DEAFNESS IN CHILDREN

Thursday, June 20th

WITH Professor Victor LAMBERT in the chair Professor Sir Alexander EWING (G.B.) opened a session on Deafness in Children. He felt there was a need for a further, new orientation of our thinking and provision of facilities for all children diagnosed as suffering from chronic and established defects of auditory function. He believed the need was urgent. His paper described recent work carried out in his Department at Manchester on the use of high fidelity amplification by children, on the adverse effect of ambient noise on the use of monaural hearing aids, and on amplification as a means of establishing auditory feed-back in children with severe perceptive deafness. A high fidelity aid gives equally great amplification at frequencies above 2,500 cycles up to 6,000 cycles, a region which includes much sound energy of consonants such as "S" and some of that of the vowels.

A group of 37 children in a school for the partially deaf had their hearing ability for speech tested when using high fidelity amplification and the results were compared with the hearing when using their own aids in an ordinary quiet schoolroom and in the same room with a background of noise at 60 db. above threshold. Most of the children had average hearing losses of between 50 db. and 90 db. With high fidelity amplification 18 of the 37 children scored 60 per cent. out of a possible 100 per cent. of the word lists. With body worn aids in a quiet schoolroom only four of the children scored over 60 per cent. and in a noisy schoolroom only one child scored over 60 per cent. Spectrographic analysis of speech had shown that normal classroom noise greatly distorted vowel formants and consonant envelopes reproduced by wearable hearing aids. It was doubtful if too much information was ever conveyed by the sound patterns of speech to children with defective hearing. His survey had shown that even partially deaf children were significantly backward in the size of their vocabularies and the range of their general knowledge.

In a normal infant, speech began with spontaneous vocalizations which he heard himself utter. These sounds developed into a vocal language by the child learning to adjust his utterances to the sound patterns of adult language which he heard. The establishment of this voice-to-ear link was essential to the deaf child from a very early age. The most recent model of high fidelity hearing aid used for speech and auditory training

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had two microphones, the second one being worn by the child so that he could hear his own voice. The speaker then described the hearing losses and progress in speech training of six pre-school-age children and six pupils in a school for the deaf who had been taught with the help of high fidelity amplification and auditory feed back. All had obviously made very satisfactory progress.

The question was asked whether binaural hearing aids would enable the infant or young child to localize the source of sounds and co-ordinate hearing with vision which in the normal infant develops by the age of seven to nine months. The speaker could not answer this question.

Mr. GAVIN LIVINGSTONE (G.B.) read a paper on the Assessment and Management of the Child with Perceptive Hearing Loss. He reminded the Conference that there were about 800,000 live births in England and Wales each year and $3\frac{1}{2}$ million children under the age of five years. Of these approximately one in every thousand had a loss of hearing severe enough to need special training. This meant that there were between 3,500 and 7,000 children under five who were handicapped by impaired hearing. The present-day trends in the management of deaf babies hinged on the following points:

1. The importance of the ability to use words and language for communication. Non-attainment of this ability resulted in frustration and psychological stunting.
2. The hearing child usually spoke fluently by four years, often earlier, and speech habits were fixed by the age of five or six. These habits were very difficult to alter after that age.
3. The impulse for the spontaneous learning of speech was at its peak between three to four years and Michael Reed had suggested that the optimum period for learning to hear was during the first year.
4. Lack of opportunity to learn at this critical time may cause delay or failure in speech development.
5. Nearly all deaf children were born with some residual hearing. Recent Danish figures showed that only 4 per cent. of all deaf children had no response to sound.

Thus in order to give a deaf child his best chance of learning words and language it was necessary to train his residual hearing and expose him to as much correct sound as possible during those early critical years. Ideally, therefore, hearing loss must be found or suspected and treatment should commence within the first 6 months of life. Alleviation of the handicap must take precedence over accurate diagnosis because the time factor was so important. Although the cause was unknown in 30 per cent. of babies born deaf, it was becoming possible within the organization of the British National Health Service and the Local Health Authorities to

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specially examine those babies exposed to the known causative factors of deafness. It was suggested that a "follow-up" or "At Risk" Register should be kept by the Local Health Authorities and to ensure that a special watch should be kept during the early years of life. Part of the answer to the problem of finding handicapped babies would need the publicizing of the factors which caused these abnormalities and stressing the vital importance of early treatment. Although not all babies "At Risk" would be found to have congenital abnormalities, there was a 14 times greater chance of finding deafness amongst this group. Four factors stood out in the list of known congenital causes: genetics, virus infections, anoxia of the pregnant mother and child and the effect of bilirubin released in the blood stream. The speaker referred to the list of factors causing congenital abnormalities suggested by Dr. Mary Sheridan and grouped under the headings of family history, pre-natal, peri-natal, post-natal and symptomatic after birth.

"At Risk" babies should have their hearing tested at least three times; firstly between the age of 6 to 10 months, again between 2 and 3 years and thirdly about 6 months before school entrance. It was important that one of the preliminary examinations should be conducted by a doctor as the possibility of multiple lesions was great. When deafness was suspected, examination by an otologist should be held in a special assessment clinic where the services of a trained teacher of the deaf, a psychologist, and a medical social worker and hearing aid technicians were available. The methods of testing hearing must be suited to the child's age, bearing in mind that for the normal child awareness of meaningful sounds gradually expands from $1\frac{1}{2}$ feet at 6 months up to 12 feet by $2\frac{1}{2}$ years. If any doubt of the child's hearing capacity arose, a hearing aid should be fitted and auditory training commenced. Two hearing aids should be fitted and for some children, such as spastics, ear level aids were more convenient. Ear moulds may need frequent renewal as there was great variation in the rate of growth up to the age of 9 years when adult size was reached. The teacher of the deaf was an important member of the team and was not only responsibly for auditory training and formal education but had a large part to play in assessment, parent guidance, pre-school training, follow-up after leaving school and even working with the elderly deaf. In places where there were no facilities for formal auditory training, it was the duty of the Otologist to ensure that someone became responsible for the needs of the deaf child. In Great Britain the local authorities were required by law to provide education for children with severe hearing loss from the age of two, if the parents requested it. Opinion was changing as to the advisability of segregating deaf children in the company of others as badly handicapped as themselves. Effective treatment now enabled many children formerly thought to be totally deaf to be successfully educated in Partially Hearing Units situated in normal hearing schools, and the principle should be applied whenever possible.

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Miss E. WHETNALL (G.B.) described the advantage of binaural hearing and the value to the deaf child of using two hearing aids when possible. Just as it was an exception for the ophthalmologist to prescribe a monocle for binocular visual defect, so it was equally unusual for an otologist to recommend a stereophonic hearing aid. When two ears were tested together the results were always better than when each ear was tested alone, sometimes surprisingly so. Investigations had shown that the threshold of binaural hearing for pure tones was 3 db. lower than that for monaural hearing. The clinical experience of Carhart and also of Bergman showed that binaural hearing aid users turned up the volume control of the remaining aid if one was turned off. Furthermore, the user found less effort was required for comfortable listening. Another advantage of binaural hearing was the ability to localize the direction from which a sound arrived. At 6 to 8 months, the normal infant would turn and localize sounds long before he could hold his head up. This did not depend on learning and was probably a function of the mid brain. Many deaf children when first fitted with two aids would immediately localize the direction of sound without need for a period of learning. The ability to localize sound was important for the understanding of complex sounds, especially speech, and enabled differentiation of foreground and background sounds. Two independent neural channels were necessary for the recognition of competing sounds arriving from different sources and although capacity was limited, each channel had a repository or parking place where extra events could be stored until the higher centres could deal with them. For the one-eared person, understanding speech in noisy places was difficult nor was it easy to follow a complex conversation between several people, as two remarks could not be sorted out at the same time. Even the younger child had been observed to obtain benefit from wearing two aids or even one aid with two ear phones jointed with a Y lead. Not only did he prefer to use both on all occasions because it was easier to hear but there was more rapid progress in the comprehension of speech and in the quality of his speech. The child's personality improved, the musical child could pick out notes and instruments whilst listening to music and the level of background noise appeared less. Ear level aids were more suitable for binaural hearing because the pick-up points of sounds were roughly equivalent to the normal ears. However the amount of amplification might not be adequate in the severely deaf child nor in the infant where sounds had to be between 10 db. and 15 db. louder than later, when they had been learnt. Loudness could then be reduced, possibly to the extent that ear level aids would give adequate amplification. Experience had shown that children found the aids easy to wear and did not fall off when playing games.

In the first year of life there was a "period of readiness to listen" and it was important that two aids should be worn during this time.

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In the speaker's experience, children with hearing losses of greater than 80 db., children where the diagnosis of deafness had been made later, unequal loss of hearing in the two ears, the presence of recruitment (a high incidence is found in rubella cases), and children attending normal school who were unable to make progress because of noise in a large class, all these made better progress if fitted with two aids. Some further evidence of the advantage of two ears was shown in a study of binaural speech audiometery carried out on 20 children. The apparatus was built on the lines of that designed by Groen in that there were two separate channels either of which could be modified. In every case tested the binaural speech threshold improved. Although slight in three cases, in another three there was a 15 db. shift at the 50 per cent. score level. The improvement occurred irrespective of whether the type of hearing loss was flat or mainly for the high frequencies. The study confirmed earlier findings about the lessening of recruitment. Summation occurred even when there was a moderate difference between the two ears on testing monaurally with pure tones and speech. In cases with a very severe hearing loss, binaural hearing brought some cases up to the 50 per cent. score level. There was no doubt about the benefits of wearing two hearing aids and the only reason for not thus fitting every deaf child was the cost. Even here a Y lead was better than an aid with a single lead since summation occurred and both ears were trained to listen and would improve in discrimination. In the speaker's experience, every young child who was able to use two aids preferred them to the use of one.

Professor F. HUIZING (Holland) discussed some Fundamental Aspects in the Modern Treatment of the Deaf Child. Until about 15 years ago a deaf child was considered to be totally deaf and educational treatment depended on the sign method or the oral approach. The introduction of electrical means of amplification made possible the utilization of the remaining hearing function. The fundamental physiological processes which underlay spontaneous speech and language development in the normal hearing child were not widely understood so although adequate amplification in hearing aids had been available, full use had not been made of this new tool. Two different properties were needed in spontaneous speech and language development. One was the attainment of muscular control to produce fluent natural vocalization which also needed peripheral auditory pathways. The other was cerebral functions including auditory memory to obtain skill in discrimination of sound. These functions, absent in the new born, were developed by a feed back system through the ear and resulted in the development of a harmonious modulation of the pitch, loudness and rhythm of the voice. To illustrate these points, the speaker cited three types of hearing which may be found in cases of mutism. In his first type there was a severe loss of hearing above a frequency of 700

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cycles, with a normal hearing for the low tones. Such a child will hear himself babble and will be able to monitor his voice in respect of melody, rhythms and overall amplitude. However the hearing loss for high tones will prevent differentiation of the important speech sounds and therefore he does not acquire speech hearing capacity and, consequently, speech either. In the second type of mutism there was a loss of 70 db. to all tones. Babbling was not heard, monitoring through auditory feed back did not occur and discrimination ability or auditory memory did not develop. It followed that no muscular control of vocalization would be acquired. In the third type of mutism there was normal hearing to all tones. Discriminative ability, auditory memory and a concept of symbols had evolved, as shown by the child's ability to understand simple verbal commands. His lack of speech was therefore due to underdevelopment of the muscular processes of vocalization. A cause for this might be a defect of appreciation of the loudness-rhythms (or time) relationship of speech despite normal appreciation of pitch and normal hearing. This would disturb the detection of the correct variations of the time parameter for more detailed syllable and phoneme recognition.

Referring again to the true deaf mute, e.g. the child with a hearing loss of 70 db. to all tones, the speaker insisted that priority must be given to the provision of a stabilized auditory feed back mechanism. This could be obtained by a wearable aid with a fixed volume control and a constant distance between the microphone and the child's mouth.

The learning of language was a neuro-physiological process and before the age of nine or twelve years the child could as easily learn two or three languages as one. This held also for the deaf child.

Mr. J. C. BALLANTYNE (G.B.), commenting on the previous speakers advocacy of binaural hearing aids, quoted from an unpublished report of March, 1963 by Dr. T. S. Littler to the London County Council's committee on improved hearing aid equipment. 70 school children attending deaf schools were divided into three groups. One group used a single Medresco O.L.57 aid with a Y lead, another group had two Medresco aids and the third group, a limited number of children, were allowed to try both methods. After nine months' trial it was found that 65 per cent. of the children could make more use of their residual hearing by using both ears. They were more alert and co-operative, had less strain in listening and more willing to use two hearing aids than a monaural aid. When given the choice, nearly all of those with an equal hearing loss in the two ears tended to favour the single aid with a Y lead. There was a small number of children with unequal hearing losses who favoured the use of two aids.

Citing the reports of Dr. Kinney (1953 and 1961) the speaker expressed concern at the observation of progressive sensorineural loss found in the ears of a group of 16 children in which aids were worn. In the later report

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the use of more powerful aids had been followed by losses of hearing of up to 25 db. in the used ear. Whilst this had not been the speaker's experience during a period when he had charge of a large number of deaf children, he felt that this was a warning that one should be prepared to change from two aids to a monaural aid if the hearing loss increased.

Referring to the far commoner cases of temporary deafness he said that it was often forgotten, whilst treatment was being carried out, what effect the deafness was having on the child's education and, particularly in the case of the 10 or 12 year old child, how much this retardation could affect the child's future career under the present educational system of this country.

Mr. Kenneth HARRISON (G.B.) discussed middle ear effusion and had found it to be the most common cause of conductive deafness up to the age of adolescence. The condition had been clearly described by Politzer, Schwartze and Hinton almost a hundred years ago. The deafness was variable, sometimes quite slight and unnoticed, and at other times marked and with a hearing loss of 45 to 50 db. He believed the effusion was inflammatory in origin due to obstruction of the pharyngeal portion of the Eustachian tube from enlargement of the adenoids or inflammation of the upper respiratory tract mucosa. He had not found allergy to be a frequent factor. In the earliest stage the tympanic membrane had an almost normal appearance but with a spidery injection of the blood vessels, more evident around the periphery. Later the membrane may have a yellowish colour, may be bulging, thinned and crinkled and may rupture with discharge of fluid. The thinned portion may be confined to the posterior region of the incus and in the attic. Less commonly bubbles may be seen in the fluid behind the drum.

If the effusion persisted after treatment of the nose and pharyngeal conditions and the general health, paracentesis followed by aspiration of the fluid was performed. The fluid was yellowish in colour and either watery or semitransparent, sticky and gluelike. In some cases it was so thick that an additional opening in front of the malleus or a tympanotomy was needed in order to remove it completely. In some cases the effusion persisted and a cortical mastoidectomy was performed, revealing small cells filled with pale œdematous granulations. Advising the temporary use of a hearing aid the speaker felt reasonably confident that the mild and moderate cases resolved at adolescence with a return to normal hearing.

Mr. T. A. CLARKE (G.B.) expressed the hope that, after the views expressed by the previous speakers, there would not be the same difficulties in obtaining the right hearing aid (or aids) for deaf children. He felt that the case for the oral method of education in all cases had not

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been proved. He hoped that some method would be developed which would recognize those children who would not succeed with oral methods of instruction only. Referring to children with conductive deafness, he said that treatments such as removal of the adenoids should be carried out within a few weeks and that they should not have to wait as long as the child with recurrent tonsillitis who would come to no harm. He stressed that these children should be followed up for periods of up to 2 years.

Dr. Theo. WALSH (U.S.A.) referring to middle-ear effusions as "fluid" ears or "glue" ears, considered that the condition was more prevalent since the use of antibiotics which relieved pain but left the ears filled with fluid.

Mr. A. MARTIN (Uganda) stated that perceptive deafness occurred in African children as in this country, with the exception that rhesus incompatibility did not occur in the native. Meningitis was a common cause and recently he had seen many cases when encephalitis was suspected. Education for the deaf child was severely limited by lack of funds and teachers and the problem of the many languages spoken in Uganda alone would be very difficult to solve.

Dr. APTE (India) had also seen many cases of middle-ear effusion in India and treatment there was carried out on the same lines as in this country.

Mr. K. MAYALL (G.B.) had found a high proportion of his cases of middle-ear effusion were cured by irrigation of the nasal sinuses where infection was frequently found. He considered that the large turbinates so often seen in these children were more often infective than allergic in origin.

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