With the support of the Fondation Pour l’Audition and in partnership with Inserm, Institut Pasteur opened a new basic and medical research institute in 2020, the Institut de l'Audition (the Hearing Institute).
For all of us, 2020 was an unprecedented experience. Worldwide, it disrupted human relations, raised a whole host of questions and projected science into the spotlight. It was also the year in which the Hearing Institute, an Institut Pasteur center and mixed research unit (UMRS 1120) affiliated to Inserm, was born.

The Hearing Institute was inaugurated by Édouard Philippe, the Prime Minister of France, on February 27, 2020, shortly after its international inaugural scientific congress at the Collège de France. At this point, it had not yet been completed. A few days later, a lockdown was imposed, bringing progress on the building work to a complete halt. The requirements of the moment dealt us a new hand: a halt to the building work, suspension of the installation of teams in the building and the establishment of working from home practices. How best to cope with all these constraints? Flexibility and imagination as a means of adapting to the unforeseen became the rule governing everyday life at the institute and provided an impetus for strong dynamics of interaction between the various Hearing Institute stakeholders, to bring the institute to life. In this highly unfavorable context, many teams from Institut Pasteur were mobilized to complete the building as rapidly as possible and to ensure that it was functional.

Objective achieved: today the research teams are all housed within the institute, together with a number of technical platforms, one of which — the imaging platform — the first to open, is already providing tremendous support for the institute’s activities. The Hearing Institute has both a virtual existence, with cycles of internal and external lectures, and a real-life existence, with new arrivals at the institute and structuring initiatives, such as teaching projects, new axes of research (leading to additional building work), new international research projects and the development of industrial partnerships.

This impressive energy has brought young and talented teams to the institute, composed of individuals from Institut Pasteur, Inserm, the CNRS, universities and hospitals, and characterized by a diversity of expertise. Many came to neurosciences from other basic or translational disciplines: physics, physiology, computational and behavioral sciences, audiology, ENT, genetics, cell and molecular biology. Their daily proximity and reciprocal curiosity, sources of inspiration and methodological renewal should make it possible to meet the challenges of knowledge and technology, through the development of disciplinary interfaces, in particular. This same approach underlies the launch of the CERIAH (the Center for Research and Innovation in Human Audiology), the cornerstone of the activities of the Hearing Institute in the domain of human applications.

The Hearing Institute, the first institute devoted to hearing in France, is an expression of the will of Françoise Bettencourt-Meyers and Jean-Pierre Meyers, to whom I would like to express great thanks. Hearing problems are a major public health issue. They affect 466 million people worldwide and their prevalence is continually increasing. The commitment of the Fondation Pour l’Audition, presided by Jean-Pierre Meyers, alongside that of Institut Pasteur, was decisive, resulting in the shared desire to work, through the Hearing Institute, towards an approach to hearing based on an understanding of its multiple facets and its place in mediating social links, with the aim of protecting and restoring hearing.

**A FEW FIGURES**

Deafness in the world

<table>
<thead>
<tr>
<th>People Affected by 2050</th>
<th>1 billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>One in a thousand newborns born profoundly deaf each year</td>
<td>1/1,000</td>
</tr>
<tr>
<td>One person in three over the age of 65 has hearing impairment</td>
<td>1/3</td>
</tr>
</tbody>
</table>

The staff of the Hearing Institute on December 31, 2020

<table>
<thead>
<tr>
<th>People</th>
<th>103</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>51%</td>
</tr>
<tr>
<td>Men</td>
<td>49%</td>
</tr>
<tr>
<td>Nationalities</td>
<td>14</td>
</tr>
</tbody>
</table>

Mean age: 40 years (25% of the staff of the Hearing Institute are under the age of 30 years)

Research in 2020

<table>
<thead>
<tr>
<th>Publications</th>
<th>45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prizes</td>
<td>2</td>
</tr>
</tbody>
</table>

(1) Louis GROSS KOWITZ Prize from Columbia University, USA, and The Scientific Emergence Prize for Basic Research (Prix Émergence Scientifique pour la Recherche Fondamentale)

<table>
<thead>
<tr>
<th>National and International Grants, Including</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERC Grant</td>
<td>1</td>
</tr>
</tbody>
</table>

**EDITORIAL**

Professor Christine Petit
Director of the Hearing Institute

For all of us, 2020 was an unprecedented experience. Worldwide, it disrupted human relations, raised a whole host of questions and projected science into the spotlight. It was also the year in which the Hearing Institute, an Institut Pasteur center and mixed research unit (UMRS 1120) affiliated to Inserm, was born.

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This impressive energy has brought young and talented teams to the institute, composed of individuals from Institut Pasteur, Inserm, the CNRS, universities and hospitals, and characterized by a diversity of expertise. Many came to neurosciences from other basic or translational disciplines: physics, physiology, computational and behavioral sciences, audiology, ENT, genetics, cell and molecular biology. Their daily proximity and reciprocal curiosity, sources of inspiration and methodological renewal should make it possible to meet the challenges of knowledge and technology, through the development of disciplinary interfaces, in particular. This same approach underlies the launch of the CERIAH (the Center for Research and Innovation in Human Audiology), the cornerstone of the activities of the Hearing Institute in the domain of human applications.

The Hearing Institute, the first institute devoted to hearing in France, is an expression of the will of Françoise Bettencourt-Meyers and Jean-Pierre Meyers, to whom I would like to express great thanks. Hearing problems are a major public health issue. They affect 466 million people worldwide and their prevalence is continually increasing. The commitment of the Fondation Pour l’Audition, presided by Jean-Pierre Meyers, alongside that of Institut Pasteur, was decisive, resulting in the shared desire to work, through the Hearing Institute, towards an approach to hearing based on an understanding of its multiple facets and its place in mediating social links, with the aim of protecting and restoring hearing.
THE BIRTH OF THE FIRST INSTITUTE DEDICATED TO HEARING RESEARCH IN FRANCE

SCIENTIFIC INAUGURATION, END OF SEPTEMBER 2019

The creation of the Hearing Institute provided Professor Petit and her research teams with an opportunity to organize an inaugural scientific meeting at the Collège de France, on September 16 and 17, 2019, in partnership with the Fondation de l’Audition and Inserm. This international scientific meeting, bringing together 340 people, included high-quality scientific presentations from a number of researchers. This event highlighted the enthusiasm of the international scientific community for the creation of this first hearing institute in France, the objective of which is to promote an integrative approach to auditory neurosciences and to develop innovative diagnostic methods and curative treatments for those suffering from hearing impairment.

OFFICIAL INAUGURATION FEBRUARY 2020

The official inauguration of the Hearing Institute took place on February 27, 2020, in the presence, notably, of Édouard Philippe, the Prime Minister of France, Stewart Cole, General Director of Institut Pasteur, Jean-Pierre Meyers, President of the Fondation Pour l’Audition, and Christine Petit, the first director of the Hearing Institute.

“With the Hearing Institute, an Institut Pasteur center, and the Fondation Pour l’Audition, we have an opportunity to build a sector of excellence, based on the work of Christine Petit and her teams.”
THE IMAGING PLATFORM

The imaging platform of the Hearing Institute (Imag-IdA) was one of the first platforms to be installed in the new building, to receive Hearing Institute researchers right from the opening of the institute.

Indeed, it houses a large range of equipment, including confocal microscopes, a spinning disk microscope and an electron microscope. These instruments can be used to study samples at different scales, extending from the observation of whole organs down to the details of intracellular structures (150 nm for light microscopy and about 10 nm for electron microscopy).

A NEW RESEARCH CENTER IN THE HEART OF PARIS

Installed over seven storeys, with a total area of 4,000 m², the Hearing Institute combines technological platforms, notably in imaging, with laboratories, and an auditorium that can be used for conferences and to receive the public.

900 m² of laboratories
50 m² for socializing
450 m² of offices
60 m² for the CeriaH
160 seats in an auditorium of 190 m²
120 m² of meeting rooms
5 technological and technical platforms

Technical and storage space

Image of a cochlea taken with the LSM900 confocal microscope (Zeiss). In green, direct labeling of parvalbumin. In red, the tdTomato red fluorescent protein – from the team of Nicolas Michalski.

Image of an entire cochlea with phalloidin-actin and myosin 7A eGFP labeling, taken with the W1 spinning disk microscope (Gataca) – from the group of Raphaël Etournay.

Image of a cochlear nucleus taken with the LSM900 confocal microscope (Zeiss). In green, direct labeling of parvalbumin. In red, the tdTomato red fluorescent protein – from the team of Nicolas Michalski.

Image of an entire cochlea with phalloidin-actin and myosin 7A eGFP labeling, taken with the W1 spinning disk microscope (Gataca) – from the group of Raphaël Etournay.
Supporting talented young researchers is one of the major goals of the Hearing Institute, which has chosen to develop a policy of support for researchers beginning their careers and for students. The teams are integrated into a structure that links basic and translational research and are in constant interaction in an environment in which ideas and knowledge are exchanged. Multidisciplinary profiles are favored within the institute, with researchers and medical doctors working together.
The team of Brice Bathelier combines advanced analytical and modeling techniques with a broad array of experimental approaches: two-photon calcium imaging, multichannel electrophysiology, optogenetics, and behavioral analyses of auditory perception. The principal projects of the team include the large-scale deciphering of sound representation in the mouse auditory system, the development of optogenetic methods for generating auditory perception through the targeted activation of central neural networks, and exploration of the role in perception of neuronal connections between brain areas processing different sensory modalities.

In addition to moving into the Hearing Institute, the team realized several projects in 2020 and prepared itself to face new challenges. Firstly, the team successfully demonstrated that it was possible to perform optical imaging, at single-cell resolution, on a structure of the brainstem in mice behaving naturally (Schwenkgrub et al. 2020). This amazing feat was achieved with a miniature microscope coupled to a gradient-index (GRIN) lens, making it possible to image structures deep within the brain of the animal with minimal damage to the surrounding structures. Using this technique, the team will be able to explore, with precision, the first circuits of the central auditory system, in which it has never before been possible to visualize the neurons identified in intact animals. This will facilitate significant improvements to our models of the central processing of auditory information.

In 2020, the team also developed its technological expertise further, firstly by installing a new optoacoustic microscope at the Hearing Institute for the high-speed analysis of neuronal activity by imaging. This microscope, acquired with the aid of DIM ELICIT funding obtained in 2020, can also be used to stimulate and observe groups of neurons, at single-cell resolution, in vivo. In parallel, a European collaboration agreement was established as part of the FET Open program (the Hearlight project) for the setting up of new miniature equipment for neuronal stimulation in individual mice, to demonstrate that precise, rich auditory perception can be generated in mice through direct stimulation of the central auditory system. This type of approach could eventually be used to develop new methods for hearing restoration in humans.

Harrell ER, Guelden MA, Bathellier B, Shulz DE – An elaborate sweep-stick code in rat barrel cortex – Science Advances, 2020, 6:eabb7189. DOI: 10.1126/sciadv.aabb7189
The research of the team of Christine Petit aims to elucidate, at the molecular scale, the way in which the auditory sensory cells perform the first step in the electrical coding of sounds in the auditory system. This step, known as auditory transduction, determines the quality of the information transmitted to the auditory cortex in the brain. Diagnostic and therapeutic innovations are also at the heart of the projects of this laboratory. The aim is to create diagnostic tools for hearing problems, identifying the cells and functions affected, and to develop therapies for early- and late-onset forms of deafness, and associated balance problems, principally through gene therapy.

The auditory mechano-electrical transduction machinery

In response to acoustic stimulation, tension develops in a fibrous link connected at its base to an ion channel and located in the receptive antenna of the sensory cells. This modulates the opening of the ion channel and the characteristics of the associated electrical current. The modes of control of the tension of the link and its anchoring to the ion channel, which make a major contribution to the properties of this transduction, remain largely unknown. We are addressing these questions through the initiation of studies on new components of the molecular machinery for mechanoelectrical transduction. We are using two complementary strategies. The first is a biochemical approach based on the analysis of mouse proteins by ultrasonic mass spectrometry (collaboration with the University of Antwerp). The other is genetic and based on studies of the ancestral mechano-electrical sensory system still present in the tentacles of sea anemones (collaboration with the University of Côte d’Azur).

From the genetic architecture of presbycusis to new therapeutic avenues

Age-related sensorineural deafness, known as presbycusis, affects a quarter of the world population over the age of 61 years. There is currently no treatment. According to the prevalence of this condition, the genetic component of presbycusis is polygenic in nature: in each individual affected, presbycusis results from the cumulative effect of frequent genetic variants of several susceptibility genes. Individually, each of these genes makes a small contribution to hearing loss. Today, the field of application of genetic therapy is essentially limited to monogenic conditions (those due to defects of a single gene). In a large nationwide multicenter study, we discovered that about a quarter of people presenting early-onset (at 50-55 years of age) forms of presbycusis suffer from monogenic forms of hearing loss. These findings indicate that genetic therapy is a curative approach that can be explored for certain forms of presbycusis. Finally, this year was marked by the signing of a number of partnership agreements with academic and industrial partners.

Clinicians collaborating in the study

Barbara Vena, Nida Mazehri, Sheng-Jia Lin, Lucy A. Dunbar

PROGRESSIVE SENSORY DISORDERS, PATHOLOGY AND THERAPY

### HIGHLIGHTS IN 2020

**Clarin-1 and -2: two new tetraspanins essential for hearing**

Usher syndrome (USH) is the leading cause of deaf-blindness in humans (accounting for 50% of cases). Three clinical forms have been described, but only patients with the USH3A form present late-onset progressive deafness. They also suffer from balance problems and visual defects, the onset, progression and severity of which vary. Only one gene underlying this syndrome has been identified to date: USH3A, encoding clarin-1, a “tetraspan” protein, so-called because it has four transmembrane domains. There are three clarin proteins: clarin-1, -2 and -3. Their respective roles and progressive auditory and vestibular problems (with or without vision loss), with the following objectives:

- To identify treatment targets for preventing and/or treating these sensorial deficits, with a view to subsequent transfer into clinical practice in humans.
The objective of the neural coding in the auditory system team is to understand how the brain perceives and analyzes complex sounds. Sound processing begins in the ear, where the cochlea breaks down complex sounds into their elementary frequencies. How these frequencies are represented in the brain is a key question in the field of hearing, and in neuroscience in general. We control the signal sent to the brain by the cochlea, by stimulating the sensory cells with light. This extremely precise control of the signal enables us to perform systematic studies to identify the information necessary and sufficient for sound identification.

In the domain of auditory neurosciences, research too often focuses exclusively on either the peripheral or the central nervous system. Studies of the auditory system as a whole require a combination of physical and biological approaches, to understand how sounds are represented in the brain. Beyond its importance for fundamental research, optogenetic stimulation of the cochlea is enabling us to develop more precise biophysical models of the auditory system to improve the performance of the cochlear implants currently in use.

In addition to moving into the Hearing Institute, the team has worked to set up its principal research projects. The pandemic, which made it impossible to receive study participants on the premises of the institute, obliged the team to change its practices radically and to perform behavioral tests via online experimental platforms (Pavlovia, Prolific). The implementation of these changes required a major effort, as these supports are rarely used in France. The team has obtained all the administrative and ethical authorizations required, and can now use these approaches, with the recruitment of very large numbers of participants.

The team is continuing its exploration of the perception of aversive sounds in individuals with normal hearing, individuals with hearing impairment, patients with epilepsy (La Timone, Marseille) and patients with Alzheimer’s disease (HUG, Geneva). The online experiments have been extended to understanding the effects of sensorial predictions and compensatory strategies in individuals with hearing impairment.

The changes that have occurred have justified the team taking a new direction towards the development of neurocomputational models and the use of machine-learning algorithms for the analysis of behavioral and neuroimaging (e.g. electro/magnetoencephalography) data. These approaches are also paving the way for translational perspectives in the domain of personalized medicine. Through the development of new industrial collaborations, the team will contribute to the deployment of portable tools for cerebral measurements, which study participants will be able to use autonomously and at home.

Finally, pursuing its research into audiovisual interactions, the team is studying the factors of variability in speech comprehension after auditory rehabilitation. In particular, the validation of a test for audiovisual evaluation in French will be completed in 2021, the fruit of a European collaboration.

The team of Luc Arnal and Diane Lazard aims to understand the cerebral operations underlying the perception of communication signals — verbal, non-verbal or musical — in humans. By combining psychoacoustic methods, neuroimaging (fMRI, M/EEG) and neurocomputational modeling, the work of this group is revealing how the auditory system integrates auditory, visual and emotional information to develop appropriate reactions. These studies are paving the way for new translational perspectives in the context of sensory deficiencies (poor hearing) and their involvement in certain neurodegenerative diseases (Alzheimer’s disease).

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The second approach involves inserting a grid of micro-LEDs into the cochlea and measuring the perceived behavior of the awake animal. For the development of this new type of cochlear implant, we have established a collaboration with the researchers of Georgia Tech Lorraine and Paris-Saclay University. An ANR proposal has been accepted for final submission in 2021. The team also works with other researchers from the institute and has obtained, in collaboration with Brice Bathelier (project leader), Nicolas Michalski and Boris Gourévitch, European funding for a study of the possible use of optogenetic implants to reproduce a sensation of sound perception.

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We are using two complementary approaches to stimulate the cochlea with light. The first is based on the generation of holographic light patterns to stimulate the hair cells individually. A complex optical assembly involving ultrarapid light deflectors is used to achieve a high degree of temporal precision. On arrival at the Hearing Institute in February 2020, we installed an infrared pulse laser; the first laser of this type at this site. Its capacity to generate extremely short impulses (< 300 fs) and its power (40 W) make it possible to stimulate a large number of cells optogenetically so as to activate the peripheral auditory system whilst recording the resulting brain activity.

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The genetic approach, based on the study of hereditary forms of deafness, has proved particularly effective in recent years for elucidating the molecular physiology of the cochlear, the sensory organ for hearing. By contrast, this approach has provided very little information about the central auditory system, despite the occurrence of central auditory system dysfunctions in about 5% of children and more than 25% of the elderly. Our team aims to identify and characterize the genetic forms of deafness leading to direct damage to the brain, but also to study the indirect consequences of deafness of peripheral origin on the brain.

Observations in humans reveal the dimensions essential for elucidating the physiology of hearing: aspects of perception and cognition, their plasticity and needs in terms of potential replacements. Many of these dimensions are not quantified by standard audiometry, and the concept of the CERIAH stems from the need to address this deficiency to validate these dimensions to measure their consistency, to identify mechanisms in association with studies of animal models, all of which should make it possible to extend analyses to the molecular and cellular scales. The CERIAH will, thus, develop tests using natural or enhanced stimuli, and will design specific tools to overcome the constraints of existing instruments.
COCHLEAR DEVELOPMENT AND THERAPEUTIC PERSPECTIVES

The team of Raphaël Etournay studies two complementary aspects in a research project aiming to decipher the molecular and cellular mechanisms of the development of the cochlea, the auditory organ of mammals. In addition to a multidisciplinary approach based on the use of mouse models, dynamic imaging, spatial transcriptomics and physical modeling, we are trying to produce cochlear organoids for use as study models, to strengthen the development of approaches for the treatment of hearing loss.

HIGHLIGHTS IN 2020

During 2020, the team made a major contribution to the establishment of imaging at the Hearing Institute, and to the development of innovative tools for image analysis and microfluidic engineering. Indeed, the team obtained OMT-ELICIT joint funding for the purchase of a high-performance spinning disk microscope equipped with nano-ablation laser and super-resolution modules. This technology can be used to film the development of the cochlea which organizes itself during culture, and to subject it to mechanical perturbations induced by the ablation laser, to decode the cellular mechanisms underlying its highly complex organization. In work linked to this project, the team has developed an image analysis algorithm for the extraction of multiple biological areas present in a collection of images obtained by fluorescence microscopy. With this tool, we have been able to contribute to studies of the cellular dynamics of a human model of a bronchial epithelium responding to infection with SARS-CoV-2.

The team has also developed an organoid on-chip system, making it possible to control the spatial distribution of growth factors during the formation of inner ear organoids. We, thus, hope to be able to direct the differentiation of inner ear organoids, which, until now have been exclusively of the vestibular type, into cochlear organoids. Once obtained, these mini-cochlear organs will be very useful for testing new treatments for deafness.

MAIN PUBLICATION IN 2020


TECHNOLOGIES AND GENE THERAPY FOR DEAFNESS

This team is directed jointly by Saaid Safieddine (DR2 CNRS) and Yann Nguyen (PU-PH, Sorbonne University). Saaid Safieddine is an expert in the molecular physiology of hearing, and the synapse in particular, and is a pioneer in gene therapy for deafness. Yann Nguyen has extensive experience in the development of innovative techniques for minimally invasive robot surgery on the auditory system. The objective of the team is to develop effective gene therapy for hearing problems via the optimization of therapeutic vectors and their delivery systems.

HIGHLIGHTS IN 2020

Our team has made great progress in the identification of recombiant adeno-associated viruses (AAV) targeting the sensory cells of the cochlea and vestibule. The team has obtained proof-of-concept for four forms of deafness: DFNB59 (PNAS, 2019), DFNB59 (Cell, 2015), Usher 1G (PNAS, 2017) and Usher 3A (JCI, 2019). The team has also recently provided the first proof-of-principle that gene therapy can completely correct the deafness phenotype in a mouse model of a form of profound deafness, DFNB59 (PNAS, 2019). This result constitutes a major advance in the domain of hearing, paving the way for the treatment of patients with DFNB59 deafness. These advances are subject to development agreements with the French company Sensonor.

MAIN PUBLICATIONS IN 2020

Our team, composed of a mixture of clinicians and researchers, works on the neuropathies and synaptopathies of the inner ear. We try to answer fundamental questions essential for diagnosis and for the clinical rehabilitation of these diseases. How do the synaptic nerve contacts of the hair cells of the inner ear and their projections onto the central nervous system change with aging, acoustic trauma and certain genetic mutations? We characterize the cellular and molecular changes occurring in these diseases, with a view to defining strategies for their treatment or the prevention of these neurological diseases of the inner ear.

We have characterized the morphological and functional changes in the ribbon synapses of the inner hair cells during aging in C57Bl/6 mice, a model of precocious presbycusis. Peineau et al. (2020). We have observed a strong degeneration of the synapses with age (more than 50% degeneration in mid-life in mice). The remaining synapses displayed a marked potentiation (expansion of the ribbon synapse, increase in the size of the presynaptic calcium microdomains and associated excitocytosis) that may account for the paradoxical increase in the acoustical reflex (hyperacusis-recruitment) in these mice with age.

The development and validation of new objective measurements of hearing for testing the functioning of the inner ear even in cases of outer or middle ear defects, is particularly important for the clinical and translational dimensions of the team (Reynard et al. 2020a). Several publications have highlighted the importance of objective evaluation of the functioning of both the semicircular canals and the otolithic receptors for assessing multisensory integration and its impact on posture control in cases of inner ear defects (Ionescu et al., 2020; Reynard et al., 2020b, 2020c).

Main publications in 2020


Grant from the French Ministry of Higher Education, Research and Innovation, Ecole Normale Supérieure (2020-2023), €100,000

Fyssen postdoctoral grant “Modeling the neural mechanisms of auditory predictions in continuous sound streams” (2019-2021), €80,000

International grants

Canadian Development from the Human Frontier Science Program (2019-2021), €240,000

EMBO long-term fellowship (2020-2022), €50,000

European grants

ERC advance grant DEEPEN (2018-2022): “Extraction of the architecture of the deep network underlying the structuring of auditory perception”, €1,600,000

European Union Marie Curie grant (2019-2021), €160,000

National grants

ANR (Agence nationale de la recherche) as part of the second Investissement d’Avenir program (light4deaf) (2015-2021), Usher syndrome, €3,000,000

ANR LatEx LifeSciences (2020-2022), €900,000

ANR HauteFrêles (2017-2023), €400,000

ANR EargoKo (2017-2023), €340,000

ANR Audimova (2020-2024), €4,200,000

ANR Robocopi (2019-2024), €52,000

ANR Daliyone (2017-2021), €180,000

ANR Hartmankno (2016-2021), €90,000

ANR Riborh (2019-2023), €28,000

ANR Mucinos (2017-2021), €96,000

ANR Gu2015 (2015-2021), €78,000

CNRS Momentum (2018-2020), €300,000

Funding for the research project “Modelling the neural mechanisms of auditory predictions in continuous sound streams” (2019-2021), €80,000

The team has increased in size, with the integration of two new PhD students (start of 2020 and 2021) supervised by Hung Thai-Van and a new scientific PhD student jointly supervised by Didier Dulon, Nemi Maranowski and Jean-Christophe Lazire (medical doctor, ENT, at Brest University Hospital). We have established a collaboration with the Inserm team of Mireille Montcouquiol (Neurocentre Magendie, Bordeaux University) on the genetic defects of the maturation of auditory hair cells (sensory hearing loss associated with hair-cell polarization defects). We have also initiated a collaboration for the identification of new molecules for the treatment of hyperacusis and tinnitus, with Susanna Peltoppalo (Institut des Neurosciences Cognitive et Integratives d’Aquitaine, University of Bordeaux). We have also obtained additional funding to prolong the PhD work of Thibault Peineau (from SAS Entandre).

Highlights in 2020

- Development and validation of new objective measurements of hearing for testing the functioning of the inner ear even in cases of outer or middle ear defects, is particularly important for the clinical and translational dimensions of the team (Reynard et al. 2020a). Several publications have highlighted the importance of objective evaluation of the functioning of both the semicircular canals and the otolithic receptors for assessing multisensory integration and its impact on posture control in cases of inner ear defects (Ionescu et al., 2020; Reynard et al., 2020b, 2020c).
THE STEERING COMMITTEE


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Technologies and gene therapy for deafness
HUNG THAI-VAN / DIDIER DULON
Clinical and translational exploration of sensorineural hearing loss
RESOURCES

DISTRIBUTION OF THE STAFF OF THE HEARING INSTITUTE BY TYPE OF POST ON DECEMBER 31, 2020

- 18 Engineers and technicians (ITA)
- 15 Support Staff
- 35 Postdoctoral fellows/PhD students/Interns
- 16 Researchers
- 19 University Hospital Staff

AN INSTITUT PASTEUR CENTER SUPPORTED BY THE FONDATION POUR L’AUDITION
Numerous partners – numbers on December 31, 2020

- Researchers
- University Hospital Staff/Doctors
- ITA
- Postdoctoral fellows/PhD students/Interns
- Support Staff

EXTERNAL FUNDING

32 Grants from external sources ongoing for a total of €23 million, €8 million of which was obtained in 2020

CONTRIBUTIONS OF INSTITUT PASTEUR, FONDATION POUR L’AUDITION, INSERM AND CNRS FOR 2020

- €570,000 for running costs
- €552,000 for equipment

FIVE-YEAR BUSINESS PLAN – EXPENSES

2019-2024

- €80,000
- Building and technical support (recurrent) 1%
- Support 9%
- Platforms 4%
- Research teams 70%
Management of tegmen defects with mastoid and epitympanic obliteration using S53P4 bioactive glass


Pupillometry assessment of speech recognition and listening experience in adult cochlear implant patients Front Neurosci. 2020, 14:55675. DOI: 10.3389/fnins.2020.55675

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Conseil régional d’Île-de-France
Ministère de l’Enseignement supérieur, de la Recherche et de l’Innovation
Commission Européenne
Agence nationale de la recherche (ANR)
Institut Carnot
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Professeur Lenriot
Action On Hearing Lost
EMBO (European Molecular Biology Organization)
Fondation Fyssen
Fondation maladies rares
Fondation pour la recherche médicale (FRM)
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