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Articoli/Articles

CONSTRUCTING CLINICAL SCIENCE

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SUMMARY

Clinical practice became clinical science in the years 1720-1820. There were many reasons for this transformation. The discoveries by Santorio Santorio, William Harvey, Marcello Malpighi, Giovanni Alfonso Borelli, Lorenzo Bellini, Thomas Sydenham, Giovanni Maria Lancisi, were perceived by students who asked for changes in the medical curriculum. In 1761 Morgagni centered the study of diseases on morbid anatomy, a way to control at autopsy the validity of diagnosis. J. P. Frank who worked on public health and John Locke who supported a method of scientific reasoning based on asking questions were also instrumental for changes. Hospitals, formerly hospices for the poor, became places for curing and healing. Military hospitals represented models to be followed. In Vienna Marie Therese inaugurated the Allgemeines Krankenhaus in 1785. In revolutionary France Fourcroy with the law Frimaire An III, 1794 gave a new rationale. Medicine and surgery were unified in the curriculum. Basic sciences were introduced. Dissection became compulsory, practical teaching became the rule. But it was with John Hunter, Domenico Cotugno and P. Joseph Desault that the great advancement was achieved. They were anatomists and therefore they made the knowledge of human body the core of medical curriculum. However experimentation on animals, as well as practical bedside teaching at the hospital also became important. Through their work hospitals and universities were associated in a common goal.

Key words: Clinical science - Domenico Cotugno - P. J. Desault - John Hunter - Anatomy - Clinical teaching - Percussion - Auscultation - Morbid anatomy

The birth of clinical science

John Hunter in London (1728-1793), Domenico Cotugno (1736-1823) in Napoli and Pierre Joseph Desault (1738-1795) in Paris were the physicians in chief of the three most advanced hospitals in medicine and surgery of their time. They represent the encyclopedical transformations which occurred in every discipline in those days in Europe.

For many centuries medical practice and medical knowledge - the former empirical the latter philosophical - have progressed in parallel without really meeting. However, at the end of the XVII century they came together, thus generating the embryo of what subsequently became medical science. The primers of the fusion of medicine with surgery were on one hand normal and morbid anatomy and experimental physiology, and on other hand the collection of signs disclosing deep lesions.

Hunter was a surgeon with a strong sense of novelty. His teaching involved dissecting corps, looking for a confirmation of the experimental findings in animals and trying to follow a logical thread. His best contributions are to be found in the *Treatise on blood, Inflammation and Gun-shot Wounds*, based on the experience made at the Belle Île siege. He was capable to advance an advanced anatomo-clinical synthesis which still represents a good model of thought. As one of his colleagues wrote, "he alone made us gentlemen".

Cotugno achieved, from the very beginning of his career, a perfect synthesis of his own of medicine and surgery. His intentions were fully realized abroad, in France, with the law 14 Frimaire An III (1794). In fact as a hospital surgeon Cotugno decided to study medicine and graduated at Salerno Medical School. A talented scientist, praised even by Morgagni, he greatly contributed to anatomy. He described sciatica and nephrotic syndrome, as well as measuring proteinuria. As a state physician of the Kingdom of Naples he organized preventive measures in the countryside. In the book *Sullo spirito della medicina* he anticipated the concept of the "teaching hospital" which became a reality when he transferred the

university clinical teaching right into the hospital. As a man of refined culture he understood the importance of international exchanges and promoted them. He felt at ease with the great men of his time while working and living in a very stimulating albeit rather peripheral city.

In France the symbiosis of medicine and surgery was achieved slowly and received state imprimatur by Antoine François de Fourcroy in 1794. La Peyronie, personal surgeon of the king in 1724, had obtained professoral chairs for the College of Surgery, and in 1731 the foundation of the Academy of Surgeons. In 1743 he had also been able to insert in the profession of surgery in the curriculum of those destined to be Maitres ès art (masters of the art).

In 1750 a practical school of dissection was founded for which La Martinière obtained from Louis XV a specific hospital devoted to teaching and clinical research. Tenon writes that surgeons organized purposely step by step a surgical course, preparing their students to learn medicine as well as surgery. In the 1788 report on Paris Hospitals Tenon gave a favourable description of their intellectual life, greatly stimulated by the debate among surgeons - one for each patient - in presence of selected students. Why were surgeons supported by the King? One of the reasons is to be found in the fact that Louis XIV in 1686 had been forced to take a break from his state duties because of an anal fistula. The disease became an important event for French and European politics. Medical treatment had failed and therefore C. Félix of the Brotherhood of St. Cosma was obliged to perform the operation which took place after accurate clinical preparation and planning. The approach was rigorous, almost experimental, and it was based on local examination and invention of specific surgical instruments. Having granted good health to the King, surgery was recognized socially. It developed and progressed rapidly in Europe during the XVIII century since it was based on facts and logic, based on anatomical foundations, which were accessible to practitioners. Furthermore, the control of lesions observed during life or at autopsy used to make of every patient a clinical case. With the substantial help of surgery a medi-

calization of the hospital was achieved, together with its natural complement - that is, with clinical teaching based on interpretation of alterations which were physiologically perceived, just because they were sought for.

Medicine did not progress at the same pace. Until the end of the XVIII century semeiotics was subjective - that is, based on symptoms described by the patient or observed by the physician. The inspiring description of Sydenham - who established a hierarchy of symptoms - did not substitute physical signs which became the initial framework of medicine. Around 1765, Diderot in the *Encyclopédie* conferred to "sign" a preminent position in medicine. In his words, a sign is

any perceived effect through which one arrives to catch a hidden effect which cannot be witnessed by senses. Therefore a symptom may be turned into a sign.

However, Diderot's is not physical examination. This was practiced in the clinical departments of Leyden, Edimburgh and Vienna, where a minority of students was admitted to attend to the hospital. Because of their anatomical and clinical education Hunter, Cotugno and Desault were able to finally open medicine to semeiotics.

Although at Vienna De Haen and V.v.Hildebrand, the successor of van Swieten, insisted on the doctor-patient relationship, it is to be proven that they gave importance to the search for physical signs as indicators of deeper local lesion. In the work of Hildebrand, dedicated to M. Stoll, one may find a register of 20 acute cases and of the related autopsies, concerning pulmonary diseases: in this case, a description of physical signs is absent. However in 1763 Auenbrugger in Vienna had described percussion: this was the beginning of clinical science of thoracical disorders. By reading Stoll's work, Jean Nicolas Corvisart was attracted (it was a straightforward seduction) by this exploratory technique. Auenbrugger's translation by Corvisart appeared in 1808. The preface started with a significant sentence: "*of all physical sciences*

none is comparable to medicine in its need to question senses". Later on he recommends "*medical education of senses*". The reputation of Corvisart's unit at La Charité hospital was due to the education conducing to the identification of undisputable facts controlled at autopsy. Through this approach it became possible to make semiotic deductions linking heart lesions to extracardiac physical alterations like edema, pleural effusions, ascites, cardiac asthma. Lesions were disclosed by physical signs which were perceived at a distance from the diseased organ. The lesion in one specific part of the body could have consequences on the whole organism. It was a turning point in the physiological thought, well illustrated by Xavier Bichat in *Recherches sur la vie et la mort*. The projectile sent in orbit in those days is still following its glorious trajectory. Fourcroy recognized the importance of this turning point in the 1801 opening address at the Health School, when he said "*he made the diagnosis of these lesions so simple that an alert fellow recognize them unequivocally*".

It is noteworthy that in the 1760 preface Auenbrugger made clear that "*the book is a faithful witness of my senses*". This is the clinical method of yesterday and of today, even at a time when instruments have evolved and provide us with numerical evidence. Modern instruments which transform everything in numbers make no exception and follow the same pattern. The starting point and the related questions proceed from a clinical exam during which the sensorial perception generates the thought. "*I perceived before thinking: this is the common destiny of mankind*" pointed out Jean-Jaques Rousseau in the initial pages of *Confessions*.

New developments

New developments are generated on the shoulders of giants. According to John of Salisbury (1159) Bernard of Clairvaux used to say that

we are like dwarfs who can foresee more and observe at a greater distance not because of a greater visual acuity or because peculiar physical

capabilities, but because we are maintained in a higher position by their gigantic bulk.

This was the opinion of Isaac Newton, who five hundreds years later wrote "*I saw further because I rested on giants' shoulders*". In the second half of the XVIII century clinical science was build on the shoulders of three giants, namely the English surgeon John Hunter, the Neapolitan physician Domenico Cotugno and Pierre Joseph Desault - the latter became the first professor of surgery in a French university, following a revolutionary decree. Because of their scientific greatness they were able to observe more distant things.

Three giants: however each of them was very different from the other two. They were brought together by talent, creativity and by their skill in anatomy. First of all, talent has to be taken into account - which for Marcel Proust and for the Nobel Prize V. S. Naipaul is a combination "*of good luck and great effort*". All of them worked hard, throughout their life. Desault and Hunter worked in a rage, Cotugno with serenity. They were creative. Hunter developed comparative anatomy by focussing on experimental protocols. Desault produced a revolution at the hospital by imposing on the physicians a careful scrutiny of the patient, by enlarging the space for teaching, by utilizing a physician or a medical student for each patient, by strict control of alimentation and drug administration, by improving hospital facilities, by eliminating the large beds which in those days hosted patients suffering from diverse diseases. Cotugno proved to be a great investigator. Between 1761 (*annus mirabilis*, the year of publication of Morgagni's *De Sedibus*) and 1769 he gained universal recognition. He had discovered the aqueducts of the internal ear, the endolymph, as well as disclosing the effect of smallpox on mucous membranes and the pathogenesis of sciatica. Last not least he had also provided a description of nephrotic syndrome and of the measurement of proteinuria, and made a significant quest for changes for a medical teaching based on facts - that is to say, on anatomy.

The key role of anatomy

Hunter, Desault and Cotugno were great anatomists. Desault as a student of surgery developed a method which opened the field of topographical and surgical anatomy. Anatomy had a crucial role not only for organ location but also for their connections, physiology and pathology. Cotugno studied anatomy and used it for research, teaching and medical practice. He also taught surgery privately and at the hospital, and this was a cause of jealousy among his colleagues.

Hunter had an innate talent for anatomy research, as witnessed by his success in his brother's laboratory. He firmly entrenched anatomy in biology, a science that was undergoing great changes. For Hunter cadavers where the proper books to be studied, since printed books were unsuitable to teach anatomy. Hunter and Desault drove anatomy towards surgery by different routes. Hunter was guided by animal experimentation and reached what can be defined a philosophical anatomy. In addition he tried to apply his general theories to surgical pathology. Desault moved from human anatomy towards physiological surgery, with a great concern for etiology and the mechanical pathogenesis of lesions¹.

The three scientists had different characters. Cotugno was brilliant, he mastered written and spoken Greek and Latin, he chiseled words, even written words. A fine talker, he was convinced, with good reasons, that in order to become a teacher at the university one had to be able to speak appropriately. Goethe, who appreciated people speaking appropriately, might have invoked on him God's blessing. Cotugno was aware that this ability might be learned with a training, which became indispensable in the preparation of presentations for students. It was a popular opinion that Cotugno prepared his lectures before a mirror, by accurately studying tones and gesture. Further, Cotugno was able to generate connections and to keep them vital. Desault behaved as a provincial even when admitted to the Académie. He was aggressive and slow in the discussion. He needed time to meditate and he did not like the debate - he was not prepared for this style of scientific exchange. He was not the typical scientist

of the academy: "I am like a saline solution which crystallizes with time". Hunter's gestures and language were mediocre too. He paid a high price for his late interest in the humanities: he remained a scientist even when he decided to undergo a formal training in humanities. However he taught at the bedside and he behaved as an artist during his experiments. Desault also taught by being present day and night at the hospital and in the amphitheatre. He taught in a socratic manner to those around him. He used to address the pupils, as Socrates and Jesus did². Cosmacini appropriately stresses that

the work of the surgeon Desault is a synthesis of the progress made by surgery in the XVIII century, while the work of the physician Corvisart prepares a qualitative leap of internal medicine in the initial twenty years of the XIX century³.

Their family life mirror their different approach to scientific life. Cotugno married a lady from the Neapolitan nobility. She was accused by Pietro, one of Cotugno's nephews, of having hindered his scientific abilities: after the wedding Cotugno preferred to live a solitary life. Desault married a beautiful lady, well known in Paris, one of the prettiest in those days. However Desault was forced by his job to be at the hospital night and day, so that he lived in an apartment near the hospital and had no time for family joys. He worked with rage, as if aware of his untimely death. Hunter on the contrary married a very intelligent woman who helped him by establishing relationship with the high society and the rich clients and by forming a well attended literary circle in their home.

The three academics, who used to do a very professional job, had a different interest in money. Hunter collected money easily and used it for scientific research - that is, to build and maintain his museum. He needed money for his experiments - some of them costed a lot. Cotugno never asked for money: making money was not a goal in his life. However, he did receive money. Most of it he left by testament to the Ospedale degli Incurabili in Naples. Desault had no time to assist his rich Parisian clients: he was guided by the daemon of perfection in surgery and of bedside teaching. He was

the inventor of new surgical manoeuvres. He died a very poor man. The Great Revolution provided a pension for his widow and did it timely and generously.

Teaching

Hunter, Cotugno and Desault had different attitudes towards their pupils. Hunter had apt pupils who after his death proved worthy of his teaching. Since Hunter's speech was not refined he could attract pupils only through scientific and professional brilliancy. The young were aware of the fact that Hunter taught the truth, consisting in facts that could be easily checked. Among Cotugno's followers emerged Folinea, Troja and Bruno Amantea. Folinea was his preferred pupil, and after 1814 he held the chair of anatomy at Naples university. Michele Troja was a surgeon and scientist with an international repute, who made his début in science with a book on bones, the *De novorum ossium, in integris aut maximis ob morbos deperditionibus, regeneratione experimenta*, published in Paris by Didot in 1775. The book dealt with experimental data on callus. Amantea was a hospital physician in chief and professor of anatomy. His capability as anatomist and surgeon was legendary, despite the fact that he has left no written works.

In all times pupils have been the most precious witness of the ingenuity of the teachers. This has been true for Plato, Aristotle, Socrates, and this is true for every age. Desault had a long list of excellent pupils. It is enough to remember Xavier Bichat, who left surgery for medicine becoming a high-rank physiologist. He shed new light on anatomy, moving from organs to tissues.

Cotugno and Desault moved clinical teaching from the university into the hospital. Cotugno transferred clinical teaching from the university into the Ospedale degli Incurabili. Desault was the first professor of surgery in the most important university of France when Fourcroy promoted the law known as law 14 Frimaire An III (1794). There was no doubt that he was the best at the bedside, in the amphitheatre, in his willingness to control the quality of the work through autopsies. It must be stressed that Baron Corvisart de

Marest, assistant to Desault and to Desbois de Rochefort, became the first professor of internal medicine at La Charité - which had been renamed Hôpital de l'Unité⁴. Desault taught throughout his whole life, beginning with 1766, the year of his first class of private teaching. Although officially he was professor only for a few months, he started a new process in medical education in France, one based on clinical preeminence.

At Desault's school exchanges between colleagues were the rule. They used to exchange experiences between them, with and without the master - the master, not the professor. Master, like *rabbi* in Hebrew. It is not a simple task that of growing pupils used to exchanging informations. However, there are masters who have had thousands of pupils - for instance, Abelard had five thousands pupils. Fifty of them became abbots, cardinals, bishops; three of them became popes. William Hunter had some three to five thousand pupils, John Hunter had a thousand of them. To grow pupils and to put them on their own two legs one needs charisma. Enrico Fermi was the tutor of ten Nobel laureates. He used to dedicate them plenty of time, after selecting them with strictness. Admission examination lasted four days. Every afternoon, Fermi used to have the door of his office open at six, and he let come in those trainees for whom he had esteem and considered worth of his teaching. He used to discuss for hours with them, opening their minds. Hunter, Cotugno and Desault had the characteristics of the giants mentioned by Bernard of Clairvaux. They shared a true love for anatomy, a discipline which they mastered and used to enlighten clinical knowledge, turning it into a science.

Publish or perish

As we use to say today: publish or perish, and - publish *and* perish. Hunter published a lot, preferably in the very succinct *Proceedings of the Royal Academy*, but he wrote only a few books. He was attracted by experimentation and on occasions he used to speak about experimental results. But more often than not the experiments were left in his experimental books. He had no

time to organize the data collected in his restless activity. He did not gather the importance of writing organized treatises for posterity. Cotugno wrote with great skill and his works were translated in foreign languages. This offered him the possibility of refusing the university chairs offered him by the University of Pavia and Pisa.

The cultural roots of Cotugno and Desault were Latin, those of Hunter Anglosaxon. Desault wrote very little. Indeed he did not write in the proper sense: Bichat, Chopart, Cassius wrote for him. This was no obstacle to the creation of a new science. Notwithstanding his early death, he had the opportunity to make himself known, even if he was no politician. However, in the crucial moments of his career he had the support of two great men - Antoine Louis and Germain Pichault de la Martiniere. Both gave him credit, since they acknowledged his intellectual brilliancy.

Desault also understood the importance of space for medical education. The abundance of space allowed him to receive hundreds of students from France and abroad. Among his primacies one should mention the contribution to the development of specialties, in particular to the development of the study of renal disease. We now list him among the "forgotten nephrologists"⁵, those who opened the field, ploughed it and produced good fruits which were however quantitatively insufficient to build up the critical mass of data needed to generate a discipline in its own right.

Working capacity

Hunter, Cotugno and Desault used to work hard. Cotugno dissected cadavers and studied them thoroughly and made significant discoveries. The daily schedule of Desault's day at Hôtel-Dieu is a good example for tirelessness. The work started at six and ended late in the evening. He alternated clinical rounds, lectures, examination of his pupils, autopsies and emergency operations.

Hunter too made maximal use of his time by starting his experiments very early in the morning, and dedicating the second half of

the day to operations. He also used to participate to all the activities of the Académie.

Great men are like mountains. Near their base one cannot fully understand the grandeur of the summit. This becomes easier when moving away from the base. This applies to Hunter, Cotugno and Desault. They achieved glory at a very young age. Hunter searched for it with great determination. His patients, belonging to the elite, increased his popularity in London. In the Academy, or wherever he was present, Hunter received recognition. The excellency of historians of science and medicine in England also account for his present fame. It is possible to extend to his character the considerations Oswald Sprenkel⁶ made about Eraclitus, who

as any Greek needed glory, since a good reputation was considered expression of the highest virtues (...) any Greek wanted to be the talk of the town at any price (...) and Eraclitus left his writings in the Temple of Artemis so that they could reach posterity⁷.

In fact, Hunter impressed his seal on his museum. Desault, “*le bourru bienfaisant*”, did not work for glory, but nonetheless he achieved it indirectly, through his excellent pupils. Having good pupils implies the risk of ruptures: pupils force their master to continuous competition. However, good pupils do not pop up like mushrooms. We owe Desault credit for having selected Bichat and for tutoring him, for hosting him in his house. He was able to understand geniality in a young man, as he was convinced that Bichat would have success in science. And Bichat, after the death of the master, went back to the notes he had taken during Desault’s presentations, and he let the novelty of the master’s teaching come out. This acknowledgement must be added to the long list of Desault’s merits. The master had looked for good and loyal pupils. Loyalty is something difficult to obtain and to preserve when competition is high. However, Cassius had no difficulty in attributing to the genius of Desault books written decades after the death of the master by using the notes he had taken during presentations.

Cotugno was glorified at the hospital, in the university, at Court, during the French domination as well as under the Bourbons. He received various acknowledgements. Maybe in his old age Cotugno, while writing letters to his many correspondents (scientists, physicians, clients, noblemen), might have regretted for the organizing roles he had accepted. It may well be that he lived the time of organizing as the inevitable consequence of the scientific successes achieved at a younger age. Perhaps when accepting the responsibility in the various committees and associations Cotugno considered it as a civic duty, an act of generosity towards science, so that his followers may operate in better conditions.

Creativity

Hunter, Cotugno and Desault belonged to the category of creative people, dedicating themselves to their chosen field while keeping a naive stare - the stare typical of childhood, the age when is possible to be open-eyed in wonder. They were creative scientists, ready to catch novelties, to appreciate the differences and the similarities which lead to new systematizations and to new structures, more than trying to impose old structures on what they saw - something impossible to achieve if one is driven by mean purposes⁸.

In *Le Savant*⁹, the Nobel laureate Charles Richet (1850-1935) pointed out that creativity is generated in the atelier of the master, through mutual consent.

Working together is lovely (...) while working one is criticized and participates with some scepticism to the efforts of the colleagues. And above all one feels the goodwill of the master (...). By this approach old theories, out of mode, are destroyed and new theories still to be perfected are ridiculed.

This is the collective way of thinking which existed in Hunter, Desault and Cotugno. The collective approach represents a strong stimulus to clinical intelligence, which is the source of progress of medical sciences.

Books

Is authoring books indispensable to obtain celebrity? The fact that Desault did not write is not unique in science. Surgeons like Antoine Dubos or Dupuytren had no time to write. It is strange that Desault should be remembered by Guthrie with one line only: "he developed methods to handle fractures". The same did Lyon and Petrucelli, who wrote: "his bandages for fractures are still in use"¹⁰. The bandage in eight is still used today for fracture of the clavicle". Socrates himself did not write. He adopted interpersonal debate as a method, thus idealizing the art of conversation. The debate sometimes generated "the divine spark and the love for wisdom"¹¹.

On the education value of written texts even Socrates was mistaken:

by abolishing the exercise of the memory, your invention (writing) will generate oblivion of the soul in those who will make use of it (...), you have invented a remedy which is useful not to memory but to reminiscence. To your fellows rather than the truth you offer a semblance of wisdom. When they will complete learning without being exposed to a real teaching, they will consider themselves learned without being truly so¹².

From Plato we learn¹³ that Socrates on two occasions consulted scrolls, however in both instances they did not contain works of the master. However he too did not write. According to Steiner¹⁴ writing carries the risk of immobilizing the discourse by conferring staticity and making it thought-free. However, the development of electronics nowadays is against the value of memory. Writing is difficult even when one loves teaching and has respect for pupils. Silvia Ronchey¹⁵ in *Il piacere di pensare* quotes a Greek phrase, *kipos pétrinos*, a stone garden: "writing is a word garden growing with difficulties on a stone soil". Hilman answers:

I point out that writing consists in sitting at a table. However - this act should be accomplished by necessity. One must feel pulled by Ananke, the Goddess of Necessity. And one must have passion.

Cesare Garboli in *Pianura proibita*¹⁶ says that

books are paradoxical objects, unique in that their value does not depend on materiality. Books live on ambivalence. Material and immaterial, public and private, intellectual and commercial. Their consumption is not a physical act but a mental one: their times are measured by centuries and by weeks.

The professor's books

To write a university textbook one needs readiness to work for others, clearcut ideas, a sense of style - and a great effort. Derek de Solla Price in *Little Science, Big Science*¹⁷ analyzed the exponential

<i>John Hunter</i>	
Table 1 - Lifetime of John Hunter.	
	Birth at Long Calderwood in Scotland starts working in Williams's atelier
1751	apprentice to John Percivall Pott at St. Bartholomew's Hospital staff surgeon at St. George's Hospital staff military surgeon at Belle-Île-en-Mer
1762	Regiment surgeon in Portugal under Mr. John Boyne Home
1762	<i>The State of the Testis in the Foetus and on the Hernia Congenita</i> admission at the Company of surgeons
1768	surgeon to St. Bartholomew's Hospital
1771	marries Anne Home
1771	<i>The natural history of human teeth</i>
1776	<i>Observations on Certain Parts of the Animal Oeconomy</i>
1785	operation for popliteal aneurysm
1786	<i>A Treatise on Venereal Disease</i> Copley Medal
1787	Sir Joshua Reynold paints Hunter's portrait death in London
1794	<i>A Treatise on the Blood, Inflammation and Gun-Shot Wounds</i> Christie sells his collection of books and paintings
1799	the government purchases Hunter's museum foundation of the Hunterian Oration Everard Home first Hunterian Orator 1859 re-interred in Westminster Abbey

growth of scientific journals beginning in 1665, the year when the *Philosophical Transaction of the Royal Society* and *Journal des Savants* came into life. He has shown that they double every 15 years while the number of papers doubles in 10 years.

Hunter marked his times. He was a man of great culture and scientific curiosity. His name emerged also through the special support of those who wanted surgery to become a science¹⁸.

According to John Abernethy¹⁹ “in the whole history of medicine we will be unable to find another scientist worth of comparison with Hunter”. According to Chevalier²⁰ Hunter transformed surgery in a science - not simply a manual practice. According to Lawrence²¹ he was “the most important product of the nation”. According to Ottley²² Hunter understood that “he could not ground scientific surgery without using comparative anatomy and physiology”. According to J. and S. Paget²³ Hunter “is the founder of scientific surgery”. According to Kobler “he is the Shakespeare of medicine (...) one of the most illustrious men born in the English nation”.

Hunter moved easily from animal experimentation to operations on humans. In 1776 the Royal Society bestowed on him the honor of six Croonian lectures on muscle movements. In the same year he was nominated Extraordinary Surgeon to King George III. In 1783 became member of the Royal Society of Medicine and of the Royal Academy in Paris. In 1787 he was awarded the Copley Medal for natural history, the greatest honor conferred by the Society, and he also he became member of the Philosophical Society of United States. In the same year Hunter was ready for a portrait painted by Sir Joshua Reynolds.

There are very few people who have had the capability of opening so many fields and to promote so many disciples. Hunter had among his patients Benjamin Franklin, he had excellent relationship with Adam Smith, with Lord Queensberry, Sir Joshua Reynolds, Haydn, Brinsley Sheridan, Lord Engilton. Many historians have underlined that on the occasion of his nomination at St. George’s Hospital he was voted by 114 out of 161 voters. such things should

support the idea that he was not an arrogant man. Perhaps what was perceived as arrogance was only a kind of defense. This might have been caused by a lack of formal education. His story also tells us that precocity is not an indispensable prerequisite to celebrity. The experience of Hunter tells us that sometimes exceptional people may prefer the study of music, arts, natural sciences to a formal education. This will not detract from their potential at the time of their higher studies.

He was successful in science because he felt gratified when he experimented. For this reason he did not need any external judgment to understand the relevance of his own achievements. In fact he was never gratified by the study of dead languages which also were part of formal education for physicians and surgeons. However he was not an illiterate, as is easily gathered from the list of his books sold by auction.

He financed his research by working hard, by going out every morning to see as many patients he could, trying to be on time, in order to gain the money needed for laboratory animals, hostlers and

Domenico Cotugno
Table 2 - Lifetime of Domenico Cotugno

1736	born at Ruvo beginning of medical studies in Naples assistant at Ospedale degli Incurabili degree in medicine at the University of Salerno <i>De aquaeductibus auris humanae internae anatomica dissertatio</i>
1764	<i>De ischiade nervosa commentarius</i> scientific trip through Italy professor of anatomy
1769	<i>De Sedibus variolarum Syntagma</i> anatomical teaching started at Ospedale Incurabili <i>Sullo spirito della medicina</i> closure of the academic activity death in Naples

assistants. It is through the achievements of people like Hunter that mankind became aware of the fact that research is not a single scientist's personal belonging rather than the property of mankind as a whole.

Domenico Cotugno (1736-1824) was a talented anatomist. Within a few years (1761-1769) he gave a significant contribution to the understanding of the inner ear (*De aquaeductibus auris humanae internae anatomica dissertatio*) and he described the nasepalatine nerve, rediscovered by Antonio Scarpa eighteen years later, and he published the *Commentarius de Ischiade nervosa*. In the latter work he described cerebrospinal fluid, nephrotic syndrome and the diagnosis of proteinuria. He observed that urine coagulated by warming, like egg white: "*albam massam tenerrimo iam coacto ovi albumine persimilem*". Finally in 1769 he published *De sedibus variolarum syntagma*, demonstrating, by autopsy, that smallpox lesions have a dermal origin.

As a great anatomist claiming for the unity of medical and surgical thought, and aiming to renovate the discipline as well as the teaching, Cotugno gave a personal interpretation of the European quest for changes at the medical faculties. He was at the same time physician, surgeon, anatomist, and university teacher. He anticipated Desault by some twenty years in requesting that medicine be centered on the study of the patients, on their histories. He had no doubts that

"Non fieri medicum ex libris, neque ex precariis mathematicorum postulatis, sed ex usu experientia et continua aegrotantium inspectione".

As a scientist of international reputation who had declined an offer to teach abroad on two occasions. With Cotugno, for the first time, the hospital and the university had a common program.

His academic life was driven by a strong interest in anatomy. But Cotugno did not limit himself to defending the discipline. He did more, being facilitated by his personal charisma and achievements in science. As a professor of anatomy he held a chair with a small

salary; however, through the King's help, he forced the university to provide the chair with a salary identical to those granted to clinical disciplines. In those days the salaries for the chairs of internal medicine and surgery were 2 to 3 times higher than those for other medical disciplines. Cotugno, by the time he left university teaching, had been able to establish at the University of Naples, by decrees of Murat confirmed by King Ferdinand IV, three new chairs of anatomy. Therefore in Naples there were professors for normal anatomy, morbid anatomy, anatomical demonstrations. Anatomy was also taught at the College of Military Physicians and Surgeons (Collegio Medico-Cerusico) which was also located at the Ospedale degli Incurabili.

He was member of many academies in Naples, in Italy and abroad, such as the Royal Society of Medicine at Paris, the Société Royale de Médecine at Montpellier, the Galvani Society in Paris, the Madrid Academy, the Medical Society at Copenhagen. His university presentations were a case for popular discussion, because he attracted artists and politicians. The Count of Brunswick, for example, after attending Cotugno's lessons, expressed the wish to become physician.

Pierre-Joseph Desault
Table 3 - Timelife of Pierre-Joseph Desault.

1751	birth at Vouhenans work at the Military Hospital at Belfort
1776	surgical studies at the University of Paris member of the Royal Academy of Surgery surgeon at la Charités surgeon at Hôtel-Dieu
1793	foundation of Journal de Chirurgie Desault meets Bichat
1795	professor of Clinical Surgery (January 7)
1795	death in Paris on June 1
1798	<i>Oeuvres Chirurgicales</i> published by Bichat

According to De Renzi²⁴ “no one used the Hippocratic method better than Domenico Cotugno. (...) All his achievements were the result of the Hippocratic method he had adopted”. At Cotugno’s death Pietro Colletta in *Storia del Reame di Napoli dal 1737 al 1825*²⁵ described him as “learned, eloquent, and eminent for his new doctrines” and he stressed that all “academicians followed his coffin because of his great efforts to teaching”.

Desault was born at Vouhenans (France Comté) 1738, the year Boerhaave died. At the age of 26 he was in Paris to learn surgery and started his own private school of anatomy based on cadavers. He taught by nature, without tables or wax models, and he used to address the students:

“Please observe, observe carefully, with attention; observe again, so that you will be able to impress on your brain the most accurate charts, more durable and more precise than those achieved by paint-brush or by chisel. You will have the opportunity to write personally, in indelible type, a book which will not disavow nature”.

He described the human body by referring to seven planes: anterior, posterior, superior, inferior, left lateral, right lateral and median. In this way he was able to locate precisely the position of the various organs and to relate them to their functional mechanics, pathology, and surgical anatomy. Using the latter as a starting point, he developed topographic (regional) anatomy as a discipline which later would be illustrated by Dupuytren²⁶.

As pointed out by Marc-Antoine Petit, Desault had exact knowledge of the organ and gave a rigorous description based on 1. Shape and contour, 2. Internal constitution, 3. Color, density, tissue composition, development (embryology), physiological and pathological movements and function in life by thorough cadaver examination, 5. Effects of age and disease, 6. Chemical composition. According to Descuret²⁷

“the genius of Desault made it possible for anatomical teaching to surpass the limitations of the time by creating an anatomical system which took into

account the form, size, position and direction of the fundamental parts of the human body. Each time he showed an organ to his fellows he took particular care to discuss the most typical diseases affecting that particular organ”.

According to Bichat

“these were the founding principles of Desault’s teaching. He created anatomical surgery in France and drove the art towards the perfection. Indeed Desault, only after long training and accurate experiments dedicated himself to clinical practice”.

According to Coury²⁸ the origin of Desault’s teaching method could be traced to the

“excellent methods for clinical teaching of internal medicine introduced by Louis Desbois de Rochefort at Charité and subsequently developed by Corvisart”.

It should be stressed that Corvisart was a pupil shared by Desbois de Rochefort and Desault in the years the latter worked at la Charité.

Desault’s daily work schedule

Clinical rounds at Hôtel-Dieu began very early in the morning from 6 to 8 AM, with an average of 400 patients. From 8 to 11.30 AM fellows received practical teaching in the amphitheatre. This was followed by consultation of outpatients, discussion of records of those discharged, performance and discussion of autopsies, report and discussion of patients operated the day before, theoretical presentations on pathology, and discussion of clinical cases. He was personally involved in all these activities. Students had the duty of summarizing the lecture of the previous day. His afternoon schedule included lectures on anatomy and the theory of surgical procedures, examination of the fellows, a public discussion and a second clinical round. Any remaining time was used for dissections and formulating or dispensing medications. This was the rule seven days a week. Desault seized any opportunity to stress the value and pri-

mary role of clinical teaching as well as the importance of analyzing diseases as they were observed by practitioners. It was equally important to discuss the outcome of various procedures. With this approach²⁹ he

“achieved a perfect integration of anatomy, operative medicine and clinical findings”.

Desault and his association with Xavier Bichat

Desault recruited Bichat on August 18, 1793. In that day the student in charge of summarizing the lecture of the previous day did not show and Bichat volunteered to replace him. At the end of the short synopsis he received the congratulation of Desault. A strong association emerged. After Desault's death the *Oeuvres Chirurgicales de P. J. Desault, chirurgien en chef du Grand Hospice d'Humanité, par Xavier Bichat, son élève, médecin-adjoint du même hospice* were published³⁰. Three years later a second edition in 3 volumes followed.

The reform of medical studies

On November 27 1794 (An III) Fourcroy established the goals of the university reform: *“peu lire, beaucoup voir, beaucoup faire”* - little readings, accurate examinations and plenty of practice will be the basis of the new medical teaching. On December 4, 1794 the Convention founded 3 schools of Health, at Paris, Montpellier and Strasbourg. The distinction between medicine and surgery disappeared as they were integrated in the curriculum and reflected in the diploma. The Convention did not establish schools of medicine, but Ecoles de Santé. This was a new concept: ‘santé’ referred to a primary need of humankind, now legislated as a right of each citizen. Clinical teaching at the hospital was enhanced by the creation of three chairs, one at Hôtel-Dieu for external diseases (surgery), one for internal diseases (at la Charité) and the third for rare cases at the Hopital des Ecoles. The length of medical studies was increased to six years and it was decided *“to enroll professors by competitive state examina-*

tion”. Desault became the first professor of Clinical Surgery in a French University by a decree issued on January 7, 1795. A few months later the genius died in poverty: the Convention granted a pension to his widow.

Clinical Science from Morgagni to Laënnec

During the 18th century people became aware that life and death do not depend on supernatural powers but are events depending on human factors which may be eventually kept under control.

A change also occurred in the hospitals - especially military hospitals. They were no longer hospices for poor people, cured on multiple beds. Clinical departments were built in Leyden, Montpellier, London, Edimburgh, Vienna, Milan, Pavia, Roma, Naples. In Austria the first teaching hospital was started by Marie Therese in 1785 (Wiener Allgemein Krankenhaus).

Giovambattista Morgagni

Giovambattista Morgagni (1682-1771) was born in Forlì. A disciple of Malpighi and Valsalva

*“among the gifts of the Italian school to the world he has a special place, since was the founder of the systematic approach to morbid anatomy”*³¹.

We was Doctor at 19 years of age, anatomical dissector at 25, professor of theoretical medicine at the University of Padua at 30 and professor of anatomy in the same university at 33. His monument is the *De sedibus et causis morborum per anatomen indagatis* which was published during the very special year 1761. In that year Leopold Auenbrugger published the *Inventum Novum* and Domenico Cotugno il *De aquaeductibus* of inner ear. Knowledge of the lesion became a tool for understanding disease processes. Autopsy became the procedure to trace the natural history of disease, and to answer the very question *“where is the disease located?”*

Giovanni Lancisi

Tissot at Lausanne became a pioneer in clinical science with the publication of the *Avis au peuple sur sa Santé* (1760). Another pioneer, Giovanni Lancisi (1655-1720), lived and worked in Rome. Lancisi was professor at the University La Sapienza for nearly thirty years and strove for a clinical physician being at the same time a human scientist. He described this model in *De ratione philosophandi in arte medica* (1709) and in *De recta studiorum ratione istituenda* (1715).

Lancisi has been undervalued since it was thought that he did not work experimentally. The charge is completely wrong. Just to make one example of his interest in research we would like to mention the so called "succession processes", as they are seen by plant biologist. These processes, still attributed to Lancisi, disclose in a soil newly produced by a vulcan, the order of the plants which will colonize it. Furthermore one should be aware that Lancisi lectured at La Sapienza but walked the wards of the Hospital Santo Spirito, thus linking teaching to practical activity in the papal hospital.

Frank at Gottigen, Pavia and Vienna introduced the discipline of Public Health and imposed to medical students to be taught to

*"perceive superficial and deeper signs of organical lesions, to learn medical procedures, to analyze biological fluids, to understand the teaching value of autopsy, to learn the effects of drugs"*³².

Leopold Auenbrugger and Hyacinthe Laënnec

Two scientists had an instrumental role in promoting clinical science. One was Leopold Auenbrugger (1722-1809), who in 1761 wrote a 95 page book describing *Inventum Novum ex percussione thoracis humani ut signo abstrusos interni pectoris morbos detegendi*. In the introduction one reads

"I am introducing a new sign which I disclosed, consisting in the percussion of the human thorax. This allows the evaluation of the resonances produced by the state of the internal cavity".

The book had no success until Corvisart translated it into French (1806). In the preface Corvisart wrote that

"the sign is relevant not only to identify the disease but also for treating it. The manoeuvre deserves a proper place in the study of the patient, just immediately after the examination of the pulse and of respiration".

With Corvisart percussion became a new method for posing questions to the physicians' perception - a method indispensable at bedside. Percussion deserved the first place in examining patients because of the many diseases of the thorax and also for its exactness. For Corvisart Auenbrugger's book was

"instrumental for advancement of medical art in one of the least developed sections of medical practice".

Another event which favoured the advent of clinical science was the introduction of the stethoscope, an instrument which made visible heart and lungs by means of auscultation. It was René-Théophile-Hyacinthe Laënnec who published the *Traité de auscultation médiate et des maladies des poumons et du coeur* (1818). A follower of Corvisart, Bichat, and Dupuytren, he used for the first time his invention *"in a young girl on whom palpation and percussion were useless because of her obesity"*. By this way the ear anticipated autopsy findings, guided the cure, and rendered autopsy less necessary. For Cosmacini the stethoscope was

*"a revolutionary instrument. The first instrument of general use for diagnose, it changed medical practice, physician's perception of the disease and the physician to patient relationship"*³³.

Physical examination by percussion and auscultation allows investigation of intrathoracic lesions which insofar were invisible to view and palpation.

It must be noticed that medicine became clinical science without making profit of the use of the thermometer. In fact only in 1858,

with Aitkin's and Clifford's modifications, the instrument became suitable for clinical applications.

Antoine-François Fourcroy

It is a paradox that the advent of clinical science was greatly favored by the work and political action of Fourcroy, a chemist who signed the decree 4 december 1794 which gave birth to Medical Faculties in France³⁴. The decree abolished all known limitation in medical teaching and introduced dissection, physiology, chemistry and clinical teaching on patients. For each medical school a library, an anatomical cabinet, and rooms for practical teaching were made available. Although a chemist he had studied and thoroughly translated Ramazzini's *Diatriba de morbis artificum* in 1776, and he oriented medical thought in France in the years 1777-1809.

An appealing and eloquent man, his language was rigorous and capturing. As member of the Convention, after Marat's death (1793), he linked his name to the great institutions which continue nowadays to honor France, after two centuries. These include the Academies, the Institute of France, the University, the Central School of Labour, the Institute of Engineering and Architecture, l'Ecole Normale, the Medical School. He left tangible traces of his interest, vision, capability and productivity. The list of his publications is impressive and is a testimony of his working capacity as well as of mental and methodological severity. He made full use of the plan to renovate medical teaching prepared by Vicq d'Azyr, which had been discussed in november 1790. Fourcroy based on it the law December 4, 1794. During the Terror he was able to let Desault get out of prison but he failed to save Lavoisier.

Surgical procedures for medical diseases

Of the utmost importance in constructing clinical science was the adoption of surgical procedures for medical practice. This introduced a sort of control - at the operation table or at autopsy - of the diagnosis and of the cure. Physicians finally examined patients at bedside. By this approach medicine consolidated the grounding of

clinical reasoning on 'signs' revealing the diseases which underwent palpation and auscultation, and were finally checked at time of the operation and on post mortem examinations. Until Roentgen, physical examination - discovering signs and interpreting them - was the cornerstone of clinical medicine.

The contribution of philosophers and students

Philosophers too contributed to the advent of clinical science. John Locke (1632-1704) rejected systems based on "a priori" assumptions. This generated "sensism", which was applied to medicine by Cabanis: "when we feel, we are". The final contribution came from students. They followed the novelties introduced in Europe and asked for their universal adoption. Their quest was finally accepted. The final triumph was the *Introduction à l'étude de la Pathologie Expérimentale* by Claude Bernard, (1868) which should be considered a Bible of medical reasoning.

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