

# Khayël Michele Arslan (1904–1988) and Vestibology in Padua

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That Professor Khayël Michele Arslan was, during the central decades of the last century, was the most prominent figure in Italian clinical vestibology — not only in Italy but especially abroad — is not merely a rhetorical statement rooted in academic tradition. Thousands of patients, particularly those suffering from Menière's disease, travelled to Padua seeking therapeutic advice, to the point that some irritated colleagues remarked that "Menière's disease must have been endemic in Val Padana."

The history of Otorhinolaryngology in Padua predates the Arslan family. The first scholar to hold a university appointment in Otology at the Royal University of Padua was Giuseppe Gradenigo (Venezia 1859 – Treviso 1926), son of the distinguished ophthalmologist Pietro Gradenigo. In 1888, Gradenigo was entrusted with the teaching of Otology at Padua, a position he held for four academic years (until 1891/92), although from 1890 he had already moved to the University of Turin.

Khayël (Khayël Andon Aram Mariam Arslanian) was born in Padua in 1904, son of the eminent Armenian physician Yerwant Arslanian (Karpuz or Anghen 1865 – Padua 1948), who later became naturalized as a "Paduan". Yerwant graduated in Medicine at the University of Padua in 1890 and subsequently became *libero docente* with legal status in Otorhinolaryngology from the academic year 1900/01. In the university yearbooks, the family surname was modified to "Arslan," al-

though this change became officially recognized only in 1926.

Yerwant Arslan taught the course in Otorhinolaryngology to the students of the fourth year of medical studies until 1934, initially alone and later together with Professor Federico Brunetti, Head of the ENT Department in Venice. After graduation, Yerwant pursued further training in Paris and Freiburg, establishing strong international connections that would later also characterize his son Khayël—who adopted the Italian name Michele after the Second World War.

Michele Arslan graduated in Medicine in Padua in 1927. However, it was above all during his internship years—both during medical school and in the immediate post-graduate period—that Khayël's scientific and clinical curiosity took shape. He spent considerable time at the Institute of Human Physiology, which had been directed from 1889 to 1921 by Professor Aristide Stefani, and subsequently by Carlo Foà (1880–1971) from 1921 to 1924, and later by Achille Ducceschi. The Institute of Human Physiology in Padua had a long-standing and strong interest in the labyrinth and its central connections, an interest introduced by Filippo Lussana (1820–1897), who arrived in Padua in 1867 after teaching in Pavia and Parma (Figure 1).

This line of research, pursued for decades, became one of the main themes of scientific activity at the institute, particularly through experimental contributions similar to those of Marie-Jean-Pierre Flourens (1794–1867) in

Paris, Jan Evangelista Purkyně (1787–1869) in Prague, and Friedrich Goltz (1834–1902) in Strasbourg.<sup>1</sup> Numerous students of Lussana and Stefani later made major contributions to human physiology, including Giovanni Gallerrani (1860–1940), later professor in Camerino and Bari; Gregorio Manca (1867–1911), later professor in Sassari; Emilio Cavazzani (1865–

1922), later professor in Ferrara and Modena; Umberto Deganello; Giulio Andrea Pari (1880–1949), later professor of Special Medical Pathology in Padua; and Achille Roncato (1887–1963), first professor of Physiology in Ferrara and later founder of the Institute of Biological Chemistry in Padua.

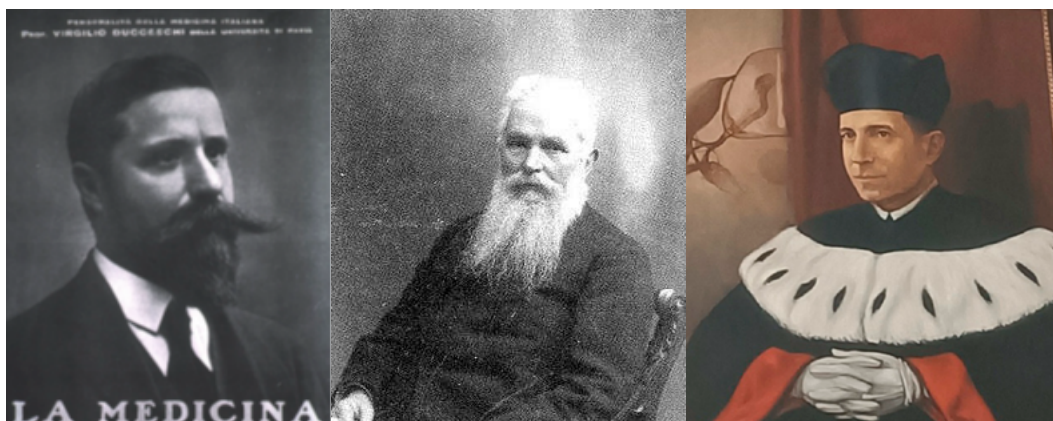


Figure 1. On the left, portrait of Professor Virgilio Ducceschi (U.S. National Library of Medicine, History of Medicine Division); in the center, portrait of Professor Aristide Stefani; on the right, portrait of Professor Tullio Terni (Library of the Section of Human Anatomy, Department of Neurosciences, University of Padua).

## Part 2 – Experimental Research, International Training, and Early Academic Career

Arslan was deeply fascinated by the quantity and quality of experimental work conducted in Padua, which definitively dispelled the concept of the so-called “acoustic labyrinth” and confirmed the fundamental role of labyrinthine function in a wide range of human behaviors, both physiological and pathological. He published the results of these investigations in 1929<sup>2</sup> and again in 1931<sup>3</sup>.

Between 1930 and 1933, he served as an internal physician at the Institute of Embryology and General Histology directed by Professor Tullio Terni (1888–1946), where he conducted research on the innervation of auricular

muscles and, above all, on the fiber tracts and nuclei in cerebellectomized and labyrinthectomized dogs.<sup>4</sup> This work was particularly appreciated by Terni, who wrote in his 1933 testimonial:

*“The systematic secondary degenerations he has identified with scrupulous tenacity are destined to provide a significant contribution to the understanding of central pathways, especially those of vestibular origin.”*

In the following years, Arslan travelled to Strasbourg, where earlier Friedrich Goltz (1834–1902) and his pupil Ernest Julius Richard Ewald (1855–1921) had proposed the model linking semicircular canal function to the perception of rotational head movements, with nystagmus as the physiological response to rotation (Ewald, 1892). After his stay in Strasbourg (under Professor Georg-

<sup>1</sup> Cfr. Megighian A, Reggiani C. Vestibology in Padua before Khayël/Michele Arslan, in this issue.

<sup>2</sup> Arslan K. Fenomeni di compenso labirintico. *Il Valsalva* 1929.

<sup>3</sup> Arslan K. On the origin of ocular vegetative phenomena consecutive to experimental labyrinthectomy. *The Valsalva* 1931; 7: ...

<sup>4</sup> Arslan K. Histoanatomical study of the brainstem of a brain-damaged and labyrinthine dog. *Boll Soc It Biol Sper* 1933 VIII: 1...

es Canuyt), Arslan moved to Frankfurt am Main, working with Professors Otto Voss and Karl Grahe,<sup>5</sup> and subsequently to the Kaiser Wilhelm Institut für Hirnforschung in Berlin-Buch, where he collaborated with Professor Max-Heinrich Fischer—also known for his

innovative proposals on vestibular stimulation, cited by Arslan himself<sup>6</sup>—and with Carl Otto von Eicken. There he carried out further studies on vestibular physiology. (Figure 2 and 3)



Figure 2. (a) Carl Otto von Eicken, Kaiser-Wilhelm-Institut für Hirnforschung, Berlin-Buch; (b) Berlin, early 1930s.



Figure 3. Collegium Otorhinolaryngologicum Amicitiae Sacrum, 1930, Frankfurt-Bad Homburg. In the front row, Arslan leaning against the balustrade holding his hat, and Barrand; Voss (2), Grahe (4), Kelemen (6), Huyzinga (7), and De Kleyn (8)

From the academic years 1928 to 1935, Arslan was annually appointed by rectoral decree as a “voluntary assistant” in the ENT Clinic. On December 29, 1934, he became Assistant Physician at the Surgical Division of the Civil Hospital of Padua. By Ministerial De-

cree of December 23, 1933, he obtained the *libera docenza* in Otorhinolaryngology, and in 1935 he was appointed Professor in charge of the ENT Clinic at the University of Padua.

The initially limited number of beds in the ENT Division—located on the third floor of

<sup>5</sup> Arslan K, Grahe K. Ueber Nachwirkungen starker Progressivbeschleunigungen. Archiv für Ohren-Nasen-und Kehlkopfheilkunde, 128, 1931.

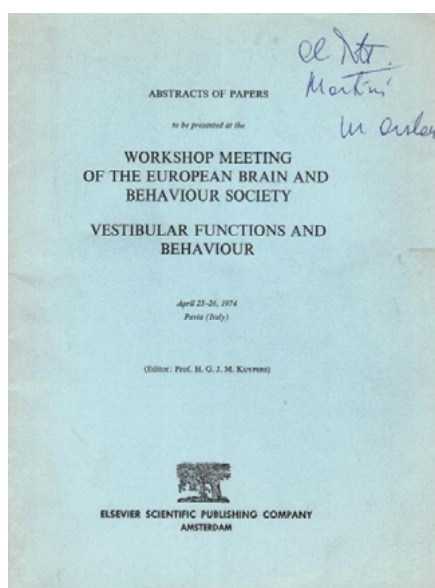
<sup>6</sup> Arslan M. [A method of accelerational stimulation according to the Buys-Fischer; its physiological principles and its simplicity which make it the most appropriate for standardization]. Rev Laryngol Otol Rhinol (Bord). 1951 May;72(Suppl):298-301.

the Giustiniano Hospital—rapidly expanded to approximately fifty beds, accommodating both clinical care and associated research services. This arrangement remained in place until 1964, when the ENT Clinic, together with other institutes, was transferred to the newly built University Hospital (Policlinico), occupying the seventh and eighth floors. For many years thereafter, the ENT Clinic had approximately 80 beds, in addition to numerous extra admissions.

Professor Arslan received numerous prestigious international honors, including the *Légion d'Honneur* and an honorary doctorate from the University of Uppsala in 1963, awarded with the following citation: “*who have eminently forwarded and refined the development within those fields of research in which Robert Bárány once worked so successfully*” (Figure 4), as well as an honorary degree from Strasbourg in 1970. He was also the recipient of the Marzotto Prize, the CRS Amplifon International Prize, the Montegrappa-Istituti Filippini Prize (1971), the Gold Medal for Merit in Public Health (1974), and finally the Gold Medal of the IFOS Congress, Miami, 1985. One of the most prestigious appointments, and one to which he attached particular importance, was his nomination as a full member of the Aerospace Technical Committee of the Council of Europe. (Figure 5)



Figure 4. Professor Michele Arslan receiving the honorary doctorate at Uppsala, 1963.



#### Experimental study of the harmful effects of Coriolis accelerations during periods of sub-gravity or zero-gravity

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(1) It is known that the vestibular apparatus is stimulated not only by gravity and by positive or negative angular and rectilinear accelerations, but also by Coriolis accelerations: when a subject is in a normal gravitational state (on the earth's surface), almost every habitual movement of the head provokes numerous different Coriolis accelerations, mixed with other accelerations which are developed both at the level of the ampullar receptors (semicircular canals) and of the otolithic receptors.

(2) The kinematic effects provoked by the Coriolis accelerations in the normal gravitational state give rise to excitations in the vestibular receptors, which are 'integrated' (by summation or inhibition) at the level of the axonic networks situated below the receptors, before the unification of the fibres in the vestibular nerve and, consequently, before Scarpa's ganglion. The mechanisms governing these integrations are not known and have not yet been subjected to experimental study.

(3) An experiment concerning the effects of Coriolis accelerations in normal subjects (in a normal gravitational state) has already been done using the following technique: the subjects underwent positive and negative angular acceleration, at angular and rectilinear speed, on a plane in strictly constant rotation; Coriolis accelerations were applied during the acceleratory stimulation, turning the subject's head in different directions (eyes closed, in absolute silence), and measuring the physical value of the intervening movement. These experiments were carried out in silence, in a darkened room, and the subject's eyes were closed. The same experiment was repeated several times, with an interval between one experiment and the next of not less than 2-3 h (the time required to efface the 'subliminal fringe of excitation' (Sherrington) of the vestibular nuclei): in each successive experiment, the physical value of the intervening Coriolis acceleration was greater (shorter time of head rotation, greater annulation of the head).

Figure 5. Presentation of the results of the first studies simulating periods of sub-gravity or zero gravity.

His international prestige was further confirmed by the honorary degree conferred by the University of Padua upon Nobel Laureate George von Békésy (Nobel Prize in 1961) on the occasion of the *International Symposium on Menière's Disease*, organized by Arslan in Padua in 1962. The diploma was presented by Professor Luigi Bucciante, Dean of the Faculty of Medicine and Surgery. After Robert Bárány—who received the Nobel Prize in 1914 “for his work on the physiology and pathology of the vestibular apparatus” in the field of otolaryngology—**George von Békésy**, born in Budapest on June 3, 1899 and later naturalized as an American citizen, was the second and last scientist to be awarded the Nobel Prize in the fields of audiology and otolaryngology, with the citation “for his discoveries of the physical mechanism of stimulation within the cochlea” (Figure 6).



Figure 6. Honorary degree conferred by the University of Padua upon Nobel Laureate George von Békésy (1961) on the occasion of the *International Symposium on Menière's Disease*, organized by Arslan in Padua in 1962; the diploma was presented by Professor Luigi Bucciante, Dean of the Faculty of Medicine and Surgery.

### Part 3 – International Networks, Scientific Leadership, and Humanistic Scholarship

Arslan maintained exceptionally active international relationships throughout his career. He was among the five Italian participants (Arslan, Bocca, d'Avino, Ferreri, and Mancini) out of a total of 39 attendees at the Second International Conference in Audiology, held in London in July 1949. In 1958, he organized the Fourth International Congress of the *Société Internationale d'Audiologie* in Padua. This was followed by a series of highly prestigious international meetings: the *Collegium Otorhinolaryngologicum Amicitiae Sacrum* in Padua in 1960; the *International Symposium on Menière's Disease* in Padua in 1961; and, in May 1973, the Tenth World Congress of Otorhinolaryngology (International Federation of Otorhinolaryngological Societies, IFOS) in Venice. Arslan served as President of IFOS from 1973 to 1977. (Figure 7)

The proceedings (*Atti*) of the Padua ENT Clinic were routinely published in international journals, such as the *Journal Français d'Oto-Rhino-Laryngologie et de Chirurgie Maxillo-Faciale* (vol. 6, 1957).

Arslan was President of the Italian Society of Audiology, founded in 1950 by Father Agostino Gemelli<sup>7</sup>, and founder of the School of Specialization in Otorhinolaryngology in Padua (1954). He also served as President of the *Accademia Patavina di Scienze, Lettere ed Arti* from 1979 to 1983 and was a full member of the *Istituto Veneto di Scienze, Lettere ed Arti*.

Beyond his scientific achievements, Arslan was a passionate man of letters. Loris Premuda<sup>8</sup> described him as a scholar distinguished by “the extraordinary breadth of his thought and his refined humanistic approach.” As a curious and cultivated humanist, Arslan published insightful and engaging studies on the illnesses of major literary figures such as Thomas Mann, Franz Kafka, and Marcel Proust, as well as numerous essays—both his own and those of his students—on prominent figures in the history of Paduan medicine.

<sup>7</sup> Società di Fonetica Sperimentale, Fonetica Biologica, Foniatria e Audiologia, poi società italiana di Audiologia e Foniatria.

<sup>8</sup> Loris Premuda, (Professore di Storia della Medicina a Padova). Ricordo di Michele Arslan. Adunanza 27 maggio 1989. Atti Istituto Veneto di Scienze Lettere ed Arti. Tomo CXLVII (1988-89), Venezia 1989.

In *Proust and His Allergy*,<sup>9</sup> Arslan wrote:

"We physicians are particularly struck by the coincidence between the evolution of the disease and the writer's creative capacity. It seems to us that the former constituted an increasingly compelling stimulus for the composition of his works."

According to Arslan, Proust was

"the poet of time—that is, of human events as they are relived in our imagination and appear and reappear in the continuous flow of our inner life [...] immediately arousing in us the desire to abandon ourselves to the slow river of memories, to immerse ourselves in lost time, and thus to become timeless."



(a)



(b)

Figure 7. (a) Professor Arslan delivering the inaugural address of the 10th World Congress of Otorhinolaryngology, Venice, May 1973. (b) Professor Arslan with William House, Los Angeles, 1964.

Equally significant was Arslan's inaugural lecture for the 1978–1979 academic year of the Accademia, devoted to *The Paduan Anatomists of the Sixteenth Century and the Discovery of the Organs of Sense*,<sup>10</sup> as well as his essay written on the occasion of the fourth centenary of Galileo Galilei's birth.<sup>10</sup>

In this context, Arslan wrote:

"Galileo arrived in Padua at the age of twenty-eight, when Fabricius was already nearly sixty. Such a friendship must initially have been preceded, on Galileo's part, by feelings of deference and respect toward his much older colleague. Deference and respect which, as we know, constituted the obligatory attitude at that time toward senior masters, and which

manifested themselves through those rhetorical expressions of homage, praise (sometimes excessive), and exaltation that abound in the dedications of printed works that have come down to us. [...]

The relationship between Galileo and Fabricius—initially marked, on the Pisan's part, by respect and reverence and only later by close friendship—was further shaped by the illness that struck Galileo during his stay in Padua. It was not a serious disease, but a form of hepatic insufficiency, with digestive disturbances, reduced capacity for intellectual application, and the whole array of more or less evident clinical signs that are particularly troublesome for those engaged in intellectual work and leading a sedentary life. Galileo entrusted himself

<sup>9</sup> Michele Arslan. *Marcel Proust e la sua allergia*. *Marg Otolaryngol.*, 1950; 6:528-31; Michele Arslan.

<sup>10</sup> *Marcel Proust and sensory phenomena*. *Rev. Laryngol. Otol. Rhinol. (Bord)*, 1958;79 (Suppl):799-805.

<sup>10</sup> Michele Arslan. *Sull'amicizia tra Galileo Galilei e Fabrizio d'Acquapendente*. *Scritti e discorsi in occasione del IV centenario della nascita di Galileo Galilei*, a cura dell'Università di Padova e dell'Accademia Patavina di Scienze Lettere e Arti. Società Cooperativa Tipografica, Padova, 1966, 123-128.

to the care of Fabricius, who assisted him so effectively as to elicit endless praise from the Pisan throughout his life, especially during the Florentine period following his time in Padua (see, in this regard, the letter Galileo addressed to Christina of Lorraine). And there is more: Galileo defended Fabricius when the latter was publicly accused by his enemies.

We must therefore ask ourselves: was the friendship between the two merely that of a grateful 'patient' toward his physician, or did they also exchange information about the discoveries each was making—the one on those organs of the body, the organs of sense, which are in fact true instruments of physics, and the other on mathematical laws, the mechanics of motion, and the properties of liquids and solids? The coincidence between Galilean and Fabrician works is too close not to admit reciprocal influences of thought. One must bear in mind: (1) that the organs of sense were described by the Paduan anatomists for the first time, together with interpretations of their functions, precisely during the period in which Galileo was teaching in Padua; (2) that Fabricius wrote his works on the organs of sense after his contacts with Galileo; and (3) that Harvey, the famous English anatomist who discovered the circulation of the blood, was a student of both Fabricius and Galileo. As Premuda notes, Harvey 'lived intensely in the Galilean environment.'"

## Part 4 – Scientific Contributions to Vestibology

Professor Arslan directed the ENT Clinic of the University of Padua for forty years (1934–1974). After retiring from active service in November 1974, he was appointed Professor Emeritus eight years later.

The scientific output of Michele Arslan comprises more than 280 publications. Among his most significant contributions are studies on vestibular physiology and pathophysiology, Menière's disease, the interaction between nystagmus of different origins, central vestibular pathways, central vertigo, collagen diseases of ENT relevance, and medico-legal issues related to cochlear disorders. Of par-

ticular interest were the research programs promoted by Arslan on the therapeutic use of ultrasound in certain pituitary disorders and in Menière's disease.

His fascination with vestibular physiopathology dates to his internship period under Aristide Stefani and can be considered the unifying thread of his entire scientific life. His first scientific publication appeared in 1929<sup>11</sup>. Arslan soon became internationally renowned for his contributions to the understanding and treatment of Menière's disease. As early as 1939<sup>12</sup>, in a paper co-authored with Fasiani, he proposed intracranial section of the acoustic nerve for cases refractory to medical therapy.

In a subsequent article published in 1946, Arslan demonstrated remarkable insight and modernity in his physiopathological interpretation:

"One is naturally led to ask: where, how, and why does that *quid* occur which provokes, with such sudden effect, the acute vestibular imbalance in the patient? The literature is truly sparse in references on this point. [...] It must therefore be assumed that the vertiginous crisis of true Menière's disease is ultimately triggered by a sudden dysregulation of cupular and statolithic mobility, caused by abrupt and abnormal compressions or rarefactions of the endolymphatic circulation that are not adequately dampened by the structures designed for this purpose (round window, cochlear aqueduct)."<sup>13</sup>

In another paper from 1947<sup>14</sup>, Arslan described the concept of spatiality in the human organism as follows:

"Our five senses are already so heavily engaged in modern life (and so often make us long for silent and shaded refuges) that speaking of a sixth sense may seem tedious. Yet such is the case: this sixth sense, the sense of spatial variations, is the most topical of all. The enormous speeds of modern means of transport, the great accelerations to which our organism is subjected—for example in acrobatic flight—are examples of a new kind of contact between human beings and the external world, a contact that demands new

<sup>11</sup> Khayël Arslan. Fenomeni di compenso labirintico. Il Valsalva 1929; Arslan K, Grahe K. Ueber Nachwirkungen starker Progressivbeschleunigungen. Archiv fur Ohren-Nasen-und Kehlkopfheilkunde, 128, 1931.

<sup>12</sup> Khayël Arslan, Gian Maria Fasiani. Contributi alla cura chirurgica della sindrome di Menière. Atti Soc. Medico-chirurgica Padova, 17, 1939.

<sup>13</sup> Michele Arslan. Sul meccanismo di scatenamento della crisi vertiginosa nella malattia di Menière. Marg Otol, 5, 1946

<sup>14</sup> Michele Arslan. Il sesto senso. Marg. Otoaryngol., 5, 1947.

sensory mechanisms and may give rise to new diseases—the so-called acceleropathies. We have spoken of a sense of spatial variations, and not, as readers might have expected, a sense of space or of equilibrium.”

## Methodological Innovation and Menière's Disease

Arslan made major contributions to the standardization of methods for studying vestibular function. In 1955, he published a monograph in the prestigious journal *Acta Oto-Laryngologica* (Stockholm) entitled *On the Renewing of the Methodology for the Stimulation of the Vestibular Apparatus*.<sup>15</sup> (Figure 8)

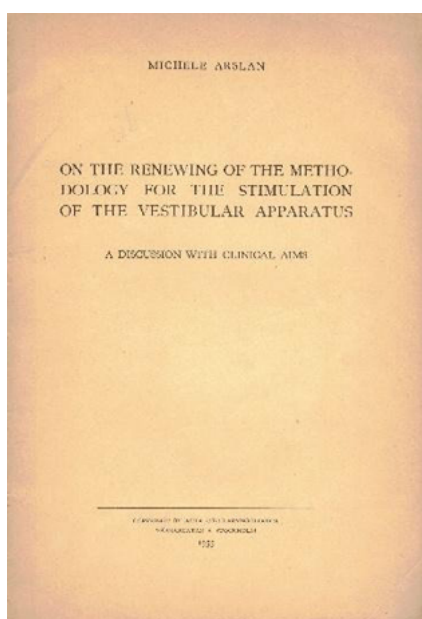


Figure 8. Arslan M. A new hypothesis on the plurifactorial etiology of Menière's disease. *Acta Oto-Laryngologica* 1955.

Toward the end of his scientific career, he devoted a major monographic issue—again in *Acta Oto-Laryngologica*—to Menière's disease: *A New Hypothesis on the Plurifactorial Etiology of Menière's Disease*.<sup>16</sup>

One of the central themes of his vestibular research was the study of Menière's disease and vestibular function in space flight.<sup>17</sup>

To support this work, a Laboratory of Biophysics and Physiology of the Vestibular Apparatus was established within the ENT Clinic in Padua. (Figure 9)



Figure 9. Prof. Michele Arslan in the Laboratory of Biophysics and Physiology of the Vestibular Apparatus.

<sup>15</sup> Michele Arslan. On the renewing of the methodology for the stimulation of the vestibular apparatus. *Acta Otolaryngol.* 1955.

<sup>16</sup> Michele Arslan. A new hypothesis on the plurifactorial etiology of Menière's disease. *Acta Otolaryngol.*, suppl 357, 1977.

<sup>17</sup> Arslan M, Martini A, Blezza F. La nocività delle accelerazioni labirintiche di Coriolis negli astronauti. *Atti Accademia Galileiana*, 1974-75, 87: 177-182; Martini A, Razzolini R. Alterazioni funzionali delle connessioni vestibolo-vegetative quali causa della malattia degli astronauti: studio sperimentale sulle modificazioni cardiovascolari durante le accelerazioni composte del capo (Coriolis). *N Arch Ital Otol Rinol Laringol.* 1976, 8: 27-29; Arslan M, Martini A, Razzolini R, Blezza F. Correlations between biological effects and physical features provoked by different endolymphatic Coriolis' accelerations. *N Arch Ital Otol Rinol Laringol.* 1976, 4: 7-18; Martini A, Blezza F. L'influenza della posizione cefalica sulla eccitazione labirintica da accelerazione angolare negativa. *Studio sperimentale biofisico.* *Valsalva* 1976, 51: 141-156; Arslan M, Martini A, Razzolini R. [Coriolis acceleration. Vestibulo-vegetative stimulations with regard to the motion sickness of astronauts. Experimental researches]. *Minerva Med.* 1976, 67:2347-9. Martini A. Ricerche sperimentali sulle accelerazioni di Coriolis in particolari situazioni di interesse aerospaziale. *N Arch Ital Otol Rinol Laringol.* 1978, 6: 245-258; Arslan M, Martini A, Razzolini R, Blezza F. Accelerazioni endolinfatiche di Coriolis quali cause di fenomeni patologici (space sickness). *Calcolo fisico dell' "effetto Coriolis".* *Scienza e Cultura* 1979, 1: 9-17; Meghian D, Martini A. Motion sickness and space sickness: clinical and experimental findings. *ORL J Otorhinolaryngol Relat Spec.* 1980; 42:185-95.

## Part 5 – Comparative Anatomy, Modeling, and Late Experimental Research

A particular focus of Michele Arslan's later scientific activity concerned the effects of morphological variations of the semicircular canals on movement in different animal species. Otto Egon Lowenstein (1906–1999) had written:

"The morphological variety existing between species, in both balance and hearing organs, justifies the huge differences not only in their movement skills, but also in the great range of frequency bandwidths that vertebrates can hear."

According to Lowenstein,

"the relative length, diameter, and shape of the canals vary widely among vertebrate species. The functional significance of these variations has not been minutely analyzed. It is, however, fairly safe to state that in animals adapted to off-ground activity, the canals tend to be longer and of smaller diameter than in animals moving near

the ground in relatively stable equilibrium."

The most interesting interspecific differences probably lie in the marked morphological variability of the *crus commune*. A particularly relevant observation in the phylogenesis of carnivorans concerns the relationship between the height, width, and length of all three semicircular canals and the cochlea, and the animals' predatory habits. The diameter of the canals, the height of the cochlea, and especially the angle between the lateral semicircular canal and the cochlea reveal clear phylogenetic relationships in both extinct and extant carnivorans.

Building on these observations—and especially inspired by the remarkable anatomical drawings of Retzius—Arslan involved the present author (his last graduate student, July 1974) and the Institute of Physics of the University of Padua (Professor Renato Angelo Ricci and Dr. Franco Blezza) in developing a modelling analysis of the role of the *crus commune* in different species.<sup>18</sup> (Figure 10-11-12)

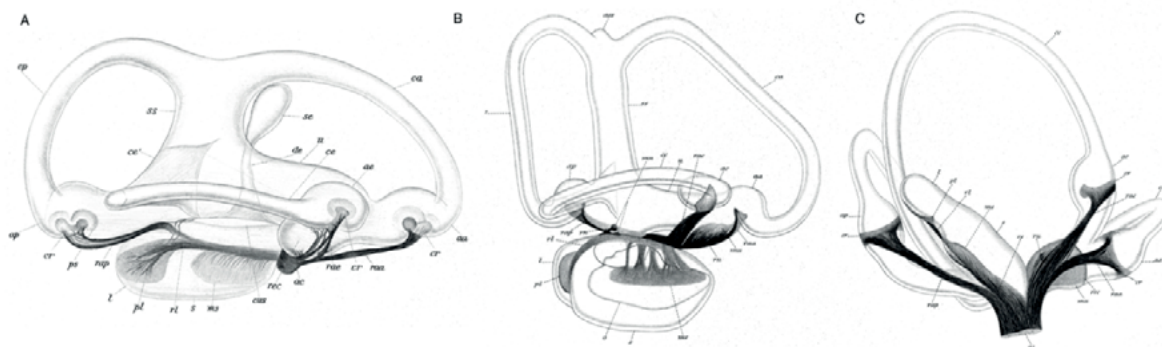


Figure 10. A *Acipenser sturio*: bonefish with archaic characters; marine with upstream rivers for reproduction; the labyrinth is characterized by a huge *crus commune*; the macula sacculi is about the size of the macula lagenae; good mobility. B *Salmo salar*: evolved bonefish; marine with upstream rivers for reproduction; the *crus commune* is long and thin; the macula sacculi is very large (unlike *Acipenser sturio*) and, according to Mygind 1968, the macula sacculi in fish is larger, the faster the fish; excellent mobility. C *Scyllium canicula*: marine cartilaginous fish with the shape of a small shark; excellent mobility. Vol 1 Tables IV; XIV; XX from Retzius (personal copy).

<sup>18</sup> Martini A. Considerazioni per una analisi filogenetica e modellistica dei canali semicirculari. *Ann Laringol Otol Rinol Faringol.* 1978, 76:455-66. Martini A, Blezza F. Elementi per una analisi filogenetica e modellistica del *crus commune* dei canali semicirculari. *N Arch Ital Otol Rinol Laringol.* 1978, 6:259-276; Blezza F. Un perfezionamento del modello con il braccio comune per il sistema dei canali semicirculari dell'uomo.

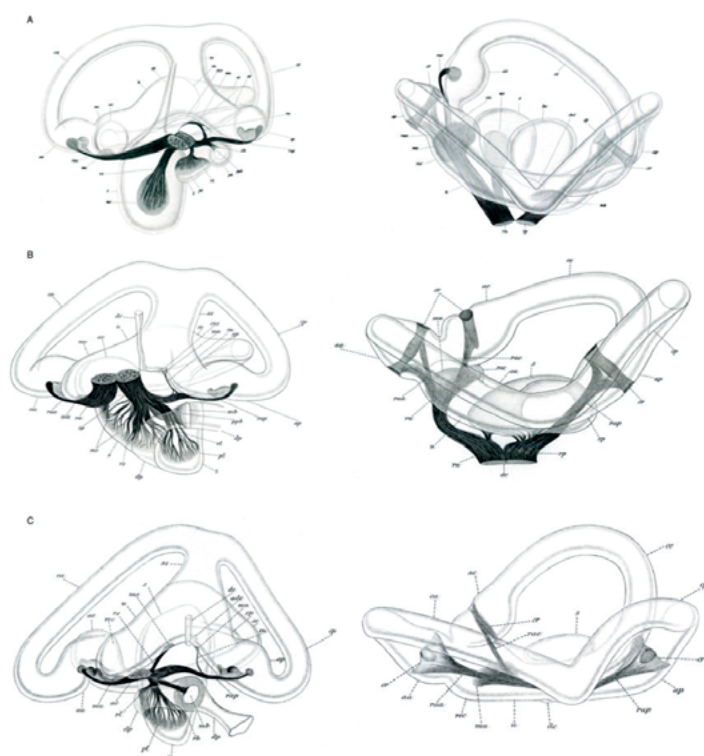


Figure 11. A *Rana esculenta*, moderate mobility. B European cistudo, poor mobility. C *Phrynosoma cornutum*: Lacertilian reptile of the Iguana family, lives in the American deserts; moderate mobility. Vol 1 Tables XXXIV; Vol 2 Tables I; V; from Retzius (personal copy).

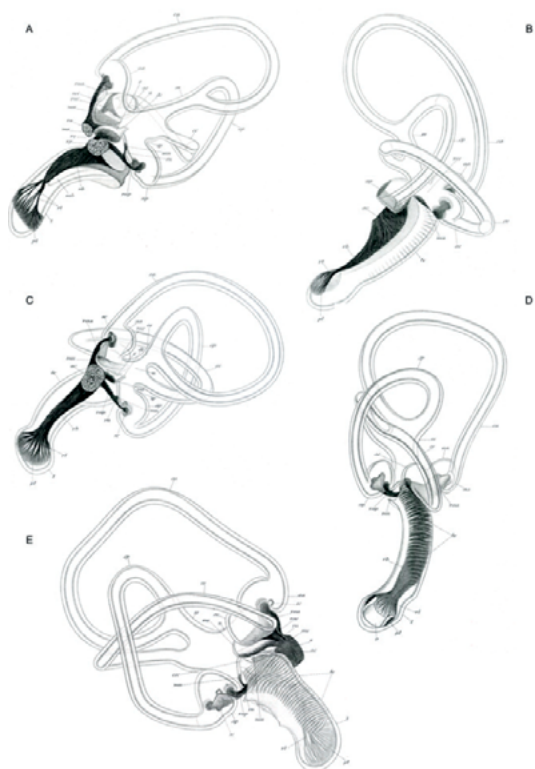


Figure 12. A *Anser domesticus*. B *Gallus domesticus*. C *Turdus musicus* (song thrush). D *Columba domestica* (rock pigeon). E *Haliaetus albicilla* (white-tailed eagle). We can see a fair evolution of the posterior labyrinth between species that have very different mobility characteristics; in the pigeon and thrush, in particular, the canals become interwoven and the maculae are very close to each other. Vol 2 Tables XV; XIX; XVI; XX from Retzius (personal copy). Figure 5 A *Lepus cuniculus* (hare). B *Scrofa domestica* (sow). C *Felis domestica*. Vol 2 Table XXI; XXVII; XXVIII from Retzius (personal copy).

## The “Padua School” of Michele Arslan

From the very beginning, the Padua School was primarily oriented toward Otology/Vestibulology<sup>19</sup> and Audiology/Phoniatrics,<sup>20</sup> with particular interest in the rehabilitation of children with profound deafness and in laryngeal oncology. The Padua School was very active in the “*Réunion des Oto-Neuro-Ophtalmologiques de la Suisse romande*” from 1941 onward, in parallel with the meetings of the “*Sociétés d’ONO de langue française*” and the *Società Italiana di Oto-Neuro-Oftalmologia*. This School has always been firmly based on solid experimental data, rather than on purely interpretative speculation, and on close collaboration with Neurology.

The Arslan School was extremely prolific, both at the university and hospital levels. Among the most notable figures of the more recent period are: Oscar Sala (Director of the ENT Clinic in Trieste and Verona, and later

successor of Arslan in Padua in 1974); Andrea Bosatra (Director of the ENT Clinic in Trieste from 1970 and later in Padua from 1992 to 1997); Vincenzo Ricci (Director of the ENT Clinic in Verona from 1974); David Megighian, Carlo Marchiori (Director of the ENT Clinic in Padua and Treviso), Alfio Ferlito (Director of the ENT Clinic in Udine), Giorgio Molinari, Gregorio Babighian, Gastone Pesavento, Italo Serafini, Surendra Narne, and many others (Figure. 13-14).

However, the history of the physicians of the ENT Clinic dates to the late 1930s.

In the academic year 1935–36, Khayël Arslan succeeded his father Yerwant Arslan and was appointed Acting Director of the ENT Clinic of the University of Padua. In addition to the Director, Prof. Enrico Rubaltelli served as voluntary assistant and Dr. Furio Cavazzani as voluntary assistant physician; for outpatient activities, Michele Caliendo and Mardiros Vittorio were also present.

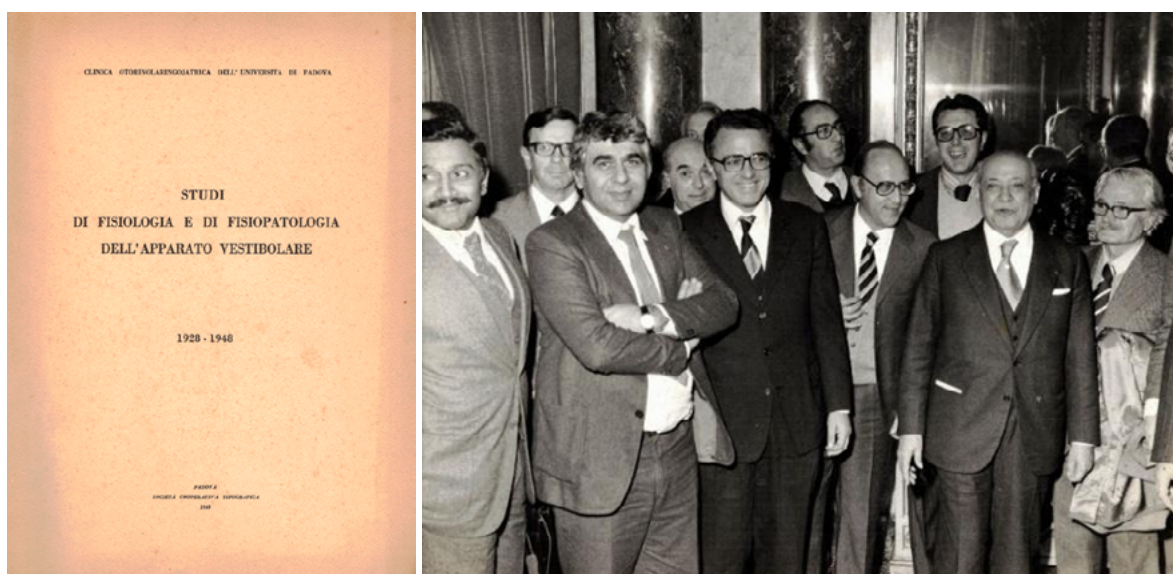


Figure 13. Arslan M., *Studies of physiology and pathophysiology of the vestibular apparatus: 1928–1948*. Figure 14. 1960s, group photo of the ENT Clinic of Padua; from left: Surendra, Babighian, Molinari, Carbone, Michele Arslan; behind them Megighian, Baldan, Frattina and Ricci (mostly cut off), and Sala (reflected in the mirror).

<sup>19</sup> Arslan M., *Studies of physiology and pathophysiology of the vestibular apparatus: 1928-1948*. Società Cooperativa Tipografica, 1949, Padua.

<sup>20</sup> Groupe des Oto-Neuro- Ophtalmologistes et Neuro-Chirurgiens de la Suisse Romande 11<sup>e</sup> Assemblée annuelle à Stresa les 15 et 16 septembre 1951 en commun avec la Société italiana di Oto-Neuro-Oftalmologia: L'apporto interpretativo dei fenomeni bioelettrici a problemi di fisiologia vestibolare per O. SALA (Padova)

Numerous *Libero Docenti* (private lecturers) in ENT contributed to teaching activities, although not to clinical care, as they were department heads in other hospitals.<sup>21</sup> Between 1935 and 1939, numerous contributions on

vestibular topics were published by members of his School.<sup>22</sup> As early as 1934, a rotating chair capable of measuring positive accelerations was available, developed by Arslan (Tönnies-Arslan chair) (Figure 15).

FIG. 2. — Fauteuil modèle Tönnies-Arslan, pour l'examen vestibulaire avec accélérations angulaires mesurables, en fonctionnement à Padoue depuis 1934.

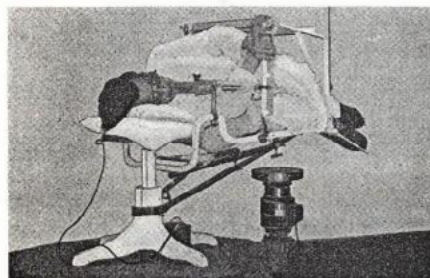


FIG. 3. — Fauteuil de Tönnies-Arslan pour l'examen du nystagmus accélératoire vertical.

FIG. 4. — Fauteuil Tönnies-Arslan, pour l'examen du nystagmus accélératoire dans le plan frontal (n. rotatoire).

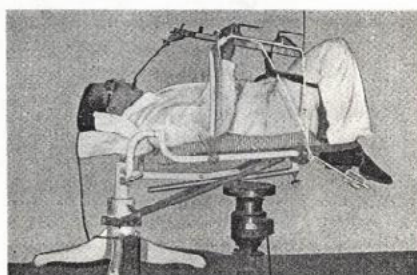


Figure 15. The Tönnies-Arslan rotating chair, from *Presse Internationale O.R.L.*, 1956, 2:3-12.

<sup>21</sup> *Libero Docenti* 1934-35 (in alphabetical order): Arslan Kayel, of Clinical Otorhinolaryngology, M.D. 23-12-1933; Arslan Yerwant, of Otorhinolaryngology, M.D. 14-12-1899; Benciolini Francesco, of Clinical Otorhinolaryngology, M.D. 11-2-1932; Brisotto Pietro, of Clinical Otorhinolaryngology, M.D. 17-10-1925, Member of the Italian Society of O.R. Laryngology, Ordinary Member of the Italian Society of Oto-Neuro-Ophthalmology; Brunetti Federico, of Otorhinolaryngology, M.D. 3-7-1911; Carrari Giuseppe, of Clinical Otorhinolaryngology, M.D. 21-12-1927, Ordinary Member of the Otorhinolaryngological Society and of the Italian Oto-Neuro-Ophthalmological Society, Assistant at the Division of Otorhinolaryngology, Civil Hospital of Venice; Dei Rossi Armando, of Clinical Otorhinolaryngology, M.D. 18-1-1933; Rimini Edmondo, of Otorhinolaryngology, M.D. 16-4-1924, Chief Physician of the Regina Elena Civic Hospital of Trieste, Member of the Trieste Medical Association, of the Italian Society of Oto-Rhinolaryngology, Corresponding Member of the French Society of Otorhinolaryngology; Rubaltelli Enrico, of Clinical Otorhinolaryngology, M.D. 23-12-1933; Valtan Oddone, of Otorhinolaryngology, M.D. 30-7-1923.

<sup>22</sup> Gastaldi G. Experimental research on vestibulo-vegetative reflexes. *Rivista Oto-Neuro-Oftalmologica*, 1939, 16:2-12; Cojazzi L., Grandi G. Research in vestibular physiology and pathophysiology, Note XIII. On the relationships between retinal arterial pressure and vestibular stimulation. *Rivista Oto-Neuro-Oftalmologica*, 1939, 21:1-13; Cojazzi L. Research in vestibular physiology and pathophysiology (Note V). *Valsalva*, 1938, 36:1-20; Pilossian Ch. Post-rotatory nystagmus after negative angular acceleration of small physical magnitude; Serra A. Relationships between caloric nystagmus and preconvulsive vegetative phenomena induced by cardiazol; Gabrieli D. Research on post-rotatory nystagmus in normal subjects; Alexandre A. *Labyrinthine function and sequelae of encephalitis*.

In 1939–40, Dr. Alfonso Palatini joined the staff as a voluntary assistant. From August 1, 1946, Drs. Giuseppe Martini<sup>23</sup> and Lucio Croatto were appointed as attending physicians in the ENT Division; in 1946–47 Alberto Delaini joined, followed in 1948–49 by Oscar Sala (temporary assistant), Luigi Cojazzi<sup>24</sup>, Clemente Gaja, and Gaetano Gurian; in 1949–50 Cosimo Resta (temporary assistant), Vittorio Botner, and Giuseppe Martini; in 1950–51 Lucio Croatto, Giambattista De Stefani<sup>25</sup>, Giannetto Poli, and Rodolfo Siviero, with Lionello Camisasca as resident physician. Out-patient activity was entrusted to Gianni De Vido<sup>26</sup>, Oscar Sala, and Lucio Croatto. In the academic year 1952–53, among extraordinary

assistants were Vittorio Botner, Gastone Pivotti<sup>27</sup>, Cosimo Resta, and Rodolfo Siviero; among volunteers Andrea Bosatra<sup>28</sup>, Lucio Croatto, Giambattista De Stefani, and Giannetto Poli<sup>29</sup>. Private lecturers included (in addition to Yerwant and Michele Arslan): Benciolini, Brisotto, Cantele, Cavazzani, Carrari, Dei Rossi, Rodighiero, Rubaltelli, and from 1952 also Camisasca (Figures. 16–17).

Among vestibular contributions, two articles by Pivotti, who together with the electronic engineer Lucarelli developed in the early 1950s a very interesting prototype of an electronystagmograph, deserve special mention (Figure 18).<sup>30</sup>

<sup>23</sup> Martini G. Le alterazioni della funzione vestibolare in cento bambini sordomuti. *Atti Laboratorio Fonetica Università Padova* 1949, 1: 3-22.

<sup>24</sup> Cojazzi L. Ricerche di fisiologia e fisiopatologia vestibolare (nota XI). *Valsalva*, 1942,39:1-12; Cojazzi L. Ricerche di fisiologia e fisiopatologia vestibolare (nota XII). *Valsalva*, 1943, 40:1-12; Cojazzi L, Sala O. [On the different influence of optokinetic nystagmus on caloric nystagmus in cases of vestibular hyperreflexia]. *Marg Otolaryngol.* 1946-1947, 5:461-70; Cojazzi L. [The importance of extra vestibular factors in the genesis of so-called vegetative vestibular reflexes]. *Minerva Med.* 1948, 39:554; Cojazzi L. [The importance of extra-vestibular factors in the genesis of the so-called vestibule-vegetative reflexes]. *Riv Otoneurooftalmol.* 1948, 23(4):299; Cojazzi L. [The importance of extra-vestibular factors in the genesis of the so-called vestibule-vegetative reflexes]. *Rass Neurol Veg.* 1949, 7:176-84.; Cojazzi L. [Vestibular changes in diabetes]. *Arcisp S Anna Ferrara* 195, 3:76-96. ; Cojazzi L, Croatto L. [Function of the vestibular apparatus in experimental alloxan diabetes]. *Boll Soc Ital Biol Sper.* 1950, 26:628-30. ; Cojazzi L, Croatto L. [Function of vestibular apparatus in experimental hypoglycemia in the rabbit]. *Boll Soc Ital Biol Sper.* 1950, 26:631-3.; Cojazzi L, Croatto L, Pivotti G. [Vestibular alterations in relation to hypoglycemia; clinical and experimental research]. *Arcisp S Anna Ferrara.* 1950, 3:165-74.; Cojazzi L, De Vido G. [Effect of vestibular function of hypertonic solutions introduced into the middle ear in the guinea pig]. *Boll Soc Ital Biol Sper.* 1950, 26: 891-3.; Cojazzi L. [Present knowledge of pathogenesis of seasickness; critical general review]. *Clin Otorinolaringoiatr.* 1950, 2: 357-83.

<sup>25</sup> De Stefani Gb. [Clinical and histopathological study of the cochleovestibular apparatus in leukemia]. *Arch Ital Otol Rinol Laringol.* 1956, 67:638-52; De Stefani Gb, Arena C. [Effects of isoniazid on cochleo-vestibular apparatus in children]. *Arch Ital Otol Rinol Laringol.* 1954, 65:802-13; Sala O, De Stefani Gb. [Study of cochleo-vestibular damage caused by streptomycin therapy with special reference to genesis of spontaneous extravestibular nystagmus]. *Otorinolaringol Ital.* 1955, 23:104-20.

<sup>26</sup> De Vido G. [Functional effects of some drugs on the vestibular apparatus]. *Boll Mal Orecchio Gola Naso.* 1953, 71:593-622; De Vido G, De Stefani Gb. [Considerations on vestibular phenomena during and after labyrinthine fenestration]. *Otorinolaringol Ital.* 1953, 21:495-512

<sup>27</sup> Pivotti G. [Influence of spinal cord bisection on vestibular reflex]. *Boll Soc Ital Biol Sper.* 1952, 28: 235-7.; Sala O, Pivotti G. [Research on the relations between accelerator stimuli of high physical value and vestibular response]. *Boll Soc Ital Biol Sper.* 1952, 28:1750-3.; Pivotti G. [Toxic effects on isonicotinic acid hydrazide on the vestibular apparatus]. *Boll Soc Ital Biol Sper.* 1952, 28:1755-8.; Pivotti G. [Isonicotinic acid hydrazide toxicity for the vestibular apparatus]. *Minerva Otorinolaringol.* 1953, 3:35-7.

<sup>28</sup> Bosatra A. [Diseases of the embryo caused by rubella; importance as cause of congenital deafness]. *Minerva Otorinolaringol.* 1954, 4:6-12; Bosatra A. Some observations on the vascularization of the VIIIth nerve. *J Laryngol Otol.* 1956, 70:605-13; Bosatra A. [Blood flow regulation mechanisms at the origin of the internal auditory artery in humans]. *Arch Ital Otol Rinol Laringol.* 1957, 68:12-25. Bosatra A. [Changes in the audiometric picture of Menière's disease after direct ultrasonic irradiation]. *Minerva Otorinolaringol.* 1958, 8:185-90; Bosatra A. [Clinical and chromosome study of a family with dominant deafness. Pathogenetic considerations]. *Arch Ital Otol Rinol Laringol Patol Cervicofacc.* 1968, 79:228-50.

<sup>29</sup> Poli G, Quarti Ml. [Meningocencephalitic symptomatology in certain cases of brain tumors]. *Minerva Pediatr.* 1953, 5:48-51.

<sup>30</sup> Pivotti G, Lucarelli A. [Contribution to modern nystagmographic recording methods]. *Boll Soc Ital Biol Sper.* 1955, 31:267-70; Pivotti G, Lucarelli A. [Technical problems of nystagmographical recording]. *Minerva Otorinolaringol.* 1955, 5:191-6.



Figure 16. The football team of the ENT Clinic of Padua, June 1948: standing from left: Simionati, De Vido, Resta, Franco, Martini, Cojazzi, and Pozzan; seated: Frenguelli, Rabito (later director of the Dermosiphilopathy Clinic), Gaja, Sala, Cadamuro.



Figure 17. From right: Spoma (wife of De Vido), Elena Gasparetto Martini, De Vido (behind), Gaja, Giuseppe Martini, late 1940s.

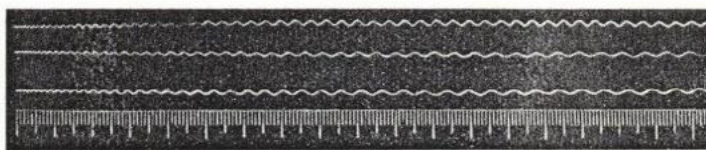


FIG. 5. — Enregistrement, fait en routine, des accélérations angulaires négatives employées pour l'examen vestibulaire depuis -934.

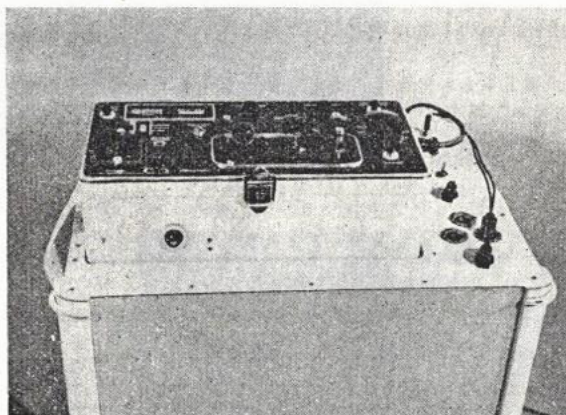


FIG. 6. — Electro-nystagmographe, modèle Pivotti-Lucarelli.

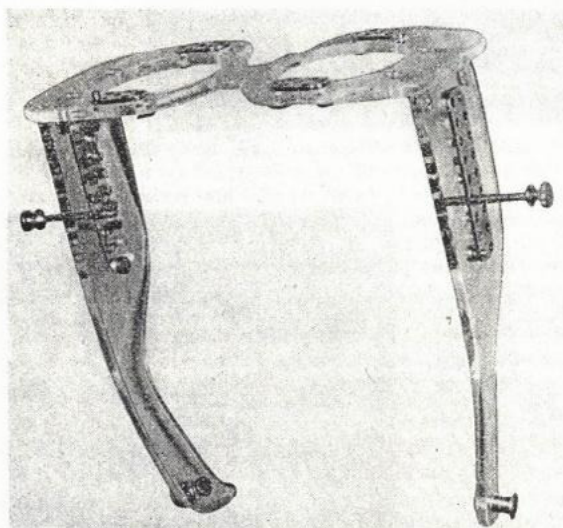


FIG. 7. — Lunettes spéciales pour électro-nytagmographie selon la méthode Pivotti-Lucarelli.

Figure 18. The Pivotti-Lucarelli electronystagmograph, from *Presse Internationale O.R.L.*, 1956, 2:3-12.

Among Prof. Arslan's pupils, those who made particularly important contributions to vestibology, Oscar Sala, David Megighian, and Giorgio Molinari deserve a particular mention. Non mi piace

**Oscar Sala (1922-2005)**

Oscar Sala was born in Marostica on June 3, 1922. He graduated in Padua in July 1945 and immediately became a voluntary and later extraordinary university assistant at the

ENT Clinic of the University of Padua, directed by Prof. Michele Arslan. In 1950 he became a hospital assistant and in 1954 an *Aiuto*. From January 1, 1956, he was a university assistant with the rank of *Aiuto*. In the academic year 1966-67, he was appointed professor of Audiology. He obtained *Libera Docenza* in ENT in 1954 and was declared eligible for professorships in Ferrara (1956) and Messina (1963). On November 1, 1968, he was unanimously

appointed by the Medical Faculty of Trieste as extraordinary professor of ENT, a position he held until October 31, 1970, when he was unanimously appointed by the Faculty of Medicine and Surgery of the University of Padua to the chair of ENT (duplicated) in Verona. In 1969, he was admitted as a full member of the Collegium Otorhinolaryngologicum Amicitia Sacrum (CORLAS), among the ten positions reserved for Italy (Figure 19).

Sala devoted himself early to vestibology. Between 1946 and 2000, he published more than 200 scientific papers, most of which concerned vestibular pathophysiology. In addition to experimental studies typical of the Arslan School, he also focused on the pathophysiology and clinical aspects of central vestibular pathways, establishing a long-standing collaboration with the Neurology Clinic, particularly with Simone Rigotti (1919–1996), later Director of the Neurology Clinic of Pad-

ua, and Hrayr Terzian (1925–1988), later Director of the Neurology Clinic of Verona and cousin of Michele Arslan. His first paper<sup>31</sup>, co-authored with Rigotti, dates back to 1946; among his first 30 publications (1946–1950), 25 dealt with vestibology, which remained his main field until the mid-1960s. He later expanded his research to include cortisone use in ENT (his 1959 monograph remained a reference for many years<sup>32</sup>), diphtheria, and nasal mucosa<sup>33</sup>. Subsequently, with collaborators such as Babighian, Molinari, and Martini, he published important papers in Audiology<sup>34</sup>, and with Ferlito in ENT oncology<sup>35</sup>. His most innovative contributions for that period concerned the central vestibular pathways<sup>36</sup>, particularly his official report at the 44th National Congress of the Italian Society of Laryngology, Otology and Rhinology, Bologna, September 27–30, 1956 (Figure 20).<sup>37</sup>

<sup>31</sup> Sala O, Rigotti S. L'influenza della stimolazione di un nervo periferico sul nistagmo postrotatorio ottenuto con la tecnica di Buys-Fischer. *Boll Soc It Biol Sperim.* 1946, 22: 614.

<sup>32</sup> Sala O. Il cortisone e le sostanze ad azione cortisonica in otorinolaringoiatria. *Collana Monografica di Minerva Otorinolaringologica*, 1959, Torino; Sala O, Megighian D. Preliminary results of local use of hydrocortisone acetate in various | Primi risultati sull'uso locale dell'acetato di idrocortisone. *Min. Otorinolaringol.* 1955, 5: 312–323. Sala O, Pesavento G. Behavior of epithelial regeneration, in mucosa and in skin, in relation to changes of connective tissue induced by local and general cortisone therapy; experimental and clinical findings. *Boll Soc It Biol Sperim.* 1958, 34: 857–860

<sup>33</sup> Sala O. Clinical and bacteriological aspects of atypical diphtheria. | La difterite atipica sia nel suo aspetto clinico, sia in quello batteriologico. *Min Otorinolaringol.* 1953, 3: 8–13; 11. Sala, O. Ricerche sperimentali sulla reattività della cute e delle mucose. *Arch It Otol Rinol Laringol.* 1953, 64: 255–272; Sala O. Considerazioni sulla atipia batteriologica e clinica della difterite faringea. *N. Ann Igiene Microbiol.* 1953, 4: 243–246; Sala O, Megighian D. L'aspecificità delle alterazioni morfologiche sperimentali delle ghiandole salivari in differenti avitaminosi; sua importanza nella interpretazione patogenetica della sindrome di Gougerot-Sjögren. *Arch It Otol Rinol Laringol.* 1958, 69: 519–540; Sala O, Gasparini G. Histochemical observations in the nasal mucosa of guinea pigs in acute anaphylactic shock, and changes induced by topical treatment with hydrocortisone acetate. *Min Otorinolaringol.* 1962, 12: 195–202; Sala O, Gravina E, Sanvitale G. Abnormalities of serum immunoglobulins (IgA, IgM, IgG) and recurring infections of the respiratory tract. *Practica Oto Rhino Laryngol.* 1968, 30: 353–364.

<sup>34</sup> Sala O, Babighian G. Les surdités neuosensorielles chroniques sont-elles toutes irréversibles. *Rev Laryngologie Otologie Rhinologie*, 1972, 93; 513–522; Sala O. Clinical significance and diagnostic value of auditory bone threshold: Some critical considerations. *Acta OtoLaryngolo.* 1973, 75: 152–155; Sala O, Babighian G. Prospettive di una terapia medica in alcune ipoacusie neurosensoriali. *Min Otorinolaringol.* 1973, 23: 61–76; Martini A, Comacchio F, Fedele D, Crepaldi G, Sala O. Auditory brainstem evoked responses in the clinical evaluation and follow-up of insulin-dependent diabetic subjects. *Acta Oto-Laryngol.* 1987, 103: 620–627.

<sup>35</sup> Sala O, Ferlito A. Morphological observations of immunobiology of laryngeal cancer: Evaluation of the defensive activity of immunocompetent cells present in tumour stroma. *Acta OtoLaryngol.* 1976, 81: 353–363

<sup>36</sup> Rigotti S, Sala O. [The variability of the postrotatory nystagmus in the intact rabbit and in the thalamic rabbit]. *Boll Soc Ital Biol Sper.* 1947, 23:459–62; Arslan M, Sala O. Sindrome vestibolare "irritativa" armonica da tumore del bulbo. *Soc. It. Neurol. Padova* 8 Maggio 1947; Sala O, Rigotti S. La variabilità del nistagmo postrotatorio nel Coniglio integro e nel coniglio talamico. *Boll Soc It Biol Sperim.* 1947, 23: 459; Rigotti S, Sala O. Ricerche sul comportamento delle reazioni vestibolari dopo asportazione del telencefalo. *Acta Neurol.* 1948, 3:1-13; Sala O. Le correnti di azione del nervo vestibolare. *Marginalia Otorinolaryngol.* 1950, 6: 241; Sala O, Terzian H. Sul comportamento del nistagmo oculare da stimolo acceleratorio in animali trattati con mianesina. *Boll Soc Ital Biol Sper.* 1952, 28:1753-5; Sala O. Le vertigini di origine "centrale". *Rel. XIX Raduno Gruppo ORL Alta Italia, Società Cooperativa Tipografica*, 1961, Padua; Sala O. The efferent vestibular system. *Electrophysiological research. Acta Oto-Laryngol.* 1965, suppl.197; Sala O. Vestibular efferent system: *Electrophysiological Research. Acta Oto Laryngol.* 1965, 59: 329–337.

<sup>37</sup> Arslan M, Sala O. Fisiopatologia e clinica delle vie vestibolari centrali. Official proceedings XLIV National Congress Società Italiana di Laringologia, Otologia e Rinologia, Bologna 27-30 settembre 1956, Padova Società Coop. Tipografica 1956.



Figure 19. Professor Oscar Sala.

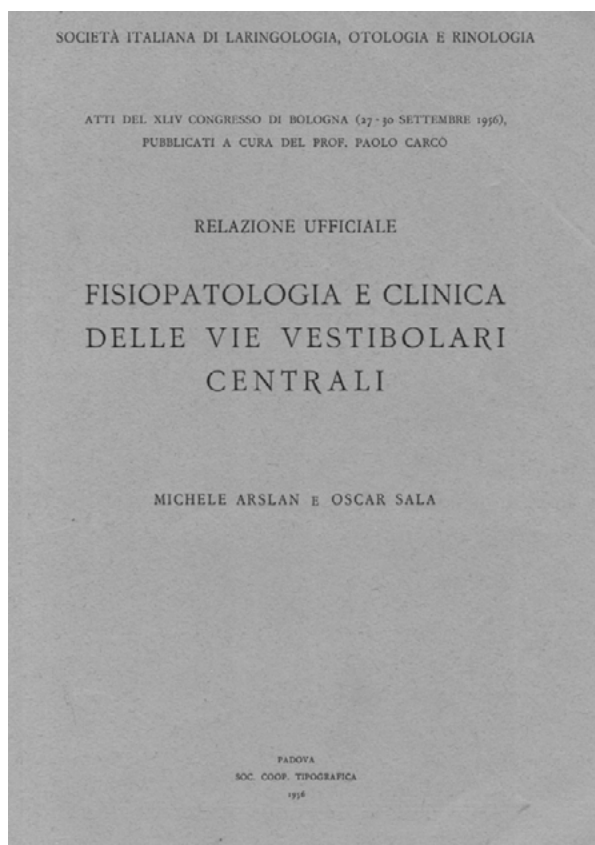


Figure 20. Arslan M., Sala O. *Physiopathology and clinical aspects of central vestibular pathways*. Official Proceedings of the 44th National Congress of the Italian Society of Laryngology, Otology and Rhinology, Bologna, 1956.

### David Megighian (1925–2007)

Born in Villafranca di Verona on 9 December 1925, after attending the Classical High School in Verona, he enrolled in Medicine and Surgery in Padua in the academic year 1944–

45. He graduated in Padua on 18 November 1950; in 1952 he was a voluntary attending physician at the ENT Clinic of Padua (Director Prof. Michele Arslan), extraordinary assistant from 1955 to 1963, tenured University Assistant in 1963, and from 1967 full university *Aiu-*

to at the ENT Clinic of the University of Padua with the qualification of head of the otoneurology service. From 1982 he was Associate Professor of Otorhinolaryngology until retirement in 1982.

It should be recalled the Verona period too: in 1969–70 he was appointed Professor of ENT, with direction of the same, at the detached Verona branch of the Medical Faculty of Padua, and from 1970 to 1974 he held the position of Audiology of the Medical Faculty of Padua at the Verona branch. He obtained numerous “qualifications”: Chief of ENT at the Hospital of Gorizia (1959); Chief of ENT at the Hospital of Ancona (1963); competition for the ENT chair at the University of Sassari (1968); competition for the ENT chair at the University of Catania (1970); competition for the ENT chair at the University of Cagliari (Figs. 21–23).

His experience at important research centers abroad was particularly significant, especially as *Gastarzt* at the ENT Clinic of Freiburg (Prof. Zöllner) and at the Institute of Neurophysiology of Freiburg (Prof. Jung) in the years 1958–1959. Jung’s Institute of Neurophysiology was at that time one of the most important neurophysiology institutes in the world. Mainly devoted to studies in humans (for example, patients with multiple sclerosis coming from the nearby Institute of Neurology), it included among its researchers Hans Helmut Kornhuber (who later became a close friend of his), famous among ENT specialists for his research on optokinetic nystagmus, but much more famous among neurophysiologists for his *Bereitschaftspotential*, or readiness potential, which precedes activity of the primary motor cortex (M1) in the frontal premotor areas.

Together with Waldecker, who carried out studies with Prof. Megighian published in 1962, Kornhuber conducted other important studies on optokinetic and vestibular nystagmus. In 1962, he also worked at the ENT Clinic of the University of Bonn (Prof. Langenbeck), where he carried out electronystagmographic research on retraction nystagmus. Davide Megighian made important contributions in the field of the physiology and pathophysiology of the system for stabilization of the visual field on the retina, which he carried out in the period essentially spanning from the late 1950s to 1980, and to the subsequent review

work on the pathophysiological, clinical, and therapeutic aspects of peripheral vestibulopathies. It is possible to distinguish works devoted to the physiology and pathophysiology of the vestibular response and works concerning the optokinetic subsystem and the mechanisms that govern it through repeated analyses of optokinetic post-nystagmus.

The theories on Jung’s *Gesamtamplitude* and the analyses of the post-optokinetic after-response are still today principles studied in terms of neural circuitry and motor control of both the optokinetic response, and they confer value on the studies carried out by Jung himself and in the subsequent period. Furthermore, the studies on EEG rhythms and on the “interferences” with the optokinetic response and its after-response, carried out with neurologist colleagues both in patients and in experimental animals, indicated the importance of brainstem structures in the control of the optokinetic response itself and of the vestibular response.

In Padua, the almost continuous collaboration with the Neurology Clinic (Prof. Belloni, Prof. Testa, Prof. Rigotti) should be recalled, were, quoting Arslan:

“I particularly wish to point out the important contribution made to the chapter on the physiology of the central vestibular system. His research on modifications of nystagmus in relation to variations in cerebral bioelectrical activity, conducted at the Institute of Neurophysiology of the University of Freiburg directed by Prof. Jung and at the ENT Clinic and the Neurology Clinic of the University of Padua, led to knowledge of new mechanisms of central regulation of the vestibular reflex.”

Since 1973, he has been a member of the Barany Society.

In addition to making important contributions in the field of his beloved Otoneurology in Italy and abroad, among his numerous publications, some written with foreign colleagues, the following should be remembered: Megighian D. Elettronistagmografia - Tecnica, metodologia, valore clinico. Ed. Minerva Medica, Torino, 1959. Megighian D, Schmidt. Diagnostik der peripheren Vestibularisstorungen. In: Berendes J, Link R, Zollner F (Hrsg) Handb Hals-Nasen-Ohren-Heilk, Bd 6 (2). Thieme, Stuttgart, 1980. Megighian D. Otoneurologia. Ed Piccin, Padova, 2008. (Fig. 24)



### Giorgio Molinari (1934–2004)

Giorgio Molinari, later appointed professor in charge of Audiology at the University of Padua, began his activity mainly with experimental work, principally of an electrophysiological type, on laboratory animals. In particular, in those years Prof. Arslan had proposed ultrasound therapy in the treatment of Menière's disease<sup>38</sup> and pituitary pathology<sup>39</sup>, as well as the treatment of hydropic pathology by the application of NaCl crystals at the level of the round window.<sup>40</sup> However, Molinari's experimental activity was also directed toward

cochlear electrophysiology and the electrophysiology of the central vestibular and auditory pathways<sup>41</sup> and of the laryngeal nerves<sup>42</sup>.

Most of this research was at that time published in the renowned *Bollettino della Società Italiana di Biologia Sperimentale*; the *Bollettino della Società Italiana di Biologia Sperimentale*—now the *Journal of Biological Research*—is one of the oldest journals in Biology, founded in 1925. Subsequently, the clinical and research activity of Prof. Giorgio Molinari was mainly directed toward topics in Audiology.<sup>43</sup> (Figure 24–26)

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Figure 24 Prof. Molinari with the residents in 1987: from right, Mimmo De Filippis, Prof. Giorgio Molinari, Riccardo Ferretti, Marina Savastano, Giovanni Braggion, and Dr. Claudio Andreoli.



Figure 25. Prof. Molinari at a congress on occupational hearing loss.



Figure 26. Prof. Giorgio Molinari (on the left) and Prof. Oscar Sala (on the right).