

History of the invention of the cochlear implant through the career of Professor Claude-Henri CHOUARD

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This information is written taking into account the modification of the French Code of Ethics for Physicians by the decree of December 22, 2020, in order to lift the general and absolute ban on advertising made necessary by a ruling of the Court of Justice of the European Union of May 4, 2017.

Warning

A few months ago, in June 2021, Professor Lionel COLLET, Member of the Council of State, Member of the National Academy of Medicine, former President of the Claude Bernard University in Lyon, Audiologist, ENT specialist and Psychiatrist, presented to the Academy of Medicine the reasons why today in France and thanks to Europe, doctors have the right to describe their merits and their work without being worried, as long as they do not use paid referencing for this.

Lionel COLLET. Physician advertising and the code of ethics: legal developments. Bull Acad Natl Med 2021 ;205(7) [to be published in August 2021]- the Editorial Board has decided to present this article in Open access, given its importance.

1- Who am I?

I was one of the first beneficiaries of the Robert Debré Reform of the French university hospital system, which began in 1957 under the presidency of General de Gaulle. This allowed me to make a significant contribution to the progress made during the decades that followed, in the treatment of two banal affections, certainly rarely fatal, but often heavily handicapping the socio-professional life of the profoundly deaf, the deaf-mute and the loud snorers.

I was able to do this because I was in charge of a department that I had been able to build according to my wishes, during the renovation of the old premises of Saint-Antoine built for Marcel Lermoyez (1858-1929). In these premises, during the 1960s, I was only the assistant of the person in charge at the time. I was to succeed him, if my older peers elected me to do so. This one, Professor Jean-Jacques DEBAIN, helped me a lot in this transfer, leaving me all freedom, in the most difficult moments of the birth of the multichannel cochlear implant, which he observed, until 1977, silently, but without any remark, which for him, very taciturn, meant approval. With him, I also understood the interest of having a department that welcomed all ENT pathology, even if the Administration did not accept children. In the middle of the 80's, and even if it was in spite of myself, this allowed me, thanks to the fortuitous but beneficial initiative of one of my Heads of Clinic at the time, already very brilliant, Frédéric Chabolle, to make my contribution to the Obstructive Sleep Apnea Syndrome (OSA) and to the snoring which always accompanies it and often reveals it.

Chouard CH., Did Napoleon suffer from chronic rhonchopathy ?, Acta Otolaryngol. 2017 Apr;137(4):361-364. [doi:10.1080/00016489.2016.1249948](https://doi.org/10.1080/00016489.2016.1249948). Epub 2016 Nov 9

Clinical results of the surgical treatment of 1222 cases of chronic snoring. Chouard CH, Meyer B, Chabolle F, Fleury B. Ann Otolaryngol Chir Cervicofac. 1990;107(3):154-8. French. <https://pubmed.ncbi.nlm.nih.gov/2344121/>

The successes that we have obtained in these 2 affections, deafness and snoring, have quickly become apparent. The media and the general public were immediately interested.

The 1st International Course on the Multi-electrode Cochlear Implant was held at Saint-Antoine from September 21 to 24, 1978.

This link gives you the list of participants where you will recognize the tenors of the past and the young wolves of the time.

https://chouard.ch/cochlear_implant/medias/Participants_1st_International_Course_on_Cochlear_implant.pdf

This course was followed by the book **Hearing Without Ears**, which I wrote almost in one go, the evening after our training meeting, so great was the emotion of our whole team and our pride difficult to hide. This book is the axis of this information site. It is also one of the pleas for the anteriority of the Parisian team of Saint-Antoine.

However, through the story of a medical invention, this little book also tells the saga of common bushes, of their fragrant plant scents and the true story of these childhood scents when I was eleven years old, which is only recognized in the last page of the book.

2- Why did I feel I was given this mission?

I was born on July 3, 1931.

It was my maternal grandfather, Doctor Paul Petit-Dutaillis, who gave birth to me. He had just retired to Paris where he was head of the gynecology department of the Saint Michel hospital. His son, Daniel Petit-Dutaillis, a student of Antonin Gosset, was a hospital surgeon and introduced neurosurgery in France during the two wars and the first half of the last century.

Both inspired my medical-surgical vocation to be the one who relieves, explains and often cures.

My vocation was also that of research and invention, no doubt inspired by the personality of my father, himself a researcher in the life sciences.

But the invention that required the most effort and gave me the most academic pride was the invention and development of the multi-electrode cochlear implant.

At Saint-Antoine with the help of Pr Patrick Mac Leod, neurosensory electro-physiologist at the Ecole Pratique des Hautes Études de Paris-Saclay, we gave birth to and developed the project, thanks to this ad hoc tandem that he and I had formed.

For twelve years our team was then far ahead of our challengers. But our momentum was lost: it almost dried up due to the rapid death, in the prime of life, of our industrialist Jean Bertin in 1975 and the pusillanimity of the Board of Directors that replaced him.

We then had many problems, before Guy Charvin, manager of several start-ups involved in the medical field, took over in 1986, and decided to build us **the fully digital (and therefore miniaturized) implant** that we had been asking for for a long time, in return for our first results.

3- What was my career?

<https://www.chouard.ch/>

The presentation of some important research that I have carried out during my hospital and university life shows that I have fulfilled the three requirements, to care, to teach, to research, which founded exactly eight centuries ago the creation of the oldest Faculty of Medicine in France, that of Montpellier, directly resulting from the revolt of the Cathars. These three obligations structured Robert Debré's great reform of medical studies (article 5 of his founding text, begun in 1959 and effective in 1968). I was one of the first beneficiaries.

Thanks to my masters, I was able to be appointed at the age of 34 to the Hospitals and to the Agrégation, in this new function at the time, both hospital-university and full time, of which I was among the first to benefit.

Immediately, in 1965, I created the ENT Research Laboratory of the CHU Saint-Antoine in an old building, but within the same hospital department where I had just been appointed Assistant. I absolutely wanted to keep this propensity to invest myself in research, and to rediscover the pleasure I had taken in it during my internship and clinical years. I needed to have, in complete independence, the tool that would allow me to prove this or that hypothesis, or to verify the validity of this or that therapeutic innovation.

At the beginning without any means, existing only by my isolated works and living only on my personal funds, this unit, by attracting some of my first students, acquired little by little its autonomy, then a certain reputation, which allowed me to obtain soon some private assistance, then subsidies of public research. The Scientific Council of my university hospital contributed largely to this, and I know what I owe to the benevolence of some of my elders, Professor Orcel and Professor Polonovski, then in particular Professor Milhaud. I was also able, from the beginning of the 80's, to start receiving non-medical students in this

Laboratory; thanks to them we benefited not only from some funds coming from the professional tax, but especially from a flow of knowledge in electronics and computer science which was very precious to us.

This activity was the reason for my election in 1976 to the Collegium International Oto-Rhino-Laryngologicum Amicitiae Sacrum. In this relatively small society, which co-opts only ten members per country, I have made fruitful friendships with foreign researchers and have been able to disseminate the results of my research worldwide.

In 1986, in view of our results, the Public Assistance decided to add a hospital side to this university unit, by creating in my department at Saint-Antoine the Laboratory of Audio Phono Prosthesis of the AP- HP, led by Doctor Claude Fugain, ENT and Phoniatriest, who ensured all the rehabilitation of our implanted patients, especially pre-lingual. This decision contributed to reinforce the material basis of our efforts by giving them a certain durability.

In this laboratory, where I was every day, because it was contiguous to the Service, worked two full-time technicians, two part-time engineers, four hospital-academics, and, in an intermittent way, four to six research trainees. Although modest, this instrument allowed me to carry out some work of which I will perhaps speak again; it is thanks to it that I was able throughout my career, to establish, when it was necessary, my clinical investigations on animal experiments, and to implement the successive prototypes of hearing aids which we developed these last twenty years.

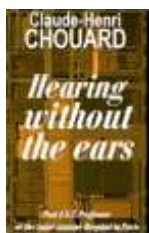
In this long daily quest, the faithful friendship and assistance of Dr. Patrick MacLéod, Director of Studies at the Ecole Pratique des Hautes Etudes, and of Jacques Génin, Polytechnicien X-Télécom : (he had contributed to the creation of Minitel, the French ancestor of the Internet). His advice was of great help to us and is still very present to me.

The geographical continuity of my hospital-university career, which for most of the time and for 50 years (1951-2001) took place in the same hospital, facilitated my efforts. My career, which I wanted to be that of a clinician-researcher, went smoothly. In 1966, I was appointed assistant to Professor Jean-Jacques Debain, who was head of the ENT Department at the Hôpital Saint-Antoine, and I naturally took over from him in 1978. I am grateful to him for the great freedom he gave me during twelve years, at the most difficult moments of my research on the rehabilitation of total deafness.

The clinical and operative activity concerning most of the facets of the ENT specialty that I have carried out since then during the last three decades of this past century, could only be possible thanks to the help of Frédéric Chabolle, who stayed with us for several years before being appointed Professor at the Foch Hospital, and on the other hand, and above all, to my faithful assistant, Professor Bernard Meyer, who has been with me since 1970, and whose doctoral thesis was an assessment of the hesitations of the pioneers of the time, who seemed to be blocked by the incoercibility of the single-channel systems of House and many others.

Bernard Meyer succeeded me at Saint-Antoine in 1999, and he has played an essential role both in all the therapeutic innovations we have developed and in the international dissemination of the successive improvements in our equipment over the last three decades of the last century.

4- The book **Hearing without ears**



https://chouard.ch/cochlear_implant/medias/Hearing_without_the_ears_Entendre_sans_oreille_Claude-Henri_Chouard_en.pdf

The book *Hearing Without Ears* tells the story of the theoretical invention of this multi-electrode cochlear implant, the verification of the validity of the design of our hypothesis, and its feasibility, and finally its birth in Paris on September 22, 1976.

This operation was followed by immediately satisfactory results as regards frequency discrimination, then, after a few weeks, word discrimination without the help of lip reading.

The preparation of this birth and its modalities are amply detailed in the various sites attached, written a few years later, still valid today, and especially in this Book accessible by the link above.

This book can be considered as a complement to the scientific publications published in support of our results. But it is not only that. It describes above all our patients, my emotions, our scruples, my real obsession with elder trees, their berries, their hollow, cottony pith, born when I was eleven. It also evokes my anger against the slowness of all the administrations and above all our serene joy to see that we were finally winning.

It is also a testament to the free time in my life that I have devoted to all those profoundly deaf people, as do almost all clinical researchers who live with their patients on a daily basis.

When I retired as a university hospitalist at the end of 1999, I felt a great sense of gratitude for all the events that our Parisian team had had to face in order to achieve the results we had arrived at.

Because finally, we had won. We were the first. And our lead lasted more than five years. (1976-1983)

And even if, apart from the BERTIN patents infringed by some, many of the technical details proposed by MacLeod are still used by manufacturers today, unaware that he had been their promoter very early on, MXM, soon renamed Neurelec, which for us replaced BERTIN, as did Oticon later on, remained among the world's leading manufacturers of cochlear implants, without any conflict of interest being attributed to us.

I have made a site formerly in HTML that can give you more details on the history of the invention : <http://recorlsa.online.fr/implantcochleaire/historicfrancaisenanglais.html>

The coming retirement and its idleness were quickly filled by my new academic activities and their duties.

But it was also then that I was surprised to see the importance of my otological activity recognized by two International Prizes which were awarded to my Parisian team at the same

time as to two researchers, one Australian, the other Austrian, for whom I have always felt a tacit sympathy, because their teams were always well represented in Paris, during our various Meetings that we organized, and in particular the 1st of them in September 1978



First it was the Paul Sabatier Medal (Nobel Prize 1912) of the University of Toulouse, which was awarded to Graeme CLARK, Ingeborg HOCHMAIR and myself, on June 18, 2015 at the 12th European Symposium on Pediatric Cochlear Implantation.

Then it was George E. Shambaugh Award conferred by the Collegium ORL-Amicitiae Sacrum, during its meeting in PEKIN, celebrating, on August 28, 2018 the centenary of its foundation in 1918.

I was tempted again by the pleasure of research, even if it was very far from my past areas of interest. Since I no longer had the opportunity to see implanted patients easily, this free time was filled by the friendly contacts that were made under our dome in the rue Bonaparte. They made me meet a multidisciplinary range of researchers close to the fundamental biological research of physicists and chemists, with their nanoscopic and often fractal vision of living worlds. For them, I was perhaps in large part playing the role of Candide: in these domains, several original works have emerged in the last few years:

C.Binot, C.-H.Chouard, Neurodegenerative diseases, infectious pathologies and liquid crystals: Hypothesis of a common information vector involving a multidisciplinary approach. 2017 <https://doi.org/10.1016/j.neurol.2017.11.002>

C.Binot, J.-F. Sadoc, C.-H. Chouard, Oncogenesis, lipids rafts and liquid crystals: A nanoscopic supplementary field for applied researches and a new hope of advances in cancer. 2018 <https://doi.org/10.1016/j.heliyon.2018.e00687>

C.-H. Chouard, C.Binot, J.-F. Sadoc, The involvement of liquid crystals in multichannel implanted neurostimulators, hearing and ENT infections, and cancers. 2018 <https://doi.org/10.1080/00016489.2018.1554265>

C. Binot, J.-F. Sadoc, C.-H. Chouard, Cell mechanics and signalization: SARS-CoV-2 hijacks membrane liquid crystals and cytoskeletal fractal topology. Biophysical Reviews & Letters (BRL. accepted for publication No. BRL-D-21-00008R1) - available on arXiv: 2107.07492.

But almost simultaneously, at the beginning of the 21st century, I was administratively obliged by my age to leave any clinical or research activity in the framework of public hospital-university institutions. This retirement was quickly filled in France by the interest that most otologists had in the implant, notably one of the most brilliant of them, Professor André CHAYÏS. In addition to his skills in many other fields, notably surgery of the ponto-cerebellar space, he succeeded very intelligently in calming the conflict between the supporters of the deaf culture and the partisans of the earliest possible implantation, before the atrophy of the cochlear nuclei due to lack of sound stimuli. André Chays invested in screening

newborns for deafness before they leave the maternity ward, followed immediately by information for parents. This procedure, accepted by all concerned and in particular by the supporters of the deaf culture and sign language, leaves the parents free to choose whether or not to implement an implantation project in the event of the discovery of profound deafness, which must be carried out rapidly, preferably before the first year, in order to be fully effective.



Prayer for an implant (195x130)