainly was needed in the turbulent seventeenth-century medicine dominated by the controversies between Galenists and empirically inspired doctors.[1]

The core of Galenism was classical natural philosophy handed down in medical texts and reasoned in the scholastic tradition. Its learned adherents considered medicine as a part of knowledge engaged in regulating human life in accordance with universal principles, thus a philosophy of health. The opponents emphasized the study of nature, "God's book of nature", over scholastic learning. They were more interested in natural history than in natural philosophy. They established a reformed medicine based on Vesalian anatomy and Harvey's physiology. The controversy was not just an intellectual discourse, it had also consequences for medical practice. Galenists emphasized the classical *diaetetica* and the preservation of health. Their opponents, on the other hand, advocated the treatment with the 'chemical' drugs introduced since Paracelsus shook the medical world. The animosity was stirred up, in the seventeenth century, by the discovery of new anatomical structures such as the digestive glands and the lymphatics, but above all by the publication of Harvey's theory of the circulation of blood.

The objects on the seal demonstrate the prevailing idea in Leiden's medical faculty about the way how to obtain true knowledge. Experience played, in that concept, a crucial role. In the seal it is reflected by the burning fire standing for truth and knowledge. The purifying action of fire expels ignorance, falsehood and fallacies. The sun is the source of the fire, and with that the source of truth and knowledge. Its beams make everything visible. They light the fire through a burning-lens and not with a concave mirror. It means that the fire does not originate from a reflection; it arises from converging beams directly derived from the sun. As the eye needs light to see , so the mind or "inner eye" needs divine light. The eye depicted on the heart therefore is the symbol of the enlightenment, the rational intuition. The heart of the woman is protected by a cuirass with Medusa's head. That head sends the ignorant flying. It represents the victory of the ratio. The ultimate asset was not knowledge as such but wisdom. It is shown in the seal by the two heads, since true and positive knowledge proceeds from reflections of past and future matters.

The well-balanced use of experience and reason is expressed with the device *Experientia et Ratione.* It is borrowed from an aphorism of Francis Bacon, *viz,* that much can be expected from a close and pure alliance of the experimental and rational faculties. In the seventeenth century, systematic experimentation played an increasingly important role, since the nature of things gives itself away sooner "under the torments of the art than in its natural freedom." Crucial were so-called *experimenta lucifera* or enlightening experiments aiming at the discovery of true causes.

Franciscis dele Boë, Sylvius brought that subject to the attention of his audience during the inaugural address of 1658.[2] He explained that the perfection of medecine could only succeed when a number of educated men was brought together, who "neglecting all detrimental obstacles of prejudice and partisanship and scorning vain ambitions to suffocate and surpass others by slyness, call and contemplate before the scales of truth, Ratio and Experience, all writings of ancient and recent authors about natural and medical subjects and, at the same time, everything they investigated, considered and observed themselves." Considering this, it is reasonable to suppose that Sylvius was the inspirer of the image on the faculty seal. He was, without doubt, *primus inter pares* in the faculty of that time, since it consisted, after the decease of Florentius Schuyl (teaching *institutiones* and botany: 1664-1669) and Johan van Horne (anatomy: 1651-1670), only of Franciscus Sylvius, Lucas Schacht (medicine: 1670-1689) and Charles Drelincourt (medicine and anatomy: 1668-1697).

Scientific research should, according to Sylvius, not be done as private enterprise. It could only flourish in the joined efforts of like-minded persons. In the oration he had pointed to his earlier efforts, while practising in Amsterdam, to establish a society where physicians would co-operate in view of the progress of medicine. During his professorship, he was able to realize such a co-operation (may be together with his colleague Van Horne) with his students Nicolaas Steno, Reinier de Graaf, Jan Swammerdam en Florentius Schuyl. The latter three published experimental physiological research, which was closely related to

Sylvius' ideas on vital functions.

From its foundation in 1575, the Leiden medical faculty had considered experience the best teacher in education. The students did not only attend the traditional lectures and disputations, but also used more recent educational tools, such as the practical demonstrations and exercises in the botanical garden, the anatomical theatre (both founded in 1592), the Caecilia Hospital (since 1636) and the chemistry, *i.e.* pharmaceutical laboratory (1669). In Sylvius' days Leiden was famous for its clinical teaching. For that purpose twelve beds were available in the Caecilia Hospital.[3] The demonstration of patients there had an exemplary character. It was not the intention to demonstrate a broad spectrum of different diseases. That aspect was still covered by the *consilia,* collections of advices for special diseases by famous physicians that were published combined with relevant case histories.

In that context the frontispiece of Reinier de Graaf's treatise on pancreatic juice deserves special attention (fig. 2). It shows a room where De Graaf demonstrates the contents of the abdominal cavity to two colleagues. In front of the dissection table are animals, including a dog with a pancreas fistula. In the background we see a patient lying in a bedstead. The picture is in fact a reflection about the three pillars on which, according to Sylvius, medical knowledge was based; *i.e.* the observation at the bedside, the dissection of the deceased and the experiments on animals.[4] The first two subjects were part of Sylvius' clinical teaching. In contrast with his predecessors and successors, he used to pay daily visits to the patients, accompanied by the students. In that way the students could much better pursue the development of diseases and the effects of the therapeutical interventions. The clinical rounds in the Caecilia Hospital were not simple demonstrations by the professor. The students had to participate actively. In dialogue with their teacher, they arrived at the diagnosis, prognosis and therapy. The post-mortems performed by Sylvius on patients deceased in the hospital gave the students a deeper understanding of the nature of the pathological changes underlying the clinically observed diseases. The third pillar, animal experimentation, was not an activity taking place within the university, which was primarily a teaching institution. Experiments


G.Wingendorp fe.
REGNERUS DE GRAAF
DE SUCCO PANCREATICO
Lugd. Batavorum ex Officina HACKIANA 1671.

probably were done at home. Sylvius used three rooms in his house at Rapenburg as laboratory. These laboratories could easily compete with the university *laboratorium chimicum.* The latter had only eight furnaces, while the former counted twenty furnaces.[5]

Franciscus dele Boë, Sylvius

In the preceding part, the name of the Leiden professor Sylvius has been mentioned frequently. It is time to introduce him more in detail.[6] Franciscus dele Boë, called Sylvius, descended from a Protestant family from Cambrai. For religious reasons the family had migrated to Germany, where Sylvius was born in Hanau in 1614. He studied medicine at the universities of Sédan and Leiden. At the latter university he enrolled for the first time on June 4th, 1632. He held a disputation *Positiones variae medicae* under the presidency of Adolphus Vorstius in 1634.[7] After a study-tour to Southern German universities, Sylvius took the doctor's degree in Basel om March 16th, 1637 with a thesis *De animali motu ejusque laesionibus.* He returned to his birthplace and practised medicine for a short period.

In November 1638 Sylvius matriculated again in Leiden. Until 1641, he was active as unsalaried lecturer of anatomy. That course gave him great fame, in particular because of his work on the anatomy of the central nervous system. His *Notae de cerebro* were included in the *Institutiones anatomicae* (1641), the famous textbook by the Danish anatomist Caspar Bartholin. Lucas Schacht mentioned in Sylvius' funeral oration that "many students, and certainly not the worst ones, attended his courses, so that it seemed as if only he could understand and explain anatomy."[8] In this period Sylvius demonstrated the circulation of the blood and convinced the Leiden professors of the truth of Harvey's theory. One of the professors, Johan de Wale changed from a severe opponent into a fervent supporter. He even did experiments, published as *Epistolae duae, de motu sanguinis ad Thomam Bartholinum* (1640), used by Harvey in his defence against Riolan's criticism.

Since there was no prospect of a professorship in Leiden, Sylvius moved to Amsterdam in 1641. After seventeen years practising there, he returned to Leiden again . In 1658 he was appointed professor of medicine, as successor of Albertus Kyper. He officially accepted the chair with the aforementioned inaugural address on September 17th, 1658. Essential elements in his teachings were observations by the students themselves. He invited, in his inaugural oration, students to observe the evidences of his teaching with their own eyes. Clinical teaching in Leiden reached its pinnacle under Sylvius. His death, November 15th, 1672, put an end to a flourishing-time of Leiden's medical faculty, also because Sylvius was considered as the person representing the culmination of iatrochemistry.

In the sixteenth and seventeenth century Galenic traditionalism competed with iatrochemistry. Iatrochemists described vital processes in chemical terms. They based physiology, pathology and therapy on chemical properties and conversions. The system of chemical medicine was not a mere pure theoretical speculation. It had explicit consequences for medical practice. Its intention was the introduction of chemically prepared drugs and the elimination of traditional approaches such as blood-letting and the use of Galenicals. New and more potent drugs, so-called spagyricals, were developed using methods like distillation and maceration. During these procedures the essence, the so-called *arcanum,* was isolated from the inert substance in which it was hidden. Sylvius considered chemistry as "the primary art [to study] natural transformations, which in certain cases - if one would be allowed to say - surpasses Nature itself, and which is not only very useful and pre-eminently necessary for the upbuilding of natural science but also for a true medical science."[9]

It is evident that sixteenth and seventeenth century chemistry was not able to present sufficient support for such interpretations. The ideas of sixteenth century iatrochemists like Paracelsus and Van Helmont were strongly speculative and mystical. Their seventeenth century successor Franciscus Sylvius tried to explain phenomena in terms relatively close to observations and experiments. He also tried to integrate his chemical theories in the so-called *anatomia reformata.* This anatomy included recently discovered structures such as lacteals, thoracic duct and the ducts of digestive glands. These structures actually played a fundamental role in Sylvius' iatrochemistry, which in fact was the adaptation of the humoral pathology to new anatomical and chemical discoveries. Blood remained the most important, life-maintaining substance.

Unfortunately Sylvius did not write a systematic explanation of his medical system. He began writing the *Institutiones medicae* in 1668, but the unauthorized Paris-edition of his courses forced him to stop this work and to concentrate on the edition of the *Praxeos medica idea nova.* He could, however, only complete the first volume (1671). The other volumes, including the appendix, were posthumously published by his former pupil Justus Schrader. This book discusses various diseases and includes much physiology, but not in a systematic order. The basic concepts of Sylvius' system can be found in disputations held under his presidency, in particular the collection entitled *Disputationem medicarum decas* (1663) containing "the primary natural functions of the human body deduced from anatomical, practical and chemical experiments.

Sylvius' physiological chemistry'[10]

Like most iatrochemists, Sylvius payed much attention to the digestive process. The purpose of digestion is "the separation of useful parts from useless parts." To release the useful parts, foodstuffs had to be broken up into components. That process implied the dissolution of bonds between the components. Sylvius supposed two types of binding agents, namely salt and oil. The salt binding was easily broken by water, in contrast with oil, which could only be transformed by fire.

The digestion was divided in two steps. The first step, a fermentation in the stomach, did not result in a complete decomposition into the purest and simplest parts. It was a preparatory process changing the bonds between the component parts of the nutrients in such a way that they easily could be processed in the next step. Sylvius defined fermentation as a process where "the common bond, which keeps all parts in a unit together, is mildly dissolved." The requirements for fermentation were sufficient water (to dissolve the 'salt binding'), moderate heat (to change the 'oil binding'), and a free outlet for gasses originating during the latter change. Recent anatomical discoveries found their niche in this part of Sylvius' physiology. Nicolaas Steno's discovery of the excretory duct of the saliva glands (1660), gave these glands an essential role in Sylvius' concept of the digestion. Saliva provided the large amounts of water and an acid ferment, necessary for the fermentation in the stomach.

The final products of fermentation were "rather pure, simple and less complex, especially liquid parts." They were further digested in the second step, an effervescence taking place in the duodenum. This was the final separation of the purest, more fluid and useful parts from impure, more solid and thick parts of the nutrients. The latter made up the faeces. The former, the so-called *chylus,* constituted the raw material for producing blood. The effervescence was a completely different chemical reaction. Sylvius defined it as: "the dissociation of combined parts and the condensation of parts to be combined, coupled with some kind of perceptible resistance of the parts, which are to be combined and with heat generated by that [process]." The protoype of such a vehement reaction was to combination of an acid spirit, *spiritus acidus,* and an alkaline salt, *sal lixiviosum.*

Acid as well as alkali were generated by the action of fire. It meant, in Sylvius' opinion, that fire particles were intrinsic components of acid and alkali. They were responsible for the sharpness of these substances. Because of the latter quality, he assumed that fire particles had a tetrahedal shape. Fire particles were released during the reaction of an acid with an alkali. Their special shape made fire particles suited to act on other parts and force these parts to move and fly apart. In this way Sylvius explained the agitation, the ebullition and the heat-development accompanying the effervescence. Sylvius supposed an analogous process in the duodenum. The fermented food came here into contact with the *humor triumviratus* or triumviral fluid, consisting of the thin watery part of the saliva, the alkaline bile and the acid pancreatic juice. The reaction of the acid and the alkaline components resulted in a 'subacidic' lymph, which was filtered through the line *[crusta]* of the intestines and passed into the lacteals.

Sylvius' theory was not only based on speculation and reasoning. He adduced also evidence from experiments. *In vitro* experiments supported the basic chemical concepts. In the eighth disputation, he described the preparation of *sal lixivium* from the ashes of burned materials, and in the tenth disputation the preparation *of spiritus acidus* by heating salts in a closed vessel. In both cases the preparation took place through the action of fire. Thus, he proved that fire particles were intrinsic components of acids and alkali. *In vivo* experiments were used to support the hypothesis of the effervescence in the duodenum. The alkaline character of the bile was a common experience, but the acidity of pancreatic juice had to be proven. That was one of the purposes of Reinier de Graafs disputation. He tapped pancreatic juice from a living dog through a fistula connected to the pancreas (fig. 3).

He succeeded after five failures. The taste of the juice was not simple to interprete. Sometimes it was without taste, sometimes salty, sometimes sourish. But the final proof was done with pancreatic juice of a recently deceased boatswain, obtained during a post-mortem. De Graaf never experienced in dogs a more pleasing acid. Another student, Florentius Schuyl, demonstrated *in vivo* the effervescence. He ligated the duodenum of a dog at both sides of the ampulla of Vater, the common outlet of the pancreatic duct and and the bile duct. After three hours the abdomen was opened again. The duodenum was swollen. After opening it, a stinking, brown liquid and gas were produced. Thus an effervescence had taken place.

The latter experiment was only a minor part of Schuyl's *Pro veteri medicina* (1670). In this treatise Schuyl tried to prove that Sylvius' theory was in agreement with the Classics. Evidently, experimental philosphers did not find it beneath their dignity to borrow from historical sources. The publication caused a quarrel with Schuyl's former student Willem ten Rhijne, who thought that much was borrow from his work. Ten Rhijne published two years later *Meditationes in magni Hippocratis textum, de veteri medicina* (1672). This text gave iatrochemistry more or less a classical basis, since it said that all faculties originate from bitter, salt, sweet, acid and astringent present in human beings.

The role of the liver

Sylvius explained the action of the heart with a mechanism analogous to that of the digestion. He postulated a so-called vital effervescence in the right ventricle. Thus, an alkaline and an acid fluid had to encounter there. The endproduct of the digestion, the 'sub-acidic' lymph was carried to the right heart via the lacteals, the thoracic duct, the left innominate vein and finally the superior vena cava. The alkaline part originated from the bile, which - as Sylvius supposed - was partly secreted into the inferior vena cava and transported to the heart. Both fluids met in the right ventricle and caused an effervescence. The fire particles were liberated and penetrated parts of the blood, which were more suitable to their nature, such as oil particles. The reaction had its analogy in the combination of acid spirit of vitriol (sulphuric acid), a volatile (alkaline) salt and oily spirit of terpentine. The heat accompanying the reaction of bile and lymph caused an expansion of the ventricle, which in turn stimulated the heart muscle to contract.

Galenic physiology regarded the liver as the central organ where the blood was formed. The portal vein transported the white nutritive jus or *chylus* from the intestines to the liver. The strong ramifications of the vein created a close contact with the liver matter. The chyle underwent a kind of boiling process leading to the formation of blood and two by-product, *viz,* a 'lighter foam' corresponding to yellow bile and a 'heavier, muddy' substance resembling black bile. The liver therefore was considered the source of three of the four humours. Its central position in the Galenic physiology was, moreover, emphasized by the fact that the liver was the origin of the venous system transporting nutritive blood to all parts of the body.

During the seventeenth century there was a growing criticism on the unique position conferred to the liver. The introduction of Harvey's theory on the circulation of blood (1628) meant that the liver was no longer the central organ from which the veins originated. Aselli's discovery of the lacteals (1622) made clear that chyle was not transported to the liver through the portal vein, but via the thoracic duct to the systemic circulation. Glisson's study of the finer structure of the liver (1654) resulted in a better understanding of its vascular structure, namely that the portal veins and its branches determined the inner structure of the liver. Finally, Malpighi's microscopic examinations (1666) strongly supported the idea that the liver was a gland comparable with the pancreas or the salivary glands. Malpighi classified the liver under the type of glands, which Franciscus Sylvius mentioned *glandulae conglomeratae,* or glands composed of many smaller glands and with a secretory duct. Sylvius distinghuised these glands from the conglobate glands such as the lymph nodes.

In the period passing between the publications of Glisson and Malpighi, there was still discussion about the place were the bile was produced. Sylvius in particular took a rather dissenting position. On July

10th, 1660 he let Peter Sloterdyck defend the disputation entitled *De bilis ac hepatis usu.* Thesis 36 raised the surmise that bile originated as follows from blood in the cystic artery. Particles resembling bile permeate the pores of the membranes covering the gallbladder into the cavity. These particles were there transformed into real bile particles by already excisting bile particles, in a manner comparable to the action of the philosopher's stone. The liver had only two functions. In the first place, it provided the frame-work for the blood-vessels and the bile-ducts: the liver "contained and enclosed the roots of the vena cava, the branches of the portal vein and the bile ducts combined in a common sheath." In the second place, "the gentle heat of its parenchym promoted a profound mixing of bile and blood which flowed back through the aforementioned vein [vena cava]." Sylvius tried to demonstrate the continuity between the bloodvessels and the bile ducts. In the final publication of Sloterdyck's disputation in the *Disputationum medicarum decas,* Sylvius added to the original more theses, describing later experiments. He thought having proved the continuity between the different vascular systems by blowing air into the hepatic bile ducts or the hepatic arteries of deceased patients which he dissected in the Caecilia Hospital.

Sylvius supposed that the bile flowed from the gall-bladder in two directions, namely via the *ductus choledochus* to the alimentary tract and via the *ductus hepaticus* to the liver. The hypothesis found little support. After Malpighi's publication Sylvius had to accept that the bile was no longer produced in the gall-bladder, but in the liver. Malpighi had demonstrated that bile production continued after removal of the gall-bladder. Sylvius' idea concerning the 'inborn heat' in the heart, was so crucial that he sticked to the opinion that bile flowed from the bladder in two directions. In the first volume of his *Praxeos medicae idea nova* (1671), he maintained the 'presumption' that part of the bile flowed back from the gall-bladder to the liver, where it passed into the blood moving to the right ventricle.

The Danish anatomist Thomas Bartholinus, who attended Sylvius' anatomy course in Leiden, thought that his discovery of the lymphatics had undermined Galen's central dogma on the production and movement of the blood in such a way, that one could deprive the liver of its central place among the vital functions. In his book *Vasa lymphatica nuper Hafniae in animantibus inventa* (1653), he wrote that the lymphatics of the liver always held an aqueous fluid, even after a meal. The liver therefore did not collect chyle! Bartholinus concluded chapter eight - entitled "the funeral of the liver after the discovery of the lymphatics" - with a satirical epitaph for "the most prominent cook and ruler of your body, the liver.. She has cooked so long that she, with her bloody rule, boiled herself down."

Sylvius' reaction was unexpected. He wrote Batholin a letter *De epitaphio hepatis* (May 13th, 1661) expressing the opinion that the funeral of the liver was ridiculous and the epitaph not justified: "Those who scoff at the once much honoured organ, should feel ashamed about their not less presumptuous than ridiculous efforts." He supposed that the epitaph was meant as a joke. An organ with such an admirable structure could hardly be without use! Sylvius wondered what function Bartholin assigned to the liver. Few months later Bartholin answered that the main purpose of his treatise was to oppose the idea that blood originated from chyle. He saw the liver only as a filter purifying the blood.

Sylvius' pathology and therapy

Health was, in Sylvius' view, dependent on normal effervescences. Disturbances of this process resulted in disease. Pathological conditions were reduced to two different types: either an excess of acid, an *acrimonia acida,* or an excess of alkali, an *acrimonia lixiviosa.*[11] These abnormal situations were caused by abnormal secretions. An abnormal, *i.e.* sharp acid pancreatic juice gave sharp pains and tensions in the lumbar and the hypochondriac region. An excess of bile induced hot fevers, mainly because bile contained an oily, and therefore inflammable component. Though phlegm made patients frightened. Abnormal lymph caused catarrh and rheumatism. Generally speaking, abnormal secretions freed more fire particles in the heart. These particles intensified the heart action and accelerated the pulse. Sylvius considered the latter sign as pathognomic for fevers. Abnormal effervescences could also be accompanied by excessive exhalations *(halitus).* They caused continuous heat and thus a continuous fever, when the exhalations were bilious. Acid exhalations gave a sensation of cold. For that reason abnormal pancreatic juice caused intermittent fevers.

Sylvius supposed that the disturbances in the blood could be corrected by direct 'chemical interference.' He rejected general measures such as blood-letting. Since diseases were simply based on excesses of acid or alkali, therapy could be reduced to a correction of the excess by drugs of an opposite nature. This implied the use of *alterantia* with a specific character, acid or alkaline. Sylvius also prefered the use of *evacuantia* with specific actions such as, dilution of the blood, mitigation of abnormal effervescences, stimulation of perspiration and interference with flatulence. All these actions were attributed to opium and therefore justified the frequent presciption of the drug.

Sylvius was an active chemist and spent much time in his laboratory to develop new drugs. Well known are his *sal febrifugium* and *sal volatile oleosum.* He prescribed the latter salt frequently. It was an alkaline substance, useful in cases caused by excess of acid. Like all volatile salts it neutralized acid, stimulated respiration and dissolved thick phlegm. Most volatile salts were, however, too sharp and thus unpleasant to use. The 'oily volatile salt', produced by dry destillation of hartshorn, had the advantage that the oily component damped the sharpness of the salt.

Mechanical aspects of Sylvius' iatrochemistry

Sylvius' explanation of the effervescence fitted well in a corpucular, mechanistic view. The actions of fire particles was closely related to their configuration. The changes they caused required direct contact with the substances undergoing transformation. Sylvius also used mechanical concepts to explain other physiological processes. He considered the production of digestive juices, such as the bile or saliva, as a kind of filtration through the pores of the *tunica,* the envelope of a gland. De Graaf specified it as follows: "arteries transfer under the purple blood-substance all kinds of fluid to the glands, each of which letting pass, like sieves, those particles whose size and outer form corresponds best with the shape of the pores; at the same excluding other particles with less resemblance." Filtration and sieving dictated the absorption of chyle from the intestines and the formation of *spiritus animalis* in the brain. It was in fact a general principle: the walls of blood-vessels in different organs had pores of distinct size and shape, letting pass only fitting partcles, so producing the characteristic and specific secretion.

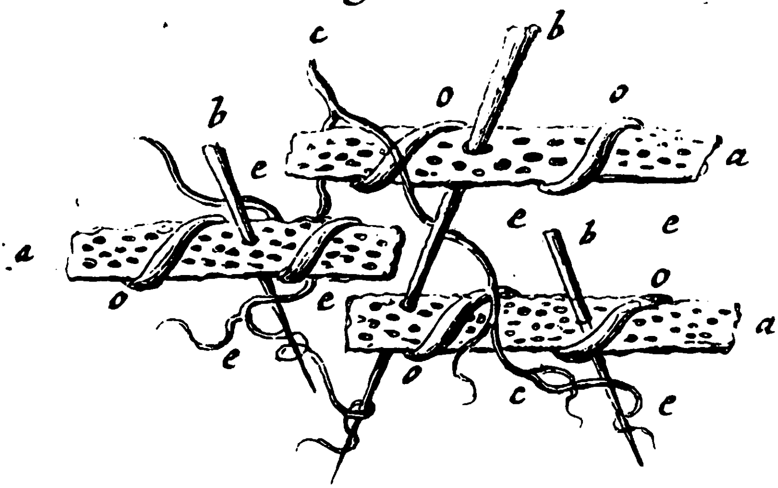
To explain the action of the nervous system, Sylvius maintained the ancient concept of the *spiritus animalis;* the purest and finest substance in the body. The pores of the capillaries in the brain cortex filtered the most spirituous and finest parts from the blood into the white substance. The remaining aqueous parts were collected in the meninges and the ventricles. The nerves carried the animal spirits to all parts of the body. Spirits not used, for instance in muscular actions, were collected from the tissues by the lymphatics and next re-introduced in the blood circulation through the lymphatic system. Lymph particapted in a second circulation used to prevent excessive expenditure of *spiritus animalis.*

Mechanical aspects were also involved in pathological conditions. It usually was a matter of abnormal physical conditions of the body fluids (too tough, too mucous) resulting in obstruction and stagnation in vessels, nerves and glandular ducts. An intermittent fever resulted from stasis of pancreatic juice. An excess of acid was responsible for the coagulation of the juice. Sylvius based this hypothesis on the observation - in a post-mortem - that a blue substance injected in the pancreatic duct did not penetrate all parts of the gland.

Copious meals made the chyle thick and mucous and caused a stasis in the lacteals. These delicate vessels ruptured and their contents accumulated in the abdominal cavity causing the clinical picture of ascites. This abnormal accumulation of fluid could also result from an excess of acid in the blood. In that case excessive binding of bloodparticles created a surplus of serum and phlegm. Therapy included just the dilution of blood, the dissolution of phlegm and the neutralization of acid. For that reason *salia vòlatilia* could not be missing. Their action was to dissolve tough and mucous substances and to correct acidity.

Sylvius reduced physiological and pathological processes primarily to reactions between acid spirits and alkaline salts. The chemical interpretation did not exclude mechanical aspects, as is shown by Sylvius' interest in the sieving action of the solid parts and the use of 'hydrodynamic' concepts. Followers like Steven Blankaart visualized the bridge between chemical and mechanistic views with the corpuscular interpretation of the fundamental reaction: the sharp, pointed acid was captured in the holes of the alkaline salt (fig.4).

Fig: 8.



Epilogue

Jonathan Swift described in the third part of *Gulliver's Travels* the journey of Lemuel Gulliver, a former medical student at Leiden university, to the country Balnibari. He visited the capital Lagado and its "Academy of Projectors". Gulliver observed there an experiment by the "most ancient student of the Academy" attempting "to reduce human excrements to its original food, by separating parts, removing the tincture which it receives from the gall, making the odour exhale, and scumming off the saliva." This imaginative iatrochemical experiment probably was a persiflage based on Leeuwenhoek's microscopic observations of human excrements.[12] The Academy was "not an entire single building, but a continuation of several houses on both sides of a street." Palomo suggested that this Academy was nothing else than the university of Leiden. The description of the buildings was inspired by the frontispiece of Boerhaave's *Index alter plantarurn* (1720), showing the main building of the university in the background, at the right side the house of the professor of botany, the Physics Theatre and to the left side the printing-office, the chemistry laboratory and the greenhouses. Palomo suggested further that Lagado is derived from the Latin name of Leiden Univerity. In its official bookmark *Academia Lugduno-Batavo* is abbreviated to *Acad. Lugd.,* which is easily transferred into *Lagado.*[13]

If Palomo's suggestion is correct, then Jonathan Swift interpreted Leiden University as an institution accepting a scientific attitude based on experimental philosophy, on experience and experiment. To which the medical faculty added the harmony with the ratio. The device *ratio et experientia* is indicative for this attitude. It was the device chosen by the medical faculty for its seal of 1670. It was also characteristic for Franciscus dele Boë, Sylvius as representative of the first natural scientific period in the history of medicine. Sylvius' iatrochemistry was above all a practice- and research-oriented medicine. He held to the importance of experience in medical practice as well as in experiments, but not without reason. In the disputation defended in 1659 by Ludovicus Meijer he spoke of *Ratione duce ac comite experientia,* reason as companion of experience. Thus, stressing in one of his first disputations the methodological basis of his iatrochemical system.

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