APPENDIX

Average Scores For Various Aspects of the Tracking Task, After Each Alcohol Dose

Performance Variable	Dose 0	Dose 1	Dose 2	Dose 3	Dose 4
Tracking error	227	230	235	246	246
Kerb bumpings	209	255	350	260	359
Inconsistency in tracking	4.82	5.08	5.63	5.78	5.53
Time per lap	403	390	386	393	398
Steering-wheel movement	674	673	690	708	764
Inconsistency in steering-wheel movement	3.61	3.51	3.61	4.03	4.15

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The World Health Organization has published its eighth annual volume of vital statistics of various countries for the year 1955 (699 pp., £3). The number of subjects has been increased in order to make possible a more thorough analysis of the factors influencing public health. In some 700 pages the report includes, in addition to the subjects usually covered, detailed specific death rates, by sex and by age, for the main sites of malignant neoplasms (lungs, digestive organs, breast and genital organs, lymphatic and haematopoietic tissues). It also presents for the first time a type of information previously unobtainable—namely, the distribution of cases of communicable disease by sex and by age. Among some other statistics not previously included are the numbers of health personnel in various countries, hospital establishments, and numbers vaccinated against certain communicable diseases in 1955.

SIMPLE CLINICAL HEARING-TESTS FOR VERY YOUNG OR MENTALLY RETARDED CHILDREN

BY

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In the course of an inquiry into problems of deaf and partially deaf children in mental deficiency hospitals and occupation centres carried out during 1955, it became apparent that there was need for a series of graded clinical hearing-tests, suitable for routine application by medical officers and psychologists concerned with official ascertainment of handicapped children, which could be repeated at intervals by different examiners and recorded in some standard fashion. Originally, with the intention of obtaining results as precise as possible, some form of instrumental testing was envisaged, and numerous trials were laboriously carried out with drums, whistles, pitch-pipes, tuning-forks, and, in a few cases, with pure-tone audiometers; but it was soon obvious that the difficulties of routine testing of mentally handicapped children with what were, to them, completely meaningless sounds were insurmountable. Since, in any case, the aim was primarily to obtain reliable information concerning the child's capacity to hear with comprehension in everyday situations, it became clear that the tests should be based on his reactions to familiar homely sounds and particularly to "live" speech. It is hoped to give in detail elsewhere the reasons for employing each individual item in the present series.

This paper is intended only to describe the general principles underlying the tests, the materials used, the procedure which was eventually decided upon, and the responses which may be expected. In order to establish comparative developmental standards, it was found necessary to keep checking the performance of mentally handicapped children against that of young normal children attending day nurseries and infant schools, and in the process it was discovered that in these groups, also, the tests could usefully be employed for sorting out children with difficulties of hearing and speech. The tests can be carried out in any quiet room, and the material required is easily obtainable. They are simple enough in content to be readily grasped by young children, but when correctly applied provide clear-cut evidence regarding capacity for auditory discrimination. Since it is essential for adequate assessment to observe how the child responds, the tests should be carried out personally by the medical examiner (or psychologist) or in his presence. They are not intended at this stage for large-scale application by ancillary personnel. Suitable techniques are already available for this purpose (Ewing, 1957).

Categories of Hearing-tests

The hearing-tests for children at present in use fall into two broad categories: (1) those which are designed as preliminary screening devices, first to sort out as quickly and effectively as possible children whose speech and hearing is below the normal for their age and who therefore require further investigation, and then to provide a means of recording results for future reference; and (2) those more precise diagnostic procedures which seek to define more accurately the nature and extent of the speech and hearing disability.

Considerable research has been carried out in Britain on both types of test, notably by the Ewings and their team of workers (Ewing, 1930, 1957; Ewing and Ewing, 1944, 1947), Fry and Kerridge (1939), Dix and Hallpike (1947, 1952), Whetnall (1952, 1956a, 1956b), Fry and Whetnall (1954), Fisch (1955), Dawson *et al.* (1956), and Thomson (1956).

Although I derived much useful information from the published reports then available, few of the tests in use were found to be suited to my purpose owing to the limited intelligence and restricted experience of the children whose needs prompted my own investigations. Statistical evaluation of the tests here described is not possible or desirable. The mental age levels given are approximate, and, although in practice the series provides a considerable amount of information concerning developmental progress, it is not designed for use as an intelligence scale. The terms "pass" and "fail" are not employed. The child is judged to respond or not to respond according to the level of performance which might reasonably be expected at his age. It need hardly be stressed that any child showing deviations from the broad pattern of speech and hearing behaviour appropriate to his chronological age should be referred for expert opinion and full diagnostic testing immediately. Children do not grow out of deafness, but they do most assuredly grow into dumbness if they are not given expert auditory training in the critical early years. The sooner the young child with impaired hearing is provided with a suitable hearing-aid and his parents are given guidance regarding his daily management the better his chance of normal development.

Much research is in progress regarding the auditory behaviour and testing of young babies under 6 months, including neonates (Graham, 1957; Ewing, 1957; Whetnall, 1958; Ballantyne, 1958). These procedures demand much training and experience. Since their application to mentally handicapped children has not yet been investigated, it is not proposed to discuss them here. The present tests are intended for use with children with mental ages between 6 months and 7 years. To date (March, 1958) they have been personally applied with 192 mentally handicapped children aged 2-16 years, and with 537 normal children between 6 months and 7 years distributed as follows: under 2 years, 107; 2-4 years, 179; 5+ years, 251.

Response to Spoken Language

In order to test whether a child possesses hearing over the range of sound cycles which are essential for speech discrimination, it is necessary to satisfy oneself that he can respond to spoken language. His reaction to other meaningful sounds possessing similar characteristics in pitch, intensity, and duration may provide valuable supporting evidence regarding the child's auditory acuity and his ability to interpret the world of sound in which he lives; but until he has given unmistakable evidence first that he *hears*, later that he can *imitate*, and eventually that he can *correctly use* the individual phonetic units of speech, it is not possible to be certain that his auditory discrimination is normal.

From 6 months onwards the child's own spontaneous vocalizations provide a useful clue to his capacity for hearing and using spoken language. They should therefore be carefully observed and recorded at the time of examination. The mother's description of his speech and hearing habits should be reported separately. Even when accurate pure-tone testing becomes possible a clinical speech test should always be given (Sheridan, 1948). Hearing for pure tones and hearing for speech, although closely related, are not identical. This is particularly true of young children. The pure-tone audiogram provides valuable information regarding the severity of hearing loss, the sound cycles involved, and the possible location of the blockage in the auditory relay system between the meatus and the cerebral cortex, but it cannot show how the individual child interprets what he does hear. Some children with poor auditory discrimina-

tion and gross speech defects show perfectly normal audiograms, while other children showing loss for pure tones function as normally hearing individuals. While it is therefore desirable to apply and compare results of both tests whenever possible, the first essential is to discover the child's ability to hear and use spoken language or, as Fisch (1957) aptly terms it, his capacity for auditory communication.

The tests are grouped in series as follows:

Baby tests { (a) 6-14 months: Voice and noise-making objects
(b) 15-18 months: " " " "
(c) 19-23 months: Five-toy test " "

2 years old: Six-toy test and first cube test

3-4 years: Seven-toy test and second cube test

5-7 years: Picture vocabulary tests and third cube test

The materials required are:

Babies.—(a) and (b) soft high-pitched rattle; squares of new tissue paper (e.g., toilet paper); small handbell; china or pottery cup with wide brim; metal spoon. (c) Ball, golf size, plastic type which will not break windows; baby doll 2-3 in. (5-7.5 cm.); motor-car 2 in. (5 cm.); 1-in. (2.5-cm.) wooden cube, different colour from motor-car.

2-4 Years.—Child's spoon, fork, and knife (blunt); baby doll 4-5 in. (10-12.5 cm.); motor-car 3-4 in. (7.5-10 cm.); train or plane 3-4 in. (7.5-10 cm.); ship 3-4 in. (7.5-10 cm.); eight 1-in. (2.5-cm.) wooden cubes, two each of blue, yellow, green, red.

5-7 Years.—Four cards of special pictures; one card decorated with coloured squares; lists of selected words and sentences.

In application three general rules must be observed. (1) The room should be quiet and homely, and the mother or other familiar adult should remain with the child throughout. (2) The tests are based on fundamental psychological and acoustic principles, so that, although it is permissible to vary the spoken "carrier phrases" and in some instances the order of application, the materials used may not be varied and the tests themselves must be applied with strict attention to detail or they will cease to give valid results. (3) The record should state clearly the test used, the distance, the results obtained, and a note regarding the child's own vocalization or speech.

Babies Aged 6-14 Months

Babies over 6 months are comparatively easy to test, those between 9 and 12 months particularly so. At this stage of development the child is eagerly seeking through vision, hearing, and manipulation to explore and find meaning in the world around him. He has already learned to associate certain sounds with human beings and the interesting events they initiate, but his experience is still so incomplete and his ability to discriminate between foreground and background noise so rudimentary that he cannot yet take the significance of any sound within his area of attention for granted, but is impelled to support his uncertain powers of auditory recognition and localization with visual verification. Hence his response to a meaningful sound in his environment is to turn immediately to look for the person or object originating it. This localizing reaction probably plays a necessary part in the child's stereoscopic and stereophonic learning, and thus in the building up of his concepts of space and possibly of time. Whatever the reason, the response is so constant at this age that it is almost automatic and can usefully be pressed into service in testing.

It is necessary to remember that the infant's world is very small and only gradually expands. Although he has vague impressions of an outer space, his span of selective visual and auditory attention is at first fragmentary in time, and in space no larger than the circle bounded by his mother's arms. His sphere of continual awareness later widens to cot and play-pen size, and only at about 18 to 20 months reaches full room size. For this reason soft, varied, meaningful sounds close to the infant are much more likely to evoke a response than loud featureless sounds further away. The examiner (E) should stand well to the side of

the child (C), but outside his immediate range of vision. To ensure the most consistent results the sound stimulus should be given on a level with the ear. Sounds below this horizontal plane seem to be less easy to hear, and above it less easy still. Sounds immediately behind or above the head, particularly when they are in the middle line, appear to be difficult to distinguish and, before 3 or 4 years, impossible to locate. Ewing (1957) has recorded similar findings.

Babies of 6 and 7 months are usually very outgoing and friendly, but after this the near approach of strangers is apt to be unwelcome and acceptance must be won. The examiner should not make boisterous frontal overtures to the child, but should allow himself to be seen moving about at a respectful distance and heard conversing with the mother. The child's reactions to the mother's voice are instructive, particularly when she is addressing herself directly to him.

E should first ask by what name the child is known at home. C may sit on his mother's knee facing outwards, or in his cot or pram within touching distance of her. C's position must not be closer than 4 ft. (120 cm.) to any wall. In all the tests it is essential that E does not stand where his movements or his shadow are visible to C. Similarly, reflections in a shiny surface, light touches, vibrations, currents of air, and even perfumed cosmetics may provide unsuspected clues to an observant child who has learned, of necessity, to make use of them. If an assistant is available E should sit in front of C observing his reactions while the assistant applies the stimuli under his direction. If E is alone he must wait until C's attention is visually attracted straight ahead (but not too deeply engaged) before he begins the test.

The sounds are given at distances from 1½ ft. (45 cm.) (at 6 months) to 3 ft. (90 cm.) (at 9 months upwards) in

the following order—voice, rattle, spoon against cup, tissue paper, handbell. The speech sounds are delivered at quiet conversational level. They consist of the low-frequency vowel OO, repeated two to four times (for example, "Oo-oo John: Oo-oo"), and the high-pitched consonant sounds "tit-tit-tit," "ps-ps-ps," "pth-pt-pt," repeated rapidly three to six times. The remaining sounds are given for one to two seconds. The rattle is shaken softly, the tissue paper is rustled quietly, the handbell is tinkled very gently, and the spoon is merely stroked round the inside brim of the cup (see photographs), unless for any reason a sharp tapping sound is needed, when the spoon can be struck briskly against the side.

With normal children of 9 months upwards the first application of the stimulus usually provokes instant turning, often with a delighted smile (E should respond to the smile), and when the same sound is repeated immediately afterwards on the other side of his head C will promptly locate it in the new position. Younger babies may be slower to react. If the first stimulus evokes no response E should wait for two seconds and then repeat it. E should then wait a further two seconds, as C may still turn slowly and deliberately although the sound has ceased. This delayed response is apt to occur also in retarded older children. It is as if there is a definite time-lag between the reception of the sound in the primary auditory area, its recognition in the audito-psycho area, and the initiation of the motor impulse. Probably for a similar reason a baby who has not responded to the single application of a sound on one side of his head will often locate it promptly and correctly when it is repeated immediately afterwards on the opposite side; but I prefer to apply a double (or occasionally treble) stimulus to one ear, since absence or delay in response provides additional information. If no response is elicited to the second (or third) repetition of the sound the stimulus should then be changed or the child will become bored and withdraw from the situation.

I have been interested to note that the cup and spoon and rattle seem to evoke the most consistent responses in young babies, perhaps because these sounds carry a concrete "near-by" meaning—that is, food and manipulative play; while the paper and handbell appear to be more interesting to the older babies whose sphere of memory and attention is expanding. After response to the handbell has been evoked it should be presented to the child, since his use of it as a plaything provides further useful information regarding his ability to comprehend its function and his willingness to make and enjoy sound (Gesell, 1925).

If the child shows a clear-cut response to any three out of these five sounds there is good reason for the assumption that he possesses enough hearing to learn to speak, but it must be remembered that the tests are not fine enough to distinguish partial deafness, particularly high-tone loss, with any degree of certainty. If the child does not respond in the expected fashion to these sounds on both sides, the tests should be reapplied as soon as possible within the following month. If the result of this second test is still uncertain expert opinion should be sought without further delay.

Speech.—From about 4 months onwards the child laughs aloud and vocalizes freely, particularly when his mother talks to him, at first in single sounds such as "ba, ka, goo," etc., and later from 7 or 8 months in a tuneful repetitive babble of the "dad-dad, bab-bab, mam-mam" variety. By 10–12 months most normal babies show by their behaviour that they understand several words used in familiar context, and their mothers may report that they can say one or two words, but these are rarely intelligible to outsiders. At 14 months many children have acquired two to six recognizable words, but others, equally intelligent, have not. By this time babbling has progressed to a more complicated jabbering, which possesses all the complex cadences of ordinary speech without its phonetic discipline. This the child practises with tireless enthusiasm when alone

The child's attention is immediately drawn by the sound of the spoon stroked round brim of cup. (Aged 8 months.)

(Sheridan, 1945). Any report of decrease in vocalization from the babbling stage onwards, or the most tentative suggestion on the mother's part that the child's cry is unusually monotonous, or that he seems inattentive to sound, should be treated with the utmost respect.

15-23 Months

Children within this age group are often very difficult to test and the examination calls for much patience and experience. In fact, if the response to the first test is uncertain and if there is any reason to doubt that the child's hearing is normal, it would be wise not to delay until a second test can be carried out, but to refer him immediately for diagnostic investigation. At this age the child is usually very active in crawling or running about, and, since to restrain him would defeat the possibility of reasonable assessment, it is often necessary to follow him round the floor. By this time he usually possesses enough auditory experience to recognize and interpret the sounds used in the baby tests described above without needing to verify them visually. He may concede one brief glance, but frequently does not offer the slightest sign that he has heard. At the same time he may not yet be sufficiently advanced to be able to co-operate in the simplest form of toy test described below. In these circumstances the child's own spontaneous vocalizations may provide the most useful indication of his ability to hear speech. Indeed, E's imitations of C's own vocalized sounds may be the best way of provoking him to stop, listen, and turn to look.

The child between 15 and 18 months should first be addressed by name and invited to join E in play. If he does not respond to these spoken overtures the baby tests at 3-6 ft. (90-180 cm.) may be tried, E remembering that it will be necessary to vary them frequently, as the immediate repetition of a sound which has just evoked response on one side will seldom, at this age, arouse equal interest on the other. The rustling of the paper wrapping of a packet of sweets followed by the spoken invitation "Come and get one," and the presentation of the bell accompanied by the definite instruction "You ring it; ring it with the other hand," are useful extensions of the baby tests at this age. Commands are more likely to produce results than mere friendly suggestions.

With children over 18 months a beginning may be made with the simplest form of toy test—that is, "the five-toy test." The objects used are *cup*, *ball*, *miniature motor-car*, *plastic baby doll*, and *toy brick*—that is, coloured inch (2.5 cm.) cube which should be a different colour from the motor-car. C is placed sitting or standing by a small table with E facing him at 2-3 ft. (60-90 cm.)—that is, conversational distance. E presents the objects slowly in the following order, saying, "Here is a *cup*" (the responsive child will delightedly echo "tup"). "Here is a *ball*—and a motor-car." Then presenting the doll E says, "What's this?", waits for C to say "dolly" or "baby," and thereafter uses C's own word. If C does not speak E says, "A *dolly*—and here is a *brick*" (the word "brick" is acoustically essential and must not be altered). Then, holding out his hand flat (not suggestively cupped), E says in this order, "Give me the *ball*, please. Thank you. Give me the *brick*, please . . . the *car* . . . the *dolly*—Good." If the child does this correctly E hands the cup to the mother and says, "Now I am going over there and you're going to give the things to Mummy when I tell you," and retreating to 6 ft. (1.8 m.) says, "Give Mummy the *ball*," then, slowly retreating to 10 ft. (3 m.), "Give Mummy the *brick* . . . the *car* . . . the *dolly*"; then, finally, "Put the things in the cup and bring them to me." Many normal children of this age find it difficult to maintain rapport at 10 ft. (3 m.). If E feels that he has dropped out of C's world at 10 ft. (3 m.), he should return to 6 ft. (1.8 m.), noting this in the case record.

If the child does not give the correct toy when requested E should wait a moment without speaking, as another

delayed response may be operating. C may even lift the incorrect toy, then put it down and hand the correct one. If C gives an incorrect toy E should put it down gently and repeat, "The *ball*, please." If C still hands the incorrect toy E puts it down again saying, "No, I want the *ball*, please." If the child persists in giving the incorrect toy or goes on handing the other toys without waiting for the command, E accepts them; then, giving the cup to the mother, holds out the toys to C, saying, "Give these to Mummy." While C is doing this E retreats to 6 ft. (1.8 m.), saying, "Good; now put the things in the cup and bring them to me." While C's attention is momentarily engaged in filling the cup the vocalized sounds "ps-ps" or "tit-tit," the high-pitched rattle, or the rustle of paper usually provoke the turning response.

Speech.—By 18 months most children have acquired 6 to 12 recognizable words. The child continues to jabber to himself while he is playing or in his cot, but as his vocabulary grows this jabbering begins to include an increasing number of distinguishable words. By 2 years the hearing child can verbally communicate his toilet needs, ask to be taken for a walk, and demand what he wants at table. He is usually putting two or three words together to form simple sentences. His understanding of spoken language, which is related to familiar objects, activities, and emotional states in his daily life, continues to improve rapidly and is far in advance of his ability to use speech. At this age he is physically restless and vocally demanding, incessantly provoking his mother to give verbal reply to his loudly expressed claims on her attention. After 20 months persistent tendency to tug at his mother's garments and point silently with his finger when he wants anything is very significant and should be carefully followed up.

2 Years

The testing of children of this age group is easier again, and the six-toy test is applicable. C is invited to a small table with E sitting facing him as before. The toys are briskly presented in this order: Here's a cup—what's this? (spoon) and this (ball, car, doll), and here is a brick. "Give me the *ball*, please, the *brick*, the *car*, the *doll*; thank you. . . . Look, I'll put the *spoon* in the cup. Now you put the other things in when I tell you." E retreats to 6 ft. (1.8 m.) and, hiding his mouth lightly with a card so that the child is unable to see his lips, continues, "Put the *ball* in the cup. Put the *brick* in the cup, the *car*, the *doll*. Good. . . . Now, when I say so, you take them out again." E retreats to 10 ft. (3 m.) and says, "Take out the *spoon*, the *brick*, the *doll*, the *car*. What's left in the cup?" This is an advanced language concept. The outgoing child usually picks out the ball promptly, saying delightedly, "Ball." The reserved child leans forward and looks into the cup without speaking. The dull child looks at E uncomprehendingly. To reassure him E says, "Take out the ball." A quiet conversational voice is used throughout. I seldom use whispered speech for children under 4 or 5 years, and only then for special reasons and with previous notice. Whispered speech is an unnatural form of communication for young children who are accustomed to hearing voiced speech at "mother-distance"—that is, at high decibel intensity. It not only tends to confuse them, but sometimes provokes anxiety and even tears, thus jeopardizing rapport or destroying it irretrievably.

In order to make sure that the child has no high-tone loss, however, it is desirable to test his hearing for voiceless consonants. The following simple test, the first cube test, can be used from about 2½ years onwards. E places the cup and six coloured inch (2.5 cm.) cubes before C, saying, "Now we're going to play another game. See these bricks. When I say, 'In, in, in,' I want you to put a brick in the cup. It will get quieter and quieter, like this (demonstrating). You try." E gradually drops out the vowel and sounds only the consonant—"In, in, n, n, n. Good. Now I'm going over there, and when I say, 'Lift, lift,' I want you

to lift a brick out of the cup and put it on the table. It will get quieter and quieter like this" (demonstrating). E moves to 10 ft. (3 m.) from C's right ear. "Ready? Lift, lift, lift, if, -f, -th (th voiceless as in 'thin'). Good." E then repeats the test for the left ear. C should not be allowed to lip-read. The sounds must be delivered at irregular intervals in order to prevent automatic performance. In practice this will be found exceedingly simple, as it is possible to monitor the child's movements visually to a split second. If C lifts the brick before the signal, E says, in playful admonishment, "I didn't say anything. Put it back. Listen." The children greatly enjoy this game, and it is a very sensitive test.

Speech.—If C's own speech has not been completely demonstrated by this time it may be necessary to engage him in some simple conversation, or, if he is capable of it, he may be asked to point to and name objects or pictures. The following simple "doll" vocabulary list provides a useful rapid test for most of the common vowels and consonants. *Doll, shoe, nose, frock, arm, feet, hair, hand, mouth, eyes, teeth.* Although at this age the normal child's phonetic usage still shows numerous infantile substitutions, his speech is adequate for most domestic occasions. Self-talk during play still continues and will probably do so until about 3½ years. Although not yet capable of sustained conversation the child can now put words together to form more complicated sentences, and is beginning to engage in spontaneous verbal interchange with other children of his own age, as well as with adults. Any child whose speech development during the first three years does not progress in this way, but remains arrested at the jabbering stage, should be referred for expert examination whether or not he appears to hear normally. He may be generally retarded or he may be a case of developmental aphasia, but he may also be suffering from high-tone deafness, so that, although he can fully appreciate the cadences and vowel sounds of ordinary speech, he cannot discriminate, and therefore cannot imitate the difficult high-frequency consonants. Denied the ability to communicate, he may express his frustration in violent temper tantrums, or in despair take refuge in silence or social withdrawal. This type of deafness is likely to be permanent. These children, unhelpt, run a real risk of being wrongly diagnosed as maladjusted, psychotic, or mentally defective (Sheridan, 1944; Minski, 1957).

3 and 4 Years

The seven-toy test is easily applicable from 3 years onwards and can be used until the child is able to cope with the more comprehensive picture vocabulary test. It has shown itself capable of holding the interest of mentally handicapped children up to 16 years and, if necessary, of normal children up to 7 or 8 years. The seven objects are a child's *spoon, fork, and knife, doll, car, train* (or plane), and *ship*. A slightly larger doll and car at this age are advisable as they are easier to handle (and harder to put in the mouth), but the smaller ones can still be used. Sitting opposite C at the table, E places the toys before him from C's right to left, in the following order—car, train, fork, spoon, knife, doll, ship. E asks C to name the objects as they are placed. If C says "engine" or "boat," E replies, "Yes, a train" or "ship." If C does not speak E says the name clearly, asking the child to repeat it before he passes to the next object, checking him again at the end of the line. If C speaks readily but shows momentary confusion between knife and fork, E should go back to these at the end of the line. If the child still shows the slightest doubt it is wise to discard the test rather than modify it and to give the six-toy test instead. If C knows all the objects, E says, "Show me" (or if C is sufficiently advanced, "point to") "the *spoon, the doll, the fork, the car, the knife, the train, the ship, the spoon, the car, the ship.*" It is essential that the words should be called in this order. E then retreats to 10 ft. (3 m.) and, covering his mouth, repeats the list in the same order.

(It will be obvious to those experienced in psychological testing of children that this simple performance provides E with a good deal more information than C's ability to discriminate the phonetic units which compose the seven words involved; for instance, his use of his right and left hands, his interest, speed, manipulative skill, and his actions which demonstrate "definition by use.")

In order to test the hearing for high frequencies E may repeat the test in a whisper at 10 ft. (3 m.), having first warned C what to expect. A more sensitive test is the following—that is, the second cube test. E places on the table before C the cup containing eight coloured inch (2.5 cm.) cubes with the instruction: "Whenever I say a little sound, oo, sh, t, anything—I want you to take out a brick and put it on the table, like this" (demonstrating): "Oo—ee. . . . Now you go on: sh, t, s, p, f, th. Good. Now I'm going over there," etc. Each ear is tested separately at 10 ft. (3 m.) as before. This is not only a more sensitive test than the "In, lift" one, but it is also more difficult, particularly for retarded children, because it includes the two plosives *t* and *p* as well as the continuants *sh, s, f,* and *th*, thus involving appreciation of duration as well as of pitch. If the child does not respond to the first delivery of *t* or *p* E should repeat the sound once. If response is still absent E should proceed to the next continuant, adding a further *th* at the end to compensate, so that the child is unaware of his lack of success. The case record should be noted accordingly. It will be obvious that the "placing" of these consonants by the speaker is important. In order to keep the sounds at their highest pitch, the short vowel "i" should be imagined as preceding each consonant—for example, (i)sh, (i)p, (i)th. It is essential to avoid "per" and "ter."

Speech.—The child of 3 years is capable of sustained conversation. His speech is usually completely intelligible, although it still shows a number of infantile substitutions and omissions, the majority of which gradually disappear before 5 years. About 3½ years self-talk during play tends to merge into a sort of running commentary of passing events, interspersed with questions, more or less vaguely addressed to the adults and children in his vicinity, to which he expects his hearers to pay at least intermittent attention. About 4 years comments become less frequent but more pertinent, while his questions become more persistent, so that he is incessantly asking, "How? When? Why?" Any deviation from this broad developmental pattern occurring in children of 3 and 4 years is likely to be of serious significance and requires urgent investigation.

5-7 Years

It is usually quicker and more convenient to use a picture vocabulary test at this stage. Those who have tried to design similar tests in the past will know that their preparation involves considerable labour. The words used must be monosyllables, preferably nouns capable of pictorial illustration, and within the experience and language capacity of very young children. M. Reed kindly provided me with a set of the admirable pictures he designed for use in the audiology unit, Gray's Inn Road (Whetnall, 1952), but they proved too difficult for the mentally handicapped children. It was therefore necessary to compile new sets of words and pictures. Six lists of 12 words were prepared. Four of these lists contain an assortment of vowels and consonants in common use. The fifth list contains pairs of words which have similar vowels but different consonants, and the sixth list is composed of words in which the high-pitched vowels *ee* and *i* are combined with high-frequency consonants. Pictures to illustrate three of the lists (given below) were prepared by a children's artist. They were then carefully arranged on the page to prevent guessing from juxtaposition.

The clinical value of spoken vocabulary tests is high. Some children are able and willing to cover the distal ear and repeat a list of words spoken at 10 ft. (3 m.) into the proximal ear, without further ado. If an assistant is available to sit by the child and check his responses, this test,

combined with the third cube test described below, provides a very convenient and rapid method of screening the everyday hearing of normal 5-year-old school entrants. It is noteworthy, however, that even the most intelligent of the 5-year-olds appear to enjoy the test and give a better performance when the pictures are presented, as if, like the babies, they still feel the need to reinforce their hearing of words by visual verification when they are isolated from context.

Since it is the speech sounds in the highest frequency ranges which usually provide the greatest difficulty, the quickest way to discover if the child has any impairment of hearing is to present the sheet representing the sixth list and ask him to point to the pictures. At first the whole 12 pictures in this set were used, but later six (seat, feet, ship, fish, pig, chick) with a two-word check were found to be sufficient. In any case of doubt the longer lists should be given. As before, E starts by sitting opposite C at 3 ft. (90 cm.) asking him to identify the pictures in turn. If C says "chair" or "bird," E replies, "yes, a seat"; or "chick." If C stumbles over any word he should be taken back at the end to this picture. If he still shows any hesitation, the vocabulary test should be discarded and the toy test presented instead. If C identifies all the pictures correctly, E retires to 10 ft. (3 m.) and, with his mouth hidden as before, delivers the list in the order given below.

In order to check discrimination for high-frequency consonants, a *third* variation of the *cube test* was evolved. C is given the cup containing eight cubes as before, two each of green, red, yellow, and blue. Beside the cup on the table is placed a card measuring approximately 8 by 12 in. (20 by 25 cm.) decorated with 12 brightly coloured squares, three each of the same four colours. C is told to stand sideways with one ear towards E and to cover the distal ear firmly with the palm of his hand, placing the fingers in the nape of the neck. He is then instructed to take out a brick as before and "put it on its own colour." This procedure not only adds to the interest of the test, it also acts as a visual distraction. Children of this age are quick to interpret any raising of the eyebrows or least movement of the head which E makes in delivering the sounds. If C shows the slightest lack of comprehension or confidence, the coloured card should be removed and the easier second cube test given instead. A fair indication of the child's probable school-room hearing for continuous speech, allowing for the quieter conditions of the examination, may be obtained by asking him to repeat a few of the sentences below, delivered in a quiet voice with mouth hidden at twice the distance of his seat from the teacher's desk.

Speech.—The spoken language of the normal 5-year-old is fluent and correct. A number of children, particularly boys, still show minor consonant substitutions, principally confusions of *th* and *f*, which are usually the last phonetic units to be differentiated, but occasionally of *s* and *t*, or of the *r*, *l*, *w*, *y* group. These minor immaturities of speech normally clear up before the age of 7 years. If they persist, audiometric assessment and speech therapy become imperative.

Specimen Vocabulary Lists

PICTURE TESTS

General: Shoe, horse, cart, seat, cup, frock, cat, bike, face, chick, fish, ship.

Vowels: House, coat, pin, book, cart, boy, horse, cat, pen, bike, cot, bear.

High Frequencies: Tree, chick, feet, leaf, fish, key, ship, teeth, pig, seat, dish, wheel.

SENTENCES

The father caught a bus.	The baby slept in a cot.
The girl ate all the sweets.	The boy has three big sisters.
The postman rang the bell.	The driver stopped the train.
The teacher made a picture book.	The wind blew away the nurse's cap.
The kitten climbed the Christmas tree.	The new dog liked to sleep in chairs.

Summary

A series of simple clinical auditory screening tests which have been found useful in the preliminary assessment of the everyday hearing of very young or mentally handicapped children is described. The material required (common household objects—toys and pictures) is listed. A brief summary of normal speech development during the preschool years is given.

The work described in this report would not have been possible without the generous help of many colleagues and friends in hospitals, public health departments, and schools. It is impossible to name them all individually, but I wish particularly to acknowledge my debt to the consultants and members of the staff of the Cell Barnes Hospital, Great Ormond Street Hospital for Sick Children, and the audiology unit of the Royal National Throat, Nose and Ear Hospital who allowed me to work in the wards or observe in clinics; also to the Medical Officer of Health of London, Manchester, Cardiff, and Cornwall County Councils, who granted me facilities to try out the tests in day nurseries, occupation centres, and infant schools. Mr. M. R. Sheridan made helpful suggestions.

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The results of successive surveys of smoking habits show that a person's replies are fairly consistent with each other. This is one of the conclusions reported in *Research Papers No. 2* on "The Reliability of Statements about Smoking Habits," by G. F. Todd and J. T. Laws, issued by the Tobacco Manufacturers' Standing Committee. Successive inquiries showed that replies given in the course of interviews during 1946–9 overstated the amount smoked by about 11%, and in the years 1952–7 understated it by about 13%. A possible explanation for this given is that the earlier figures, although intended to refer to packeted cigarettes, referred also to hand-rolled cigarettes owing to ambiguity in the questions. After 1950 the report states that the figures suggest that informants had an inherent tendency to understate their consumption slightly. "On the other hand, since in most tables in the papers informants are classified into broad groups consisting of non-smokers of cigarettes and of smokers of 0–4, 5–14, 15–24, and 25 or more cigarettes a day, the percentage of smokers, particularly in view of the proportion smoking 10 or 20 cigarettes a day, likely to be classified wrongly even with a 15% error is negligible. For instance, if those who said they smoked 20 cigarettes a day in fact smoked 23 cigarettes day, they would still be placed in the same consumption category." An analysis of other figures showed, according to the report, that the number of cigarettes stated to have been smoked on the day before an interview can reasonably be recorded as the number likely to be normally smoked at that time.