THE WORKING OF A HEARING-AID CLINIC

BY

R. SCOTT STEVENSON, M.D., F.R.C.S.Ed.

Surgeon, Metropolitan Ear, Nose and Throat Hospital

The earliest hearing-aid was probably the hand held behind the ear, and ear trumpets and tubes go back at least 250 years. Non-electric aids, such as ear trumpets and auricles, magnify only to a slight extent—about 15 decibels—but this can be surprisingly helpful, especially to an elderly deaf person afraid of the mechanics of an electric aid. The first electric hearing-aid, which was in essentials a portable telephone, was made in 1898 in America by the Dictagraph Company; this was a micro-telephone type of aid which worked from a single low-tension battery and generally had a carbon granule microphone with a hard or soft carbon diaphragm. The micro-telephone apparatus was quite convenient to carry about, but amplification was confined to the lower notes, and so it was useful only to cases of conductive ("middle-ear") deafness and not to cases of perceptive ("nerve") deafness. In 1934 a new phase in the development of hearing-aids began with the invention in Britain (the Americans copied the idea later) of the radio-valve amplifier, using the 18-mm. type of valve. These instruments, although fairly large—rather like an old-fashioned box camera—were much more efficient than the micro-telephone type, as they could reproduce sounds over a wide frequency range. The year 1938 saw the development of the first real pocket valve-amplifier hearing-aid, employing a fairly large high-tension battery and the usual type of low-tension battery, which had to be carried in separate pockets or in a lady's handbag. During the war of 1939–45 there was a rapid development of new electrical equipment for military purposes, particularly miniature 10-mm. radio valves (used in certain types of fuses) and much smaller batteries with longer life. These lent themselves to incorporation in hearing-aids, which could therefore be made much smaller and yet give the same maximum efficiency. It was at this time that the American hearing-aid manufacturers overtook the British ones, as they were not subject to the same restrictions; but since the war British hearing-aids have recovered the lost ground, and in some cases surpass their American counterparts.

In this country, until quite recent years, the position regarding hearing-aids was a reproach to the medical profession, who were content in cases of intractable deafness to allow a deaf patient to go to one commercial firm after another until he found—or was persuaded that he had found—an aid that appeared to help his hearing. In 1929 the National Institute for the Deaf stepped in to help the deaf by drawing up an approved list of dealers in hearing-aids, who (with a few notorious exceptions) signed an agreement not to canvass, not to publish extravagant and misleading advertisements, to inform a client when no aid appeared likely to help, and to allow a reasonable home trial for a small fee. The Institute was not allowed by law to circulate a black list, nor could its approval of dealers' ethical methods cover approval of the particular hearing-aids which they sold, but it did what it could. In 1930 it set up a research committee in association with the London School of Hygiene and Tropical Medicine, and the late H. M. Wharry carried out investigations at University College Hospital on the value of the micro-telephone hearing-aids then available, employing the 4A gramophone audiometer. Mr. Wharry's preliminary report in 1932 was not followed up after his untimely death, though Dr. G. P. Crowden and the late Dr. Phyllis Tookey Kerridge did some valuable work with deaf school-children and the Medical Research Council published a report on the use of hearing-aids by Dr. and Mrs. Ewing and Mr. T. S. Littler. In 1937 the National Institute for the Deaf stimulated a new advance. At that time the only modern audiometers being used to help in the prescription of hearing-aids were in the hands of commercial firms, and to avoid this a well-wisher offered to present one to the Institute to set up a hearing-aid advice department. It was pointed out, however, by the Institute's Medical Committee that before being tested with an audiometer or trying a hearing-aid a deaf person should

have his ears properly examined, for the deafness might be due to wax or suppurative or be relieved by Eustachian catheterization or other means, and that the suggested clinic should therefore be associated with a hospital.

An Important Service to the Deaf

The Metropolitan Ear, Nose and Throat Hospital started its Hearing-aid Clinic in the spring of 1937 in conjunction with one of the afternoon out-patient clinics. It was soon found to take up an inordinate amount of time, for the hearing-aid cases required special testing of hearing and the careful fitting of instruments, and for this reason it would probably have been dropped altogether but for the enthusiasm of the then almoner (now secretary), Miss Warshaw, who saw in a hearing-aid clinic a means of carrying out an important service to many deaf patients whom the otologists were inclined to dismiss as incurable. Even during the war years the Hearing-aid Clinic never stopped, although the hospital was bombed and its out-patient department was moved temporarily, first to Watford and then to new quarters at Granville Place, W.1. At this period the patients were first examined at the daily out-patient clinics by the honorary aural surgeon in charge, and when a hearing-aid seemed indicated audiometric tests were done by the almoner and suitable hearing-aids tried and fitted by her. For a time an assistant from a reputable firm of hearing-aid dealers came one evening a week to fit hearing-aids to referred patients; but experience proved that this was not a good method of getting an unbiased choice of hearing-aid, and it came to an end after a few months. At the beginning of September, 1945, when the hospital resumed its normal peacetime activities, the Hearing-aid Clinic was reorganized, with a staff of one full-time audiometrician and one trainee.

The Hearing-aid Clinic, which at present occupies four rooms, works to an appointment system, and is open every day from 9.30 a.m. to 5 p.m. (often later), except on Saturdays, when its hours are 9.30 a.m. to 12 noon. Every patient is first interviewed by the almoner and then examined by one of the aural surgeons in his out-patient clinic (unless he brings a recent letter from an otologist), who carries out an investigation of the history of the deafness and the reasons why a hearing-aid is wanted, as well as a routine examination of the ears, nose, and throat, tuning-fork tests, voice and whisper tests, Eustachian catheterization if necessary, and arranges such pathological or x-ray examinations as may be indicated. A deaf patient considered likely to benefit from a hearing-aid is then sent on to the Hearing-aid Clinic, where an audiometric examination is made, one copy of an audiogram being filed and one put with the out-patient case-notes. The rooms used for audiometric examination are ordinarily quiet comfortable rooms with furniture in them, not a specially built bare "silence-room": this is emphasized because we have heard an otologist say that he was going to start a hearing-aid clinic when he could get a silence-room built—which may take a very long time in these days. A deafness research clinic has different objectives and requires different equipment from a hospital hearing-aid clinic—a "silence-room" is necessary at the former but not at the latter.

Training the Audiometrician

At the Metropolitan Ear, Nose and Throat Hospital we have trained our own audiometricians, and are training others. No one can do good audiometry without guidance, without experience, and without knowledge of the methods available and the problems to be met. Hallpike (1948) has said (in an *obiter dictum* at an otological discussion) that "it is not really necessary to create another branch of technical auxiliaries." On the other hand, the American otologists Lederer and Hardy (1946) wrote: "It is not good enough to assign the job [of audiometry] part-time to a medical secretary who knows no more about audiometric testing than to snap switches and turn dials. Every aspect of the work with the hard of hearing suggests the need for respecting the psycho-social behaviour of the patient, and good audiometry is no exception." And Carhart (1946) said that the interviewer who decides whether the patient is to be fitted with an air- or a bone-conduction instrument, and on which ear the aid is to be worn, "obviously must have wide training and experience." Our audiometricians are not taken from the nursing staff: it seems to us a waste, at a time when

there is a shortage of nurses, to assign a trained nurse to this work. They are well-educated (high-school standard) young women drawn to social work, who might, for example, have become hospital almoners or medical secretaries. The course has a duration of six months, and comprises training in making correct and reliable audiometric charts of the various types of deafness, in testing patients for suitability for hearing-aids, and in selecting the appropriate aid for the individual case; it includes attendance at the hospital speech therapy and lip-reading clinics. At the end of their course the students have to pass an examination in the basic principles of anatomy and physiology of the ear, the basic principles of acoustics, the physics of audiometers and hearing-aids and their mechanisms, the psychology of the deaf, the handling of deaf-mute children, and the principles of lip-reading; they must also have an adequate knowledge of medical terminology and of professional ethical conduct. It is stated on the certificate given after examination that the holder is not entitled to examine patients or fit hearing-aids except under the direction of a registered medical practitioner, and that any breach of this condition is contrary to the interests of the patient and will render the certificate liable to cancellation.

Testing by the Audiometer

Hallowell Davis, Stevens, *et al.* (1947) have stated, after extensive investigations, that it is a fallacy that hearing-aids, like eyeglasses, must be "fitted" to the detailed idiosyncrasies of the individual impairment, and that an audiogram does not help greatly in fitting a hearing-aid. We have found, as a result of our experience in the Hearing-aid Clinic, that when an audiometric examination shows a hearing loss of 30 to 40 decibels in the speech frequencies a hearing-aid becomes necessary, and a suitable aid should give a gain in speech reception of at least 50 decibels. The instruments of two years ago were not of much help with a loss of 50 decibels, but those of to-day are helpful in many cases with a loss of as much as 70 decibels. Hallowell Davis and Stevens believe that most deaf patients hear best with an aid that amplifies all the frequencies uniformly, and this conclusion is supported by the M.R.C. Committee on Electro-Acoustics, which found that the best results could be obtained with a uniform amplification of the sounds in the range of speech. We defer to these opinions, but we must say that the experience at our Hearing-aid Clinic is that in most cases either high or low frequencies have to be emphasized in the hearing-aids. It is noticeable that "nerve"-deafness patients, with a higher frequency loss, are often helped—in a way that would have been considered impossible a year or two ago—by modern aids that appear to boost the higher frequencies actually by cutting down the lower frequencies. Many cases that an otologist has diagnosed as "middle-ear" deafness because bone conduction for the 256 and 512 tuning-forks was markedly better than air conduction have been shown by the audiometer to be cases of "nerve" deafness, with marked hearing loss for the higher frequencies. Bone conduction, with masking, must always be tested with the audiometer as well as air conduction, and helps in differential diagnosis.

The audiometer is essential, not so much for the actual "fitting" of the hearing-aid, but as part of the clinical examination that gives the picture, as nearly complete as possible, of a case of deafness, and as a permanent record for later comparison. Audiometers must be regularly tested and correctly calibrated—we have four audiometers in our clinic, and one of them is usually away for calibration, retesting, or repair. In addition there is a gramophone audiometer for testing groups of children, and we have on order a "peep-show" (Dix and Hallpike, 1947, 1948) for testing the hearing of very young children.

There are now three full-time audiometricians in the Hearing-aid Clinic, and each tests the hearing and fits the patient with a suitable hearing-aid. The clinic has a "library" of hearing-aids, only those manufactured by firms on the "approved list" of the National Institute for the Deaf being included, though new instruments not on the list are tried out. The firms invited freely lend their latest instruments (we have had only one refusal, and one firm was excluded because it would not allow a discount for hospital patients), which comprise Acousticon, Amplivox, Auratone, Belclere, Bonochord, Compensator,

Multitone, and Sonotone, several types of each being available. In addition there is a large variety of non-electrical instruments, comprising single and double auricles, ear-shells, speaking-tubes, and banjo-type, bell-type, cup-type, swan-type, and expandible trumpets.

The Fitting of Hearing-aids

The patient who comes to a hearing-aid clinic wants, above all, to hear and understand the human voice; other sounds, such as music or the door-bell or the general sounds around, are less important to the average deaf person. Speech should be intelligible but not uncomfortably loud, and if possible should have a "natural" quality. The frequencies necessary for the comprehension of speech range between about 250 and 4,000 cycles per second. It is not necessary for a hearing-aid, therefore, to provide for all the audible frequencies, but if they are cut off at 3,000 some consonants, such as *f*, *s*, and *t*, are inaudible and speech is difficult to understand; when cut off at 2,000 speech is incomprehensible. In fitting hearing-aids the audiometrician speaks sentences to the patient containing first words that are low in pitch (e.g., *wall*, *hole*), then of medium pitch (e.g., *king*, *name*), and lastly high in pitch (e.g., *bit*, *face*). Words are also spoken faintly and then loudly, and the volume control of the instrument is checked. When the patient has decided which instrument to take on trial, the audiometrician, by causing extraneous noises, shows him how to concentrate on hearing what he wants to hear and to ignore the extraneous sounds. He is told to wear the instrument at first only at home and not in the street, to get accustomed first to the new sounds of familiar persons and surroundings, and only gradually to be introduced to stranger and unexpected sounds.

All existing modern hearing-aids are basically similar; there are innumerable minor differences, but the electrical instruments used in the Hearing-aid Clinic all consist essentially of a microphone, an amplifier, and a receiver. Engineering compromises are unavoidable in the design and construction of a hearing-aid, for the objectives of low cost and light weight are definitely opposed to the objectives of high fidelity, high amplification, adequate power output, and long battery life. In the United States and Canada no deaf person now thinks of using any receiver other than a midget telephone receiver fitted snugly into the external auditory meatus with a moulded plastic insert; our experience is that the disk-type of receiver, with head-band, is more efficient than the moulded insert receiver, but because it is uglier and more uncomfortable nearly all the patients at the clinic demand the plastic moulded insert, and the audiometricians are instructed in making individual moulds. Bone-conduction receivers, which were popular with carbon microphone aids, have only a limited use with the valve type of instrument; this is because they give poor reproduction of sounds above 2,000 cycles per second and because a relatively higher electrical power is needed as compared with the ordinary receiver. Nevertheless a small number of deaf patients with good bone conduction do find that a suitable bone-conduction receiver (there are three types) applied to the mastoid gives a better result than a disk or insert receiver.

Secondary considerations are important to the patient: the instrument should not be too expensive either in initial outlay or in upkeep; it should be small and light in weight, easy to manipulate, comfortable to wear; and repair and replacement service and a supply of batteries should be reasonably available. Although hearing-aids are basically similar in their mechanism, it is surprising how a patient will pick out one particular instrument as much more suitable to him than any of the others—sometimes because of qualities that appear bad to the audiometrician, such as a raucous tone that "gets through" to him, or because an instrument is the most expensive (not the cheapest), or even because he prefers the colour of the case. The patient's work has to be taken into consideration—professional, clerical, manual, home duties, and also whether a portable aid is really necessary. The audiometricians are instructed, while giving every help in choosing the most suitable aid, to leave the final choice to the patient; it is bad psychology to appear to force any particular aid on the patient even when it seems to the audiometrician the most suitable; and, in addition, comfort in hearing is as important in making a choice as is clearness.

A "difficult" patient may be referred to the medical psychologist associated with the Hearing-aid Clinic, Dr. Hilda Weber, who also instructs and advises the audiometricians on the psychology of the deaf and on the proper approach to their problems; sometimes the psychiatrist on the staff of the hospital, Dr. Kenneth Hazell, is called in to help. It is a rule that all patients who have been fitted with a hearing-aid must be referred to the teacher of lip-reading or speech-reading on the staff of the hospital, Miss Sylvian Martin, who has two clinics weekly. Speech correction and lip-reading are essential auxiliaries to the hearing-aid—60% of words may be understood by the use of a hearing-aid alone, but up to 90% by combined hearing-aid and lip-reading. Older persons unfortunately find lip-reading more difficult to learn than do young people.

Grants to the Deaf

When an electrical aid is required and has been chosen the patient is carefully instructed in how to wear and how to use it; the type is then approved by the aural surgeon in charge of the case and the patient takes a note to the manufacturer, who supplies the specified aid on a week's (sometimes a fortnight's) trial. At the end of a week the patient returns and reports progress to the aural surgeon, consults the audiometrician about any difficulties in using the instrument, and then sees the almoner again with regard to its purchase. The manufacturers on the hospital list all allow a discount of 25% (15% on certain instruments), and the almoner assists the patient with advice about obtaining grants-in-aid. Some Approved Societies give grants, as do the Hospital Saving Association and other voluntary contributory schemes. The Royal Surgical Aid Society may give a grant, but "letters" from subscribers have to be obtained; the Hospital Saturday Fund, Church funds, and the Gentlemen's Aid Society may help with grants; and some commercial firms or employees' organizations make grants from their benevolent funds—the railway-workers and printers' organizations have been particularly good. Some City companies, such as the Vintners, Curriers, and Clothworkers, have been helpful in giving grants in certain cases, and the Goldsmiths Company in particular has helped to provide many hearing-aids for Londoners through its fund, administered by the National Institute for the Deaf. Deaf-blind patients get help through the blind organizations; children suitable for hearing-aids can obtain them free through the educational authorities; and the Assistance Board gives grants in special cases. It is claimed by the hospital almoner that no patient requiring a hearing-aid has ever had to go without it on financial grounds. When the instrument has been purchased the patient is given careful instructions on how to look after it. All patients are seen again at the clinic after three months, and retested with the audiometer; in almost every case the hearing has been found to have improved owing to the stimulative effect of a suitable aid and to the improvement in the psychological outlook.

Some Results

The time taken up by each patient at the Hearing-aid Clinic, including preliminary examination, audiometric examination, and fitting with a hearing-aid, varies from one to two hours—certainly no patient ever takes less than an hour altogether. In spite of this, and of the care taken in fitting aids, an unexpectedly high proportion of the hearing-aids are returned after the week's trial. It was primarily to help reduce this wastage that a medical psychologist was attached to the Hearing-aid Clinic.

The reasons that are given for returning a hearing-aid vary: "Found it a nuisance"—did not switch it on and off as instructed; "Dared not wear it at work—would get the sack"; "Did not want to let everyone know I was deaf"—as if people wouldn't know already; "Too old to cope"; "Could not hear when several people were talking"—needed education in listening; "Could not hear in church or at the pictures"—difficulties of acoustics explained; "Felt everyone was looking at me"—further lesson given in wearing modern aid; "Anything on or in the ears worried me"; "Too dear to buy," "Too expensive to run"—in spite of help from the almoner; "Difficulty in obtaining suitable batteries"—this should have been only temporary; "Didn't think it worth the money"; "Wanted

rather to have an operation to cure my deafness"; "Prefer to wait for the Government aid"—especially during the past six months.

In 1946, 355 electrical hearing-aids were recommended at the Clinic, and 170 of them were returned; 120 non-electrical aids were recommended, and 62 of them were returned. In 1947, 778 electrical aids were recommended, and 256 of them were returned; 53 non-electrical aids were recommended, and 28 of them were returned. It will be noted that the proportion of non-electrical to electrical aids has greatly diminished in the past year, and the reason for this seems to be the improvements in the valve-amplifier aids, which have made them more suitable for cases of "nerve" deafness. It has been suggested that the chief reason for the return of hearing-aids is their expense, and that the advent of the Government free hearing-aid will wipe out this wastage; but an endeavour has been made to show that the financial factor has not been an important difficulty in regard to the provision of hearing-aids in suitable cases, and when the Government aid is available lack of choice may well be an additional factor in patients returning (or giving up using) hearing-aids. This wastage at our Hearing-aid Clinic has given us a certain amount of sympathy with the commercial dealers, who have argued that insistence on a preliminary trial has increased their costs and immobilized a large proportion of their stock of instruments.

There is no doubt that more time should be spent—if only it could be spared—on training patients to get accustomed to the selected hearing-aid and in listening to different sounds (songs, orchestral music, voices) and to different individuals and groups. We envy the United States War Veterans' Organization when we read that *five weeks* are spent in residence at Deshon, Philadelphia, and similar centres in selecting hearing-aids and training the patients to use them properly—with the result that only 5% of the instruments are returned.

Conclusions

The modern valve-amplifier hearing-aid has improved greatly in the past two years, and is able to help many cases of perceptive ("nerve") deafness as well as most cases of conductive ("middle-ear") deafness. It will probably be a still better instrument within the next five years.

The provision of a suitable hearing-aid is only part of the rehabilitation of a deaf person, and adequate training in its proper use is necessary. Training in lip-reading should always be combined with the use of a hearing-aid, and "difficult" deaf patients are often helped by a medical psychologist. Every hospital ear, nose, and throat department should be associated with a hearing-aid clinic—of which at present there are only 19 in Britain, and some of these consist in a hearing-aid dealer making periodical visits.

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The Ministry of Labour and National Service, in conjunction with the Ministry of Health, is sending three mobile nursing exhibition vans on tour in different parts of the country to encourage recruitment to the nursing and midwifery professions. The vans are fitted out partly as an exhibition with photographs, a nursing panorama, a skylight view into a model operating theatre, and a display of surgical instruments, and partly as an interviewing room in which persons interested—young people, parents, teachers, and others—may ask about pre-nursing courses, opportunities for training, salaries, or other points about nursing and midwifery. A technical nursing officer of the Ministry of Labour will be available to give advice and information.