DEFECTIVE HEARING AS A NATIONAL PROBLEM*

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I conceive it to be my duty in this opening paper to make it clear in what respects defective hearing is of national significance, to define the scope of our deliberations, and to indicate, in outline only, the many and varied aspects of the problem which will be dealt with in detail by those who have come here to-day to give to us the knowledge and information they have acquired by special study and experience.

Man is dependent on his special senses for his awareness of his environment and his appreciation of his fellow men, for the possession of sensitive and delicately balanced sense organs linked with the central nervous system enables him to pick up and interpret the varied physical stimuli of the external world, and to react in a way which we describe as normal. If his organs of reception of stimuli are less sensitive than those of his fellows he is at a disadvantage in the struggle for existence, the handicap being particularly severe if the special senses of hearing and vision are involved. Advances in medicine and surgery, the application of physics to the study of defective vision, and the routine inspection and care of the vision of the school child, have reduced the individual and national handicap of visual defects very markedly. The same, however, cannot yet be said of defective hearing, and therefore the Section of Medical Sociology of the British Medical Association is giving this subject special consideration in the hope that the lines of progress towards a solution of the problem will become clear, and that professional and public interest will be aroused to take action for the good of individual sufferers and of the nation as a whole.

At the outset, lest there be any misunderstanding, I must make it quite clear that the special question of the congenitally deaf does not fall within the scope of our deliberations, since this has been given, and is receiving, careful and detailed attention and study by those authorities and individuals who have made it their life-work to help such unfortunate sufferers. It is, however, our duty to concern ourselves with the problems which arise when we consider the incidence, causes, and individual handicap of acquired deafness and defective hearing; to appreciate the grave significance of the problem as a whole to the nation, and to define, if possible, ways and means and methods of prevention and alleviation.

While it has been computed^{1 2} that in Great Britain there are at the present time approximately 40,000 totally deaf, the number of individual adults and children suffering from acquired deafness or defective hearing in one or both ears, and described as the deafened, the partially deaf, or the hard of hearing, is largely a matter of conjecture. We should not, I think, be underestimating the number if we placed it at 2,500,000, for reasons which I hope to make clear when dealing with the question of the detection, assessment, and incidence of defective hearing. It must not be assumed, however, that every man, woman, or child among these two and a half millions is seriously handicapped in everyday life, employment, or education by inability to hear satisfactorily. Many of them have impaired hearing in one ear only; others have such minor degrees of deafness that they themselves do not notice it; while in certain cases—for example, in some noisy trades—it may be a positive advantage to the worker to

be in a measure deaf to noises which cause distress to others with normal hearing. It is true, nevertheless, that a very large number of adults and children are severely handicapped by acquired deafness, which tends to isolate them more and more from their fellows according to the severity of the condition, to hinder them when seeking employment, and, in the case of the child of school and pre-school age, not only to interfere with educational progress, but to retard or prevent the development of normal speech.

It is clear even from this very brief examination of the position of the partially deaf that special problems of social life, education, and employment have to be faced, studied, and dealt with in detail in any comprehensive scheme for the lessening of the handicap to the individual. However, were our deliberations limited to the consideration of the hardship to the individual directly due to impairment of hearing function alone we should fail to see the wood for the trees, and should lose sight of that aspect of the subject which appears to me to be of grave national importance—I refer to the fact that in the majority of cases the cause of defective hearing is disease. In studying acquired deafness we are at once confronted with problems of disease, and in the interests of the health of the nation, therefore, it is essential that the subject should be approached from the points of view of both preventive and curative medicine.

The National Aspect

One has only to consult the statistics that are available for the routine medical inspection of recruits for the Services, and consider the causes of subsequent discharge of men from the Army during training, to become convinced of the seriousness of the present state of the health and physical fitness of the young manhood of the nation, and to have driven home to one's mind the grave significance to health of the widespread incidence of conditions of disease which find their first outward expression in impairment of hearing function in one or both ears. Five years ago I made inquiries into the causes of rejection of recruits for the Army, and consulted the official reports on the health of the Army which are compiled every year by the War Office authorities. It was a matter of some surprise to find that the chief single medical cause of rejection of men applying for service was old and current middle-ear disease. At that time the ratio of rejections per 1,000 men medically examined was 41.38, and the following table, taken from the Report on the Health of the Army for the year 1932, shows that in recent years the ratio of rejections for middle-ear disease, including deafness, has increased to over 50 per 1,000, while these same conditions head the list of causes of discharge within six months of enlistment.

Principal Medical Causes of Rejection and Discharge of Men from the Army during 1931-2 and 1930-1³

Diseases	1931-2		1930-1	
	Ratio per 1,000 Rejected on Examination	Ratio per 1,000 Discharged within Six Months of Enlistment	Ratio per 1,000 Rejected on Examination	Ratio per 1,000 Discharged within Six Months of Enlistment
Diseases of middle-ear (including deafness)	51.20	5.24	53.97	5.53
Defects of lower extremities	41.90	2.46	38.48	2.0
Loss or decay of many teeth	43.24	2.18	35.04	1.50
Insufficient weight	28.77	0.15	26.57	0.22
Other diseases of heart	27.01	0.90	25.36	0.77
Defective vision ...	24.26	1.70	21.74	1.50
Valvular disease of heart	18.98	0.68	17.53	0.70
Flat feet ...	20.81	1.12	15.48	1.08

* Read in opening a discussion in the Section of Medical Sociology at the Annual Meeting of the British Medical Association, Bournemouth, 1934.

The strain of Army training is not great, and, provided the individual is physically fit, the benefit which should be derived from such training is enormous. On the other hand, if some infection is sapping his strength, the recruit will prove unable to profit from the regular life, physical training, and open-air conditions associated with the healthy environment and life of the soldier in peace time; while on active service it has been found that men suffering from middle-ear disease are extremely liable to fall sick. In fact it has been proved to be a bad investment to enroll anyone showing evidence of middle-ear disease or defective hearing, although in civil life even such obvious evidence of infection as discharging ears is apt to be lightly regarded by individuals themselves, and, I regret to say, even by parents.

Reliable figures in respect of the state of physical fitness of the general population are not readily available, and it is therefore very fortunate indeed that the data obtained in the systematic and searching examinations carried out by the Services are published in their annual reports by His Majesty's Stationery Office. In 1928, out of 53,075 applicants for service in the Army, 2,568 were rejected as physically unfit on account of diseases of the middle ear and deafness. In 1932, 54,159 men were examined and 2,993 rejected for the same reason, while a further 290 were discharged as unfit on these grounds within six months of enlistment. It is apparent, therefore, that, even among the young men of the nation, between 5 and 6 per cent. show definite evidence of diseases which are associated with impairment of the hearing mechanism, and that these conditions constitute a major cause of physical disability in the nation.

I have emphasized this, the national aspect of the problem of defective hearing because, in the face of the indisputable evidence quoted from official sources, it is abundantly clear that the subject merits the immediate and closest attention of those who are concerned with the nation's health.

Causes of Defective Hearing

Although disease must be recognized as the principal cause of defective hearing, it must also be borne in mind that cases of material hardship due to acquired deafness without impairment of health are not uncommon among certain classes of industrial workers—for example, boiler-makers, in whom bilateral defective hearing is directly attributable to the nature of their employment. To a lesser degree also accidental injury to the hearing apparatus is a cause of deafness, but unless both ears are damaged the individual handicap is slight, and common experience teaches that in later years all of us must expect a progressive decline in acuity of hearing which, according to the severity of the condition, necessitates correction by appropriate electrical or mechanical aids, the scientific prescription of which is still in a very elementary stage.

From the medical point of view it is the incidence of defective hearing in one or both ears associated with conditions of disease which is significant. In the individual child of school age it is the presence of bilateral defects of hearing of varying degrees of severity which needs special consideration, for, provided the better ear of the child possesses good hearing, the educational handicap is slight. To the sufferer the health aspect is of first importance, but bilateral impairment of hearing function may occasion social hardship. From the point of view of industry the severity of the defect, the impairment of health, and the nature of the individual's employment are factors which determine the handicap to the worker.

Disease, employment, accident, and advancing age are causes of acquired deafness. Each cause and condition

presents its own peculiar problems of prevention, cure, or correction of the defect, or amelioration of personal handicap according to the individual or group of individuals concerned; and while I propose to deal with prevention in respect to the first and second of these causes, I am leaving it for those who follow to consider such subjects as medical treatment and care of partially deaf children, education, the correction of hearing defects, and questions of vocational selection and employment.

Prevention of Deafness Due to Disease

Diseases of the internal and middle ear and pathological conditions of the nose and throat predisposing to infection of the hearing mechanism affect the hearing and health of the individual, and therefore the preservation of both must be the objective of any comprehensive scheme of prevention. While the prevention of the occurrence of these pathological conditions may be a matter of great difficulty, the checking of the progressive impairment of hearing and of health by the early detection and appropriate treatment of cases and potential cases has already proved of value.

Before any steps could be taken in the direction of preventing and limiting the ravages of diseases affecting the hearing mechanism, it was essential to know the common age of onset of the pathological conditions in question, and to have a reliable routine method for the detection of the earliest signs of defect. Consideration of the figures given in the Army reports previously referred to led to an examination of the data published in the annual reports of the Chief Medical Officer of the Board of Education, in order to ascertain if the high incidence of defects of hearing and middle-ear disease in young men was present among children of school age. The returns of the routine inspections of school children appeared to show that this was not the case, for in 1928⁴ the incidence of defects of hearing was 4.2 per 1,000 children examined, and of middle-ear disease 5.4. Even when the defects found in special inspections were taken into account the incidence of these conditions in children of school age appeared to be only one-quarter or one-fifth as great as that found among applicants for service in the Army. Was it possible, therefore, that cases of minor impairment of hearing associated with disease in its early stages were passing unnoticed, for it has long been known that the common infections of childhood are frequently followed by middle-ear disease? A very cursory inquiry revealed the probability that, owing to the difficulty of testing accurately the hearing of school children, ear by ear, in the time available and by the methods then in vogue, it was highly probable that a number of children with minor impairment failed to be detected as needing special examination and treatment by the otologist for conditions of potential disease or actual early disease of the hearing mechanism.

Detection of Defective Hearing by Audiometer

On the occasion of the International Physiological Congress in America in 1929, by the courtesy of the Bell Telephone Research Laboratories in New York, I was given the opportunity of inspecting, and witnessing demonstrations of, various types of audiometers which they had developed, and it appeared that the 4A gramophone audiometer was an ideal instrument for the group testing of children and the detection of early signs of deafness. The American research workers introduced me to their English representatives, the American Telephone and Telegraph Co., and the Western Electric Co. in London, who had had one of these audiometers in their possession for a year or so, and who very kindly loaned the instrument for a preliminary test on children in the borough of Hornsey. It was apparent at once that we

could not obtain satisfactory results with a gramophone record of American speech, and on informing the Western Electric Co. of this they arranged for us to make our own record.

By means of the audiometer, speech sounds of known intensities are delivered to the ear by standardized telephone receivers, forty of which may be linked up without any diminution in the intensity of the sound from each. It is possible, therefore, to test the right ears and left ears of as many as forty children at one time, the record being played once for each ear. There is obviously no opportunity for lip-reading, and as the speech sounds used are numbers, which are written down by the child on a prescribed form, no difficulty of spelling is encountered, and a permanent record is made of what the child has heard. Numbers of two or three digits are used, each figure of which is spoken separately—for example, 526 is heard as five-two-six, and each successive group of digits is stepped down in intensity by a known amount. The level at which the child fails to hear and record the numbers accurately gives a gauge of the acuity of hearing for speech sounds. It is possible easily to test the hearing of 100 children per hour in groups of thirty-two or forty, so that as the whole of a class is dealt with at one time in the space of about 15 to 20 minutes, little disturbance of educational routine is occasioned.

Dr. A. H. Gale collaborated with me in the preliminary survey on the elementary school children in the borough of Hornsey, the results of which were published in the *Medical Officer* for September, 1930.⁵ That investigation showed that, by means of the gramophone audiometer, not only were all the known cases of hearing defects picked out, but a very large number of children, unknown to have any defect, also failed to pass the hearing test. Subsequent special examination by Dr. Friel showed that in these new cases there existed conditions which needed treatment. In brief, 6.6 per cent. of the children were found to have defects in one or both ears, as compared with 0.42 per cent. shown in the annual returns for the routine medical inspections of elementary school children. It is true to say that a number of these children had very minor impairment, which would pass unnoticed by the ordinary watch tick, whisper, or voice tests, particularly if conducted in the short time available for the individual in the routine medical inspection of school children. None the less, the cause of the impairment could be detected, diagnosed, and appropriately treated with a high probability of restoring the hearing to normal and eradicating the cause before serious damage had been done or a chronic condition had developed.

Subsequent to the initial inquiry in the elementary schools of the borough of Hornsey, further audiometer tests were carried out in the same area, which substantiated the previous findings. An analysis of the results of tests on 1,368 boys and 1,240 girls—2,608 children in all—ranging in age from 7 to 16, revealed a percentage incidence of defective hearing in one or both ears of 6.8.^{6,7} Independent use of the audiometer by the school medical authorities in the borough of Tottenham,⁸ where 10,000 children have now been tested, and the results of tests in some of the schools of the London County Council all point to the important conclusion that already among children of school age the incidence of defective hearing associated with conditions of disease is as high as that revealed in the medical examination of applicants for service in the Army, and that therefore, to be really effective, measures of prevention must be devised to include children of pre-school age.

From the evidence which has been collected it appears that if the general population of the country were systematically examined for impairment of hearing it

would be found that from 6 to 8 per cent. possess some defect in one or both ears, and that in the majority of cases these defects in young adults or children are directly due to early or chronic conditions of disease. Applying this percentage incidence to the total population of Great Britain, it is apparent that to estimate that two and a half million adults and children have some detectable defect of hearing is not unreasonable. Even if the number were half this figure it would be a formidable task to provide the medical attention which is called for on grounds of the physical disability caused, quite apart from the problems which arise when we consider the lessening of individual handicap.

Prevention of Deafness Due to Employment

It is well known that workers in certain noisy trades—for example, boiler-makers and riveters engaged on ship construction or other work—tend to become deaf, and in a recent investigation for the Industrial Health Research Board⁹ I was able to satisfy myself, by direct observation with the audiometer, that workers of fifteen or more years' standing do tend to develop a bilateral impairment of hearing which in some cases amounts to a material social handicap, though not affecting the man at his job. In employment of this nature, measures for the prevention of defective hearing are not concerned with disease but with the physical characteristics of the environment of the worker at his work; for the continuous noise, the air vibrations, and pressure changes caused by the rhythmic action of the pneumatic tools he uses frequently place too great a strain on the delicate hearing apparatus, with the result that the hearing mechanism ultimately protects itself and the individual by becoming less sensitive to the noises themselves as well as to the sounds which the individual wishes to be able to hear in ordinary life.

Among seventy-six riveters, whose duration of service ranged from about five to forty years, I found thirty-three with defective hearing in both ears. In some of these the impairment for speech sounds was of a severe degree. Among fifty-eight non-riveters, mostly fitters, turners, and machinists at the same shipyard, who had similar lengths of service, only four were found to have bilateral defective hearing. It is clear, therefore, that in the case of riveters we must either protect the hearing apparatus of the individual or control and limit the excessive air vibration and noise in the working environment so that the strain on the hearing mechanism is not too great. In both directions efforts are being made to protect the worker against this cause of deafness—namely, by protecting each ear of the individual by a suitable defender, and using silencers or less noisy tools for the work. Various ear defenders are available, and some of these I have tested under conditions of excessive noise between decks on a boat under construction in H.M. Dockyards at Devonport, and also in the boiler shops of the L.N.E.R. at Stratford. To be of use in practice, any ear-stop or defender must be comfortable to wear for long periods. I place this condition first when we consider work in industry, for unless this is the case, however good a defender may be, the worker will naturally not use it if discomfort or pain is caused. Secondly, it must be easily fitted so as to give good protection; and lastly, it must not be costly, for frequent replacement will prove to be necessary. A very simple ear-stop of cotton-wool and wax, devised by W. R. Luxton, my technical assistant, fulfils all these conditions, and judging by the voluntary use of these stops by riveters, holders-up, and rivet boys, and their appreciation of the protection afforded, I feel sure that the workers in excessively noisy trades would derive material benefit from their systematic use.

Conclusions and Routine Measures of Prevention

In planning any general scheme for the prevention of defective hearing there is one fact of outstanding importance which must be borne in mind—namely, that certain conditions of disease arising in early childhood are commonly associated with very minor impairment of hearing function in one or both ears, and that in later life not only may deafness of severe degree develop, but serious injury to health will result if disease in its early stages is left untreated.

Measures of prevention must therefore be effective during pre-school and school age, for it cannot be too strongly emphasized that the evidence which has accumulated during the past five years proves that in a very large proportion of cases minor defects of hearing are among the earliest detectable signs of the existence of pathological conditions, which may, and in fact often do, remain unnoticed unless attention is drawn to them by refined methods of testing hearing and assessing the hearing acuity of each ear of the child in relation to some reliable physiological range or standard of normality.

The investigation on elementary school children in the borough of Hornsey in 1929-30 proved that the first essential step in prevention, the detection of early cases, could be achieved by the routine use of the gramophone audiometer, and enabled a practical scheme for attacking the problem of defective hearing in both its medical and educational aspects to be defined as follows:^{6 10} (1) detection of cases and measurement of defects by audiometer tests; (2) medical examination and diagnosis; (3) medical or surgical treatment; (4) retesting of each case by audiometer to assess the effects of treatment; (5) decision by medical and educational authorities in regard to the subsequent care of the child.

The experience of the school medical authorities in the borough of Tottenham,⁸ where this routine has been followed for the past three years, is most encouraging, for it has proved both possible and practicable not only successfully to treat a very large proportion of cases of early disease, but to restore hearing to normal in many cases in which the defects were severe. If this can be done in one area among a child population of some 25,000, it can be done generally, and is in fact being done in several other areas, and if our discussion to-day results in stirring the public conscience in the interests of the children of the nation, and in enlisting the co-operation of medical, educational, and scientific authorities, it will not be many years before there will be a material decline in the incidence of defective hearing, a lessening of the handicap to the individual sufferer, and an improvement in the health and fitness of the general population.

REFERENCES

- ¹ *The Problem of the Deaf*, National Institute for the Deaf, 1934.
- ² Eichholz, A.: *A Study of the Deaf in England and Wales* (H.M. Stationery Office, 1932), p. 14.
- ³ Report on the Health of the Army for the Year 1932 (H.M. Stationery Office, 1934), p. 56.
- ⁴ Annual Report of the Chief Medical Officer, Board of Education, 1928 (H.M. Stationery Office, 1929), p. 13.
- ⁵ *Medical Officer*, 1930, p. 113.
- ⁶ *Proc. Roy. Soc. Med.* (Section of Otolaryngology), 1934, xxvii, 26.
- ⁷ *Journ. Laryngol. and Otol.*, 1934, xlix, 247.
- ⁸ Annual Report, School Medical Officer, Tottenham, 1932.
- ⁹ Thirteenth Annual Report, Industrial Health Research Board, 1933, p. 9.
- ¹⁰ *The Teacher of the Deaf*, 1931, p. 75.

The University of Durham College of Medicine has arranged a special post-graduate course to be held at the Royal Victoria Infirmary, Newcastle-upon-Tyne, from September 10th to 21st (Saturday and Sunday excluded), from 9.30 a.m. The course includes demonstrations, etc., at the Babies' Hospital, City Hospital, and Princess Mary Maternity Hospital on the Monday, Tuesday, and Thursday afternoons.

Clinical Memoranda

PRESERVATION OF THE UMBILICUS IN THE RADICAL CURE OF UMBILICAL HERNIAS IN CHILDREN

The radical cure of umbilical hernia is very rarely called for in children, in whom the natural tendency to cure is very great. Nevertheless there remain cases which neither undergo a spontaneous cure nor respond to treatment by a truss, and consequently operation is indicated.

It is customary in this operation to make an elliptical incision around the umbilicus and remove it entirely. Such a procedure leaves an abnormal and unsightly abdomen, and in children especially may result in serious psychical symptoms in time to come. The absence of an umbilicus in a child at school must call for comments from other children which are apt to make the child self-conscious, resulting in its avoidance of all forms of sport in which this part of the body is liable to be exposed—for example, bathing, sun-bathing, and so on. This in time may make the child morose and shy, so that it will shun the society of other children, and this may be the origin of a "repression" which affects its entire existence.

The removal of the umbilicus in this operation is entirely unnecessary, and in the words of Victor Bonney—to whom I am indebted for the suggestion to apply it to this condition—"the best surgery is not only efficient, but constructive and artistic as well." When Bonney requires a long abdominal incision he makes it through the umbilicus in the mid-line, re-forming the umbilicus at the conclusion of the operation. I have applied his technique to the treatment of umbilical hernias in children and have found it entirely successful. He tells me that he has used this incision for a great many years, and has applied it to the treatment of umbilical hernias in adults, in whom, I think, it is very desirable, though not of such great importance as in children.

In cases where the umbilicus has been removed at some previous operation, and in which he has to reopen the abdomen, Bonney leaves a little tab of skin on either side, which is turned in to make a new umbilicus. He has not so far described this technique, but it will appear in the new edition of Berkeley and Bonney's book on *Gynaecological Surgery*, which will be published in the autumn.

Spitzzy's operation is designed to save the umbilicus, but I have not found the results so good as when I have followed Bonney's method. This consists in making a vertical incision in the mid-line which traverses the umbilicus, and dissecting the skin off the sac on either side. The sac is then cleared, removed, the peritoneum closed, and the rectus sheath sutured in the usual way. In suturing the skin of the umbilicus the needle is inserted at one edge, it next passes through the fascia in the mid-line, and finally through the skin on the opposite side. When this suture is tied it draws the skin down to the fascia, and as a consequence the depression of the umbilicus is re-formed as shown in the accompanying photograph. If there is redundant skin, some of it may be removed before the sutures are introduced, provided the line of excision follows the natural contour of the skin.

I would like to express my gratitude to Mr. Victor Bonney for prompting me to publish these notes, and I feel that if this technique is more widely practised removal of the umbilicus will come to be regarded as a surgical crime. I am also indebted to Dr. S. N. Varian, house-physician at the Herefordshire General Hospital, for his excellent photograph.

Hereford.

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