History corner
The origin of Audiology and the contribution of Italian Audiology: the Milano school (Part 1)

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The background

Would Audiology have been "born" if there had not been the Second World War? Probably yes, but without the rapid development it had in the next 10 years after the end of the war.

James Jerger in 1963 declared: "Audiology is a young but lusty infant. Born less than two decades ago in the convergence of modern electronics and the military aural rehabilitation programs of the Second World War, this new field has already generated an extensive international literature" (Jerger, 1963).

THE INTERNATIONAL COURSE IN AUDIOLOGY

Stockholm, 11th to 20th September, 1950

INAUGURAL ADDRESS

BY G. HOLMGREN

STOCKHOLM, SWEDEN

Your Royal Highness, Ladies and Gentlemen,

The International Course in Audiology that we are inaugurating today is the first of its kind and represents quite a recent innovation.

Audiology — that is to say, the science of hearing — is still, in the present sense, only a few years old. We have long known that impaired hearing is very prevalent, and the forms and grades of it that more or less render the sufferer an invalid are also extremely common, as we know from experience, even though no country possesses reliable statistics. In most countries very little has been done, and indeed has been possible to do, on the part of the general public. The ear specialists have been confronted with a problem the solution of which, they have felt, has been beyond their power and the material resources at their command.

World War II left in its wake such a vast number of veterans with damaged hearing that the United States Army and Navy found it necessary to organize relief centers, so-called Audiology Centers for Rehabilitation of the Deaf. These centers have treated an immense number of patients, many of whom they have succeeded in fitting for a normal social and business life. The experience thereby gained has in fact been so extensive and so important that audiology centers for civilians, too, have sprung up like mushrooms. Indeed the number of such centers in the U.S.A. today is estimated to be well in excess of one hundred. Outside America, in contrast, plans for such organizations exist in several countries, but as yet have scarcely been realized in any of them. The audience gathered here today demonstrates to the full that the importance of an organization for combatting deafness on a far greater scale than hitherto is generally realized.

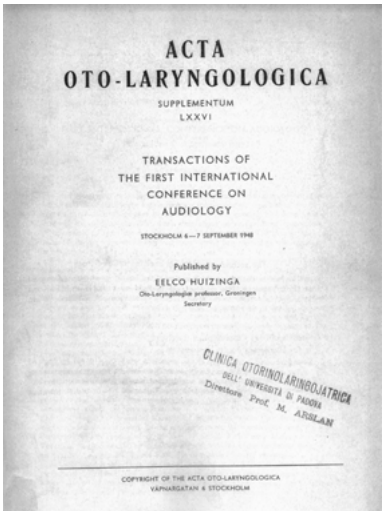
The idea of arranging this course was first suggested at the end of last year by Dr. Sadowsky, of Tel Aviv, Israel. The feelers that were from here immediately put out in many countries excited everywhere very keen interest, indeed in some quarters real enthusiasm. The course that has now been realized enjoys the support of about forty teachers and more than two hundred participants from twenty-three different countries throughout the world, including several of the most eminent audiologists in America. It is the rapidity of this development, and the scientific, social and humanitarian importance of audiology, that has prompted the Organizing Committee to invite to the inauguration of this course an assembly of eminent personages, in the hope of gaining their support in the work for the benefit of the deaf which is now envisaged in so many countries.

I have the honour to welcome to this assembly Her Royal Highness Princess

Figure 1a G. Holmgren's inaugural address at the first International Course in Audiology

On 1950 the first International Course in Audiology was held in Stockholm and in that time Gunnar Holmgren said in front of "your Royal Highness" these words:

> "Audiology – that is to say, the science of hearing – is still, in the present sense, only a few years old…We have long known that impaired hearing is very prevalent…In most countries very little has been done .. World War II left in its wake such a vast number of veterans with damaged hearing that the United States Army and Navy found it necessary to organize relief centers, so-called Audiology Centers for Rehabilitation of the Deaf…the number of such centers in the U.S.A. today is estimated to be well in excess of one hundred. Outside America, in contrast, plans for such organizations exist in several countries, but yet have scarcely been realized in any of them" (Figure 1 a,b).



ACTA

OTO-LARYNGOLOGICA

SUPPLEMENTUM

LXXVI

TRANSACTIONS OF

THE FIRST INTERNATIONAL

CONFERENCE ON

AUDIOLOGY

STOCKHOLM 6—7 SEPTEMBER 1948

Published by

EELCO HUIZINGA

Oto-Laryngologie professor, Groningen

Secretary

CLINICA OTORINOLARINGOJATRICA

DELL'UNIVERSITÀ DI PADOVA

Direttore Prof. M. ARSLAN

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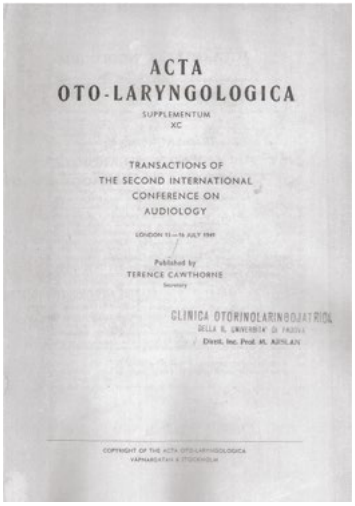
VÄPNARGATAN 4 STOCKHOLM

Figure 1b Acta Oto- laryngologica, Transactions of the first International Course in Audiology , 1948

Before this event other conferences were organized, in 1948 Holmgren invited in Stockholm a group of members of the Collegium ORLAS interested in audiological problems; this is known as "the first International Conference in Audiology ". About this event Eelco Huizinga reported "there were about 40 participants representing 16 countries, 13 from the old and 3 from the new world.. .... Holmgren's intention was to try to come to some forms of international organization in the important and ever expanding field of audiology, which includes everything connected with sound, hearing and hardness of hearing".[1]

The second Conference was held in London in July 1949.[2] At this meeting out of 39 participants, 5 were Italian: Arslan, Bocca, d'Avino, Ferreri, and Manci. (Figure 2)

In 1952 Pierre Trenque (Lyon), Terence Cawthorne (London), HAE Van Dishoeck (Leiden) André Aubin (Paris) founded the International Society of Audiology "to facilitate the knowledge, protection and rehabilitation of human hearing and to serve as an advocate for the profession and for the hearing impaired throughout the world".[3] However during the congress in Paris in 1955 it was stated that the foundation dates back to 1948 in Stockholm.


ACTA
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TRANSACTIONS OF
THE SECOND INTERNATIONAL
CONFERENCE ON
AUDIOLOGY
Published by
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CLINICA OTORINOLARINGOIATRICA

Figure 2 Acta Oto- laryngologica, Transactions of the first International Course in Audiology , 1949

The first International congress of the Society of Audiology, was organized in Leiden in 1953, and a merger was made with the French Society who had organized the "*1er Congrés de la Société Internationale d'Audiologie*" (Figure 3) with a remarkable participation of the Italians. [4] An extraordinary congress was held in Buenos Aires in 1954 (Aldo G. Remorino); the second international congress in 1955 took place again in Paris (André Aubin), also here the Italian contribution was worthy of note[5] and the following two were held in Italy in

[1] (1949) First International Conference on Audiology: Stockholm 6 – 7 September 1948, Acta Oto-Laryngologica, 37:sup76, 1-5, DOI: 10.3109/00016484909122657

[2] (1951) The International Course in Audiology in Stockholm 1950: Report on the program, details of the course and publication of the proceedings. Project for a second course in applied otology possibly to be held in Stockholm in September, 1951, Acta Oto-Laryngologica, 39:1, 89-94, DOI: 10.3109/00016485109119252

[3] https://isa-audiology.org/about-isa/history

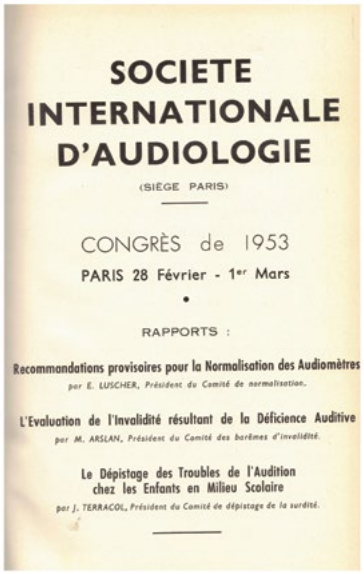
[4] Il 1 er Rapport edited by Vidau and Fiori-Ratti (Rome): *Les aspects métaboliques des problémes audiologiques*; On 36 communications, 12 were from Italy:

1. F. Brunetti, M. Coassolo (Turin): Perméabilité de membrane de l'oreille interne etude au microscope électronique
2. GB de Stefani (Padua): Le mécanisme d'action des ultrasons appliqués directament sur le labyrinthe dans les hypoacousies
3. R. Hahn (Turin): L'interdépendance auriculaire après évidement pétromastodien et après fenestration
4. E. Bocca, C. Calearo, V. Casdsinari (Milan): Examen de la fonction auditive corticale dans les tumeurs du lobe temporal
5. U. Bombelli, A. Manfredi (Rome): La willismetrie
6. G. Rossi (Turin): L'exploration audiométrique dans les lobectomies temporales
7. V. Mollica (Turin): L'amélioration auditive par tympan artificial
8. P. Menzio (Turin): Localisation spatiale auditive et hypoaousies
9. G. Moretto (Turin): Localisation spatiale du son et prothèse auditive
10. E. Damiano (Turin): Intensité d'émission sonore et localisation spatiale auditive
11. E. Sebastiani (Turin): Remarques phonétiques sur les troubles de la parole d'origine auditive
12. P.F. Pieri (Montecatini): Laction des eaux thermale de Montecatini sur la surdité rhinogène

[5] M. Arslan "*Rapport du Comité des Barèmes d'Invalidité: L'évaluation de l'invalidité resultant de la déficience auditive*" Communications

1. A. Manfredi (Rome): Examen auditif avec tons complexes
2. U. Bombelli (Rome): Recherches sur l'audiometrie a tons complexes
3. G.B. de Stefani (Padua): L'indice de capacité auditive chez les traumatisés auriculaires

Montecatini in 1956 (Pier Felice Pieri) and in Padova in 1958 (Michele Arslan) (Figure 4).


SOCIETE INTERNATIONALE D'AUDIOLOGIE

(SIÈGE PARIS)

CONGRÈS de 1953

PARIS 28 Février - 1er Mars

RAPPORTS :

Recommandations provisoires pour la Normalisation des Audiomètres
par E. LUSCHER, Président du Comité de normalisation.

L'Evaluation de l'Invalidité résultant de la Déficience Auditive
par M. ARSLAN, Président du Comité des barèmes d'invalidité.

Le Dépistage des Troubles de l'Audition chez les Enfants en Milieu Scolaire
par J. TERRACOL, Président du Comité de dépistage de la surdité.

Figure 3 Act of the first International congress of the Society of Audiology held in Leiden in 1953

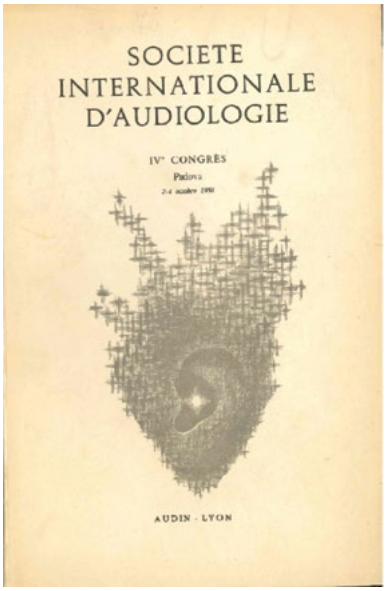


Figure 4 Act of the International congress of the Society of Audiology held in Padova in 1958

During inaugural address Aubin said "*notre jeune Société qui est agée peine de trois ans est en pleine activité*" leaving the presidency to Luigi Pietrantoni. These conferences were born as a rib of the Collegium Oto-Rhino-Laryngologicum Amicitiae Sacrum.[6] From the very beginning, although the medical component is predominant, the discussion between a "technical" audiology and a "medical" audiology is very heated. In particular, Otologists, at that time the predominant component of CORLAS, warned of the danger that Audiologists could erode the scientific field of the specialty. Already after the presentation of Norton Canfield (Yale) at the first conference 1948, Edmund Fowler (New York) disputes the approach given on the organization of rehabilitation centers. Maurice Sourdille in the London conference of the following year, presents a reading on "*coinsiderations generales sur l' Audiologie*" and proposes to insert it as part of one of the four "*groupements spéciaux annexes"* to the ENT specialty giving rise to the specialty of *"Oto-Neuro-Optalmologie e d'Audiologie*".

Italy and the Milano school

These first audiological congresses were attended by several important Italian figures: at the first congress in Paris Luigi Pietrantoni (Milan) was vice chairman and Lucio Croatto (Padua) was the secrétaire des séances; Michele Arslan was président du Comité des Barèmes d'Invalidité and Azzo Azzi (Milan) and Lucio Croatto (Padua) were part of the Comité de Dépistage de la Surdité. At the second congress in Paris in 1955 the first relation "Les aspects métaboliques des problèmes audiologiques" was presented by Prof. Leopoldo Fiori-Ratti and during the congress the Italian participants were very active. [7]

On the 36th Congress of the Italian Society of ENT, held in Genoa in October, 1947, Leopoldo Fiori-Ratti and Angelo Manfredi present-

4. E. Borghesan (Palermo): Les secteurs de syntonie du recepteur cochleaire
5. L. Fiori-Ratti, A. Manfredi (Rome): Le "test" radioaco chez le sujet normoacusique

[6] The CORLAS was created in 1926, in Groningen (the Netherlands) at the initiative of Charles Emile Benjamins and Adriaan De Kleyn with the intent to bring together in a spirit of friendship the ENT physician after the disaster of the first world war.

[7] E. Borghesan (Palermo): "les secteurs de syntonie du recepteure cochléaire". Allocution de M.Magarotto secrétaire général de la Fédération Mondiale des Sourdes; présentation de film La surdité méconnue chez l'enfant (Arslan-Croatto, Padua); GiovanBattista de Stefani (Padua) L'indice de capacité auditive chez les traumatisés auriculaire; Angelio Manfredi (Rome) examen auditif acìvec tons complexes; Ugo Bombelli (Rome) recherches sur l'audiométrie a tons complexes

ed an Official Report entitled "Electrophysiology of Hearing", thus bringing to the attention of Italian specialists in ENT, the state of the art of the most advanced American experimental research and stimulating the clinicians' interest in eventual practical applications of the US results. They discussed the masking effect of sound, hearing fatigue due to prolonged exposure of the hearing organ, the cochlear potentials, the cochlear microphonic effect, the brainstem auditory evoked potential, and the electrical activity of the cortex.

In the following decade, the development of Audiology in Italy is mainly due to the ENT Clinic of the University of Milan directed by Professor Luigi Pietrantoni.

The city of Milan played an important role with regard to deafness: in Milan during the second half of '800 the "Pio institute for poor deaf and dumb in Milan" was founded and in 1880 was held the Second International Congress on Education on the deaf also known as the "Milan Conference or Milan Congress". (Figure 5)

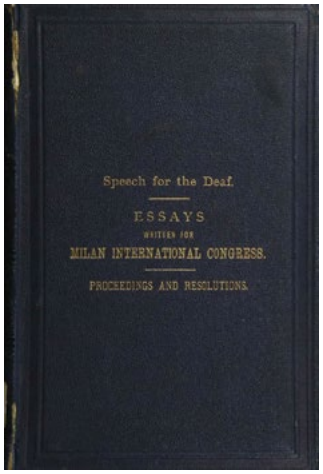


Figure 5 "Essays written for Milan International congress" in 1880

During the conference it was declared that oral education (oralism) was superior to manual education (signed) education. After deliberation, the congress endorsed oralism and passed a resolution banning the use of sign language in schools. After its passage, schools in European countries and USA switched to using speech therapy without sign language as a method of education of the deaf.[8]

In 1950, during the conference on Experimental Phonetics, Phoniatrics and Audiology, hold in Milan, it was founded the Italian Society of Audiology and Phoniatrics of which Agostino Gemelli became president.

Figure 6 Luigi Pietrantoni by courtesy of Giovanni Felisati

Luigi Pietrantoni (1899-1960)(Figure 6), particularly known as an oncologist surgeon in the head and neck area, started to direct the ENT Clinic of the University of Milan in 1947; he was pupil of Francesco Lasagna (1882/1946) who had directed the Milan Clinic from 1941 to 1945 and who had created the Electroacoustic Center in 1942 as part of the Clinic. Pietrantoni gave a particular impetus to the development of Audiology in Milan and from 1956 to 1958 he was also president of the International Society of Audiology.

A particularly important step was the organization of the "Audiology Course" (13-21 January 1951) held at the Otorhinolaryngology Clinic of the University of Milan [9] The proceedings of this course were immediately published in a volume that has constituted in the next years one of the principal basis for the study of Audiology in Italy (Figure 7 e 8).[10]

[8] https://projects.iq.harvard.edu/asl/deaf-history-timeline

[9] Main participants were Eng. Angelo Manfredi from CNR in Rome, the physiologist Rodolfo Margaria , Azzo Azzi, Carlo Agazzi, Ettore Bocca, Amedeo Pellegrini, Pietro Scevola, Gualtiero Lugli, Trabucchi (pharmacologist), Gino Sacerdote (Galileo Ferraris Institut Turin), Erhard Lüscher (Chairman of the Inselspital ENT Department Berne 1931-1941 and then Basel), AB Alexander (London), JE Fournier (Paris)

[10] Clinica Otorinolaringologica della Università di Milano, Corso di Audiologia, Istituto per la Diffusione di Opere

Figure 7 From left to right: Sambataro (Milano), Bernabei (Siena); Clerici (Legnano); In the middle row: Pellegrini and Saronno (Codogno), knelt downbelow Pasini , Azzi and Pietrantoni, Agazzi (Bergamo), Gatti Manacini (Brescia), Bocca (Milan), Felisati (Milan), Bassini (Cinisello Balsamo, Merate),Magri (Bollate), Meda and Niguarda (Cremona e Desio). by courtesy of Giovanni Felisati

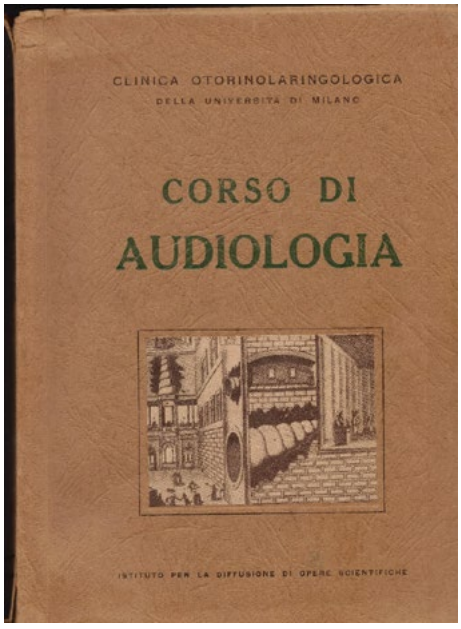


Figure 8 Proceeeding of the "Audiology Course" (Milan, 13-21 January 1951)

Scientifiche, Milano 1951

In the same year 1951 took place the IX meeting of the "Gruppo Otorinolaringologico dell'Alta Italia", and the official report was "Modern methods of clinical audiometry: tonal and speech audiometry" was edited by Ettore Pirodda and Ettore Bocca (E. Pirodda, E. Bocca, 1951) (Figure 9a,b,c)

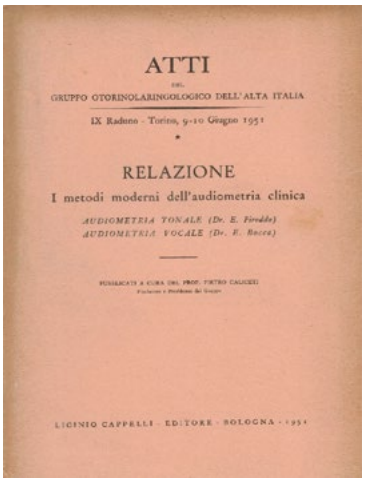


Figure 9a Official report "Modern methods of clinical audiometry: Tonal and speech audiometry" of the IX meeting of the "Gruppo Otorinolaringologico dell'Alta Italia"

Figure 9b Ettore Pirodda by courtesy of Antonio Pirodda

Figure 9c Ettore Bocca by courtesy of Paola Arslan

The Milan school, which spreads throughout Lombardy and in the universities of Sassari and Ferrara, has become over time an important international point of reference especially for the study of central hearing processes; for these reasons in his "Modern developments in Audiology" on 1963 (Figure 10), James Jerger entrusted this chapter to Ettore Bocca and Carlo Calearo (Bocca 1961).

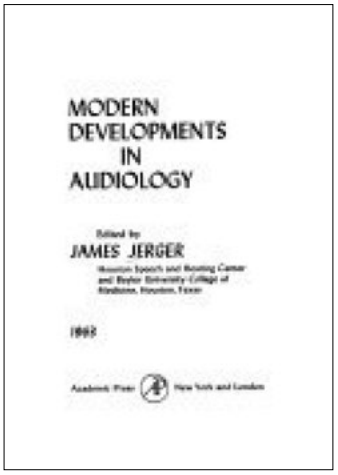


Figure 10 Modern Developments in Audiology. Front Cover. James Jerger. Academic Press, 1963

However in the 1970s that Italian contributions to American handbooks became sparse or nil, as a proof of this the most important manual of the time "Handbook of Clinical Audiology", edited by Jack Katz in 1972 (Williams & Wilkins Baltimore) does not contain any contributions from Italian audiological schools.

About the Milan school, we repost the following testimony of Dino Felisati (Felisati 2007) (Figure 11)

Figure 11 Dino Felisati by courtesy of Giovanni Felisati

"I got my degree in 1948 and Professor Fausto Brunetti, Head of the ORL Unit of the Hospital in Venice said to me..."I am old and my appointment as Head is coming close to the end; you are young and you need to be part of a stimulating atmosphere. There is one such place in Italy: the ORL Clinic of the University of Milan, of which my friend Luigi Pietrantoni. Ettore Bocca and Carlo Agazzi were the right and left arm of Prof. Pietrantoni. Bocca was literally bursting all over with geniality, Agazzi was the expression of rationality and order. The Clinic was divided into various Services, a complete Department ante litteram, a Head was appointed responsible for each Service. Bocca was responsible for the Audiology Service, which had been called by the name of another Maestro from the Milanese School: Francesco Lasagna, a study and research centre that, in little more than ten years, was to produce results of world renown. I was, therefore, bound by great admiration and friendship to those colleagues that worked with Bocca: Amedeo Pellegrini, Giulio Pestalozza, Giovanni Zanotti, Carlo Calearo and, later, Giampiero Teatini and Antonio Antonelli. Projects were carried out by that group of great brains, allow me to recall some of the most important:

– vocal audiometry with the first lists of phonetically balanced words and the logatomi (fragments of senseless words), which were added to the tonal audiometry;

– study of central deafness based upon the use of lists of phrases pronounced with accelerated voice, with a distorted voice (by means of various big or low pass filters), the interrupted voice, prepared in order to make the perception of the spoken messages more difficult."

In January 1951, at the same time as the Audiology Course, came out the "Rivista di Audiologia Pratica" (Journal of Practical Audiology), published by the Maico Audiological Center of Milan and directed by Enrico Buchwald, with the greeting addresses of Agostino Gemelli and Pietro Caliceti (director of the ENT Clinic of Bologna) and of Luigi Pietrantoni (director of the ENT Clinic of Milan); a crucial personality for the magazine was Azzo Azzi, the editorial committee made up of Giuseppe Bellussi (Turin), Ettore Bocca (Milan), Ugo Bombelli (Rome), Paolo Filippi (Genoa), Leopoldo Fiori-Ratti (Rome), Cesare Frugoni and Ettore Pirodda (Bologna).(Figure 12)

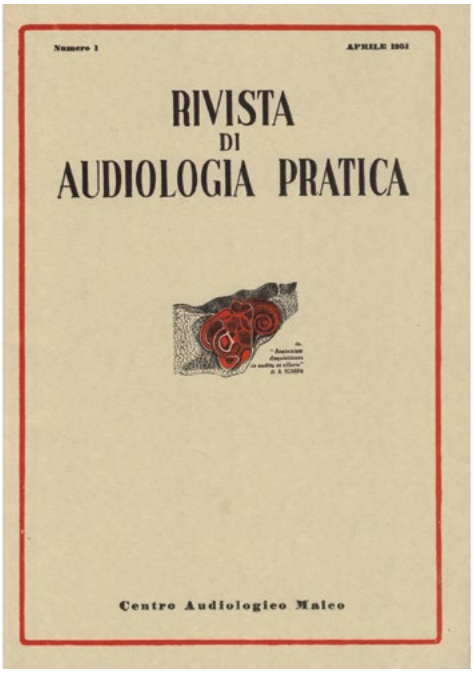


Figure 12 " Rivista di Audiologia Pratica"

The purpose of the publication was "to fill a gap in the Italian specialist literature". It is aimed at both younger and more trained otologists. For the youngest this Journal will serve to clarify the foundations and developments of practical Audiology by proceeding in each question step by step from easy to difficult; another initiative was to offer a free bibliographic service.

The journal was published by Maico whose medical director and importer was the italian Enrico Buchwald, who was certainly an innovator. Maico (Medical acoustics instruments company) was founded in Minneapolis, USA, in 1937 when Leland Alfred Watson, pioneer of medical electronics, opened the first laboratory and during the 1950s it went through a continuous evolution.

In addition to Enrico Buchwald, others key figures that immediately after the war, contributed substantially to a big reorganization of the sector were Charles Algernon Holland, the founder of Amplifon and Otello Giovacchini, the first importer of "Mercury" (Mercury was, with Maico USA, one of the first and largest manufacturers of equipment acoustics). (Figure 13-16)

Figure 13 Amplifon Building by courtesy of CRS Amplifon

Figure 14 Amplifon mobile unit "Laboratorio acustico viaggiante" by courtesy of CRS Amplifon

Figure 15 Amplifon advertising poster by courtesy of CRS Amplifon

Figure 16 Maico advertising poster by courtesy of Mauro Menzietti

The Journal of Practical Audiology came out regularly for more than 10 years at least until 1962 and was undoubtedly an updating tool for those who in those years began to be interested in a new discipline such as Audiology in Italy.

Later, in 1967 it was born the "Notiziario bibliografico di Audiologia" (Bibliographic newsletter for Audiology) published by Amplifon under the inspiration and direction of Prof. Antonio Antonelli.(Figure 17).

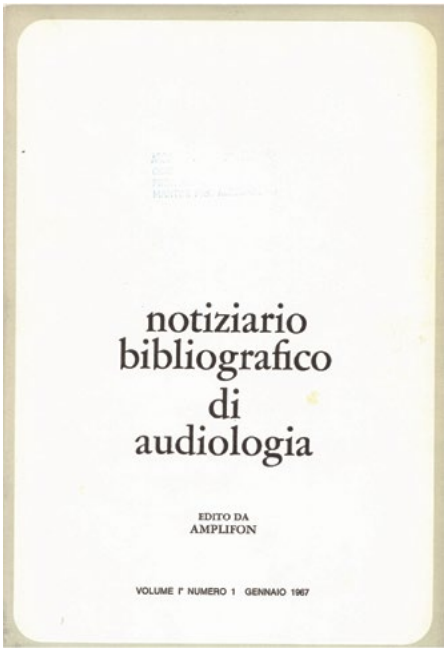


Figure 17 "Bollettino Amplifon n. 1"

From audimeter to audiometers

In the first half of the twentieth century many important discoveries were made in the field of anatomy-physiology of hearing and acoustics that had modified the previous knowledge substantially based on the theories of Helmholtz (Wever and Bray, Adrian, Davis and Saul, Hallpike, Lorente de Nò, von Békésy.) (Felisati 2007)

Diagnosis of hearing loss was still based, for the quantitative evaluations, on the use of a whispering or spoken voice and a watch, and, for a qualitative evaluation, on the use of a tuning fork. There were also other instruments: Politzer's acumeter, Galton's whistle, Struycken-Schaefer's monochord. Cochlear-phonatory reflex (Lombard's test), cochlear-eyelid (for newborns) or galvanic reflex for assessment of the eighth nerve. Tube function was evaluated by means of Politzer inflator and with Valsalva's manoeuvre. (Felisati 2007)

In 1885, Arthur Hartmann designed an 'Auditory Chart', which included left and right ear tuning fork representation, a few years later, in 1899, Carl Seashore introduced the audiometer as an instrument to measure the 'keenness of hearing'. The instrument operated on a battery and presented a tone or a click with an attenuator set in a scale of 40 steps. Max Wien conceived the concept of a frequency versus sensitivity (amplitude) audiogram plot of human hearing sensitivity in 1903. Since 1919 vacuum tubes have been used in electronic audio devices. In 1922 Western Electric produced the first commercially available electronic audiometer for the measurement of the sensitivity of hearing, designed by E. P. Fowler and R. L. Wegel; it allowed for hearing testing from 32 through 16,384 Hz. (Fowler 1922, Fowler 1922b, Bunch 1941, Bunch 1943)

Wever and Bray described in 1930 stimulus-evoked electrical currents near the cochlea with a wave form similar to that of the original sound stimulus. It was Adrian who later coined the term "cochlear microphonics" for this phenomenon.(Gitter 1992)

The first modern audiometer with a flat zero line for all pitches was constructed in 1937 and in 1947, Bekesy constructed the automatic audiometer. (Sente 2004)

The use of audiometers in Italy was already widespread before World War II. In the "Trattato di Medicina Aeronautica" (Figure 18) published in 1942 and edited by Arturo Monaco, Agostino Gemelli and Rodolfo Margaria, in chapter VI Benedetto Casella (medical colonel CSA and professor of Otolaryngology in Rome) reported that already in 1933 the results on the pilots were presented; he wrote "since 1925, tests carried out in the Medical-Legal Institute of Florence on over 2500 pilots... in some of them a hearing loss was found mainly on high frequencies". (Monaco 1942)

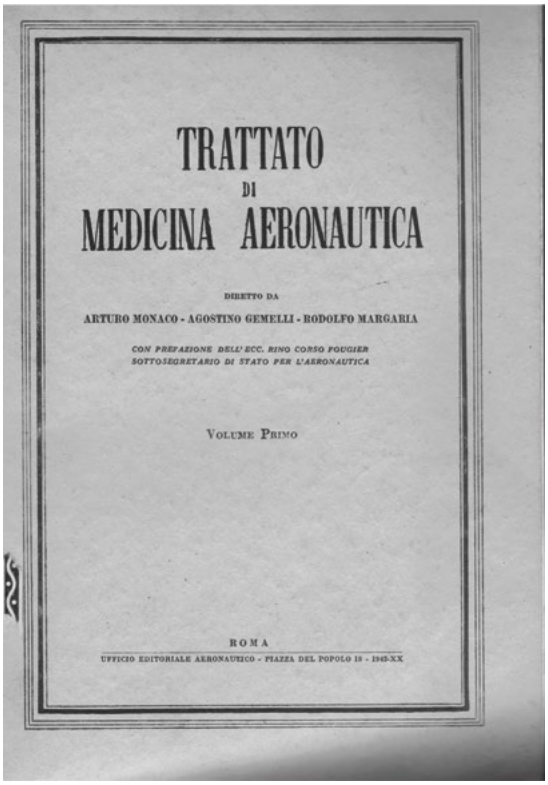

TRATTATO
DI
MEDICINA AERONAUTICA
DIRETTO DA
ARTURO MONACO - AGOSTINO GEMELLI - RODOLFO MARGARIA
CON PREFAZIONE DELL'ECC. RINO CORSO FOUGIER
SOTTOSEGRETARIO DI STATO PER L'AERONAUTICA
VOLUME PRIMO
ROMA
UFFICIO EDITORIALE AERONAUTICO - PIAZZA DEL POPOLO 18 - 1942-XX

Figure 18 "Trattato di Medicina Aeronautica",1942, edited by Arturo Monaco

G. Bilancioni on the "Manuale di Oto-Rino-Laringoiatria" (Figure 19) dedicates 33 pages to the functional hearing test no mentioning the use of the audiometer (Bilancioni 1930) ; also in the third edition of the famous treatise by Salvatore Citelli of 1936 (Citelli 1936) (Figure 20), there is no mention of the audiometric exam. In this sense, it is interesting, for example, to compare the 1930 edition of "Otolaryngology Semeiotics" by Dr Khayel (Michele) Arslan with that of 1939 (Figure 21-22).

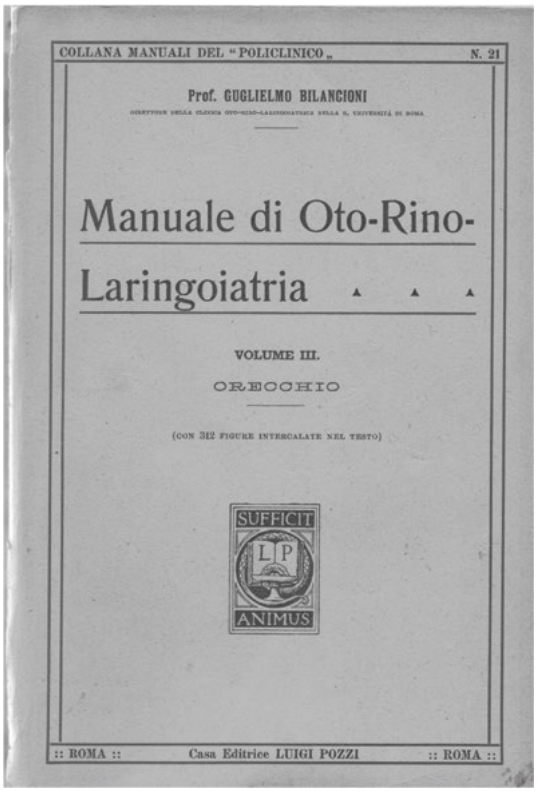


Figure 19 Guglielmo Bilancioni, "Manuale di Oto-Rino-Laringoiatria" Luigi Pozzi, Roma 1930

Figure 20 "Malattie dell'orecchio" edited by Salvatore Citelli, UTET 1939

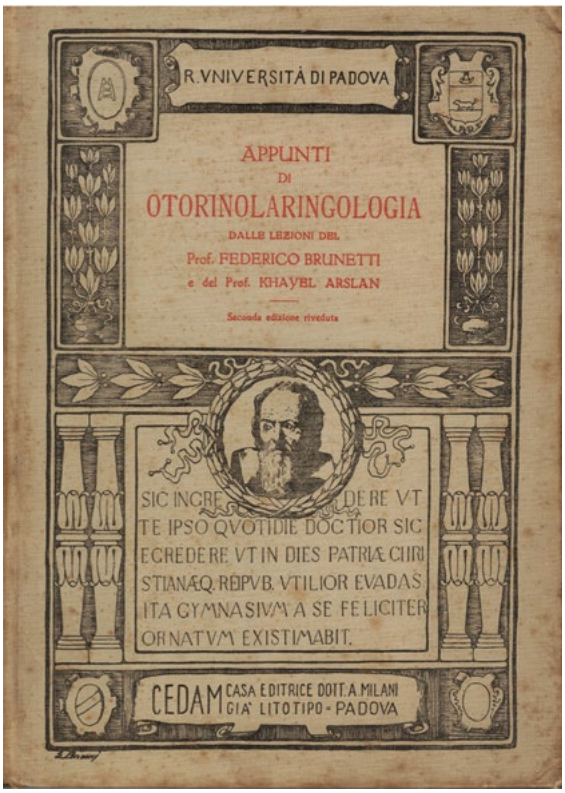


Figure 21 "Otolaryngology Semeiotics", F. Brunetti and K. Arslan

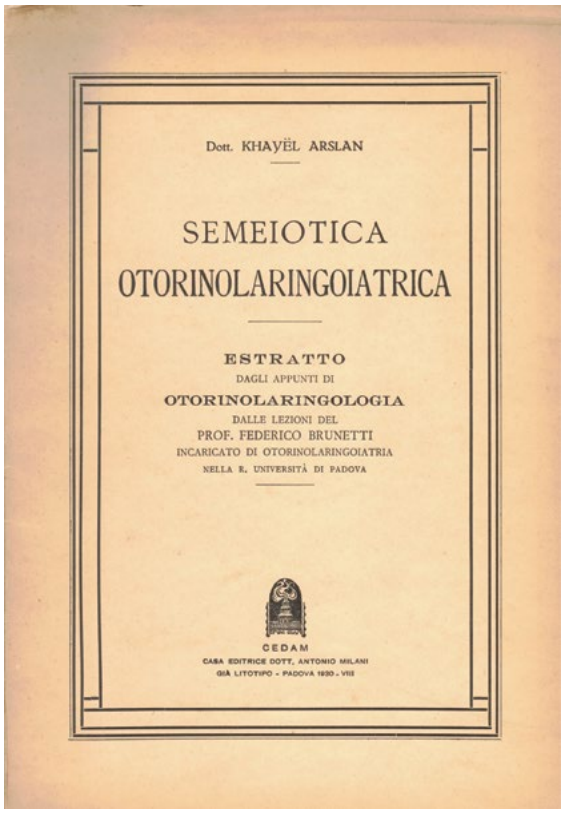


Figure 22 "Semeiotica Otorinolaringoiatrica", F. Brunetti and K. Arslan

The paragraph about the examination of the acoustic function, discussed the possibility of quantitative analysis (determining at what distance the subject hears the human voice, ticking of the clock, or constant noises obtained with Politzer's acumeter) and the possibility of qualitative analysis using the tones (obtained with tuning forks, Galton's whistle, Struycken-Schaefer's monochord). In the 1939 edition, the audiometer was added to point d) described as a device which exploits the properties of tone production by oscillating circuits and which in construction comes close to audio-receiving devices, allows all the tones of the audible tonal scale (and therefore not only "do" as it is obtained with the tuning forks) with variable intensity. Therefore it realizes, in a certain sense, the possibility of a quantitative analysis. The results of the examination of the acoustic function are fixed in figures, expressing the length in cm (for quantitative analysis) or the time in minutes seconds of hearing the series of tuning forks (for qualitative analysis). The results obtained with the audiometer are expressed instead with a particular graphic, called audiogram, which is similar to the visual field, used in the semiotics of the visual function.

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