THE CHILD'S ACQUISITION OF SPEECH

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In the course of a research into defects of articulation in school-children I discovered, with some astonishment, that although the child psychologists have already built up a considerable literature regarding the development of *language* in the young child, there were apparently no records of any large-scale observations concerning the normal acquisition of the actual speech sounds. Most of this work on the acquisition of language has been done by non-medical psychologists recording the linguistic development of one child or of a small group of children, usually the offspring of highly intellectual parents. The latest English observers (to mention only a few) include M. M. Lewis, Susan Isaacs, C. W. Valentine, and G. Seth (writing in collaboration with D. Guthrie, the laryngologist); while the whole field of mental development in relation to language development has recently been admirably surveyed by A. F. Watts. Leopold Stein, who now works in London, approaches the subject from the point of view of the medical psychologist who is also a philologist and a speech therapist, and for this reason his work is particularly valuable.

The reason for this apparent neglect of research into the acquisition of normal speech sounds was immediately obvious when I began my own investigations. The difficulties are four-fold. (1) The young child, in passing from the stage of babbling to the stage of fully articulate speech, makes use of a number of sounds for which there is no recognized phonetic symbol, so that accurate charting is sometimes impossible, and the recorder is obliged to use those symbols which most nearly represent the child's speech. It is therefore essential that the recorder should be an experienced phonetician. (2) It is unscientific to draw conclusions from incomplete records of a child's speech, but it is exceedingly difficult, in the time at one's disposal, to persuade some children to demonstrate the full range of their phonetic usage. The observer must therefore be skilled in the examination of young children. (3) It is unwise to generalize from the speech of one child or of a small group of children. It is therefore necessary that the recorder should have facilities for observing large numbers of young children with widely differing intellectual, social, and geographical backgrounds. (4) In order that speech sounds may be normally acquired it is necessary that the child's mechanism for speech and hearing should be perfect. It is therefore desirable that the observer should be a medical officer experienced in detecting even slight deviations from the normal anatomical, physiological, and psychological standards.

In the course of some 3½ years I have been able to collect complete records of the speech of 650 children under the age of 5 years. Of these, 620 were children attending nursery schools and clinics, while the remaining 30 were mostly children of friends and relations whom I was privileged to observe over prolonged periods. In addition to these there were dozens of other children encountered in nurseries, trains, shops, even in bus queues, who provided me with fragmentary samples of their speech. The records were charted according to age (in 1/4-year periods) and sex.

The Child's First Efforts

From the detailed analysis of this mass of material a definite pattern gradually emerged. Following the infant's realization that the speech and gestures of his adult attendants possess meaning—a realization which normally occurs about the age of 8 to 9 months—he begins to make responsive sounds whenever he is spoken to, and to play with his own vocal sounds when he is alone. These sounds are usually of the repetitive variety—"bab-bab-bab," "mum-mum-mum," "dad-dad-dad"—sounds which are promptly appropriated by the parents as proper names. Soon this game is carried a step further by the child's recognition and subsequent echoing of the cadences of adult speech, so that his babbling assumes normal vocal inflections or "tunes." Listening outside the nursery door to

this tuneful babbling, it is often impossible to believe that the child is not using articulate speech. He uses most of the vowels and consonants, but the sequence of utterance is so undisciplined that the result is unintelligible. At this stage the child's comprehension of speech, which rapidly outstrips his performance, is often remarkably good. ("Shut the door, please," "Look, here's Daddy coming," and "Never mind, I'll kiss it better," says the mother, and he immediately responds.) The child now realizes that speech is the most convenient form of communication. The use of real words follows. Often this real word is comprehensible only to the mother. It is imperfectly articulated and therefore difficult to interpret, but since he uses it consistently for any given object or activity his mother rapidly learns to understand him. Just as the experienced ear makes up the missing frequencies from a telephone conversation, although only about 70% of the speech sounds are actually transmitted, so that the listener is unconscious of any deficiency, so the mother listening with the ear of knowledge and love will assure one that the child's speech is "perfectly plain," and that "he can say anything," although the recorder is struggling to interpret a glorious jumble of phonetic substitutions, elisions, and omissions.

For some time not only the tunes of speech but the loudness and shrillness of the voice itself are greatly exaggerated. I have observed this many times in children of every social grade and level of intelligence. They tend to shout, using a very wide range of notes, as if a nice discrimination of pitch and intensity comes only with more experienced listening and imitation. The first "words" or sound groups often consist only of vowels and a tune, and are frequently accompanied by an explanatory gesture; thus the child says "i-i" ("dicky") and points at the sparrow in the garden, or, handing the last brick, "a—aw!" ("that's all!"). Or the word consists of a labial consonant, a vowel, and a tune; thus "baw" = "ball," "mow" = "mouth," "woh a?" = "what's that?"

Vowels

The vowel sounds used re-echo the accent of the environment in which the child lives, but certain deviations from the environmental normal are constantly observed. The long vowels—"oo" (pool), "aw" (paw), "ah" (palm), "er" (pearl), "ee" (peel); and the short vowels—"u" (as in hut and in put), "o" (hot), "a" (hat), "e" (set), "i" (sit), appear some time before the diphthongs; but frequently the sound "e" (set), and less frequently the sounds "u" (hut and put), and rarely "o" (hot) and "i" (sit), are lowered to the sound "a" (hat); while "u" (put) is lowered to "o" (hot) so that "egg" = "agg," "head" = "had," "pull" = "poll"; and less frequently "foot" = "fat," "duck" = "dak," "cot" = "cat," even "bib" = "bab," although more usually the "i" (bib) becomes "e" (beb). The diphthongs are difficult to write in ordinary script, but they are the vowel sounds in the words "mail," "mile," "boy," "sole," and "cow." They consist of two vowel sounds closely joined together, the first of which (in English usage) is generally given more weight and resonance than the second, to which the tongue glides only lightly and briefly. The diphthongs appear to cause the child considerable confusion at first, so that the latter less prominent half is often omitted; thus "lady" = "leddy," "now" = "nah," "noise" = "nawse," although occasionally the latter half is used—thus "lady" = "leddy," "cow" = "coo." Later when the presence of two sounds has been appreciated the diphthongs themselves are sometimes interchanged; thus "coal" = "cowl," "day" = "die," and less frequently "my" = "may." I have recorded these apparent Cockneyisms over and over again in the speech of children who have never heard a true Cockney vowel in their lives.

Consonants

While the vowels are being acquired consonants are rapidly tacking themselves on to them—first at the beginning of the word (since the initial consonant is normally spoken with more weight than the terminal one and therefore is more rapidly appreciated by the child's inexperienced ear) and, much later, at the end and in the middle of the word. The first consonants to be acquired are usually the nasal sounds (m and n) and the labials (b and p), followed by the "front stops" (t and d). Less often the "back stops" (k and g) are used first, but

whichever pair the child first acquires he normally uses only that pair for both front and back stops for an appreciable time; thus when the front stops are chosen, "top"="top" and "doll"="doll," but "doggie"="doddy," "cup"="tup," "cat"="tat"; or where the back stops are used, "cup"="cup," but "two"="koo," "dirty doggy"="gerky goggy," "toy tank"="koy kank."

The sounds represented in ordinary script by the letters "r," "l," "w," and "y" are usually late in appearing, and are frequently interchanged, so that a "rabbit" may be a "wabbit" or a "labbit" or a "yabbit"; a "lion" may be a "rion" or a "yion," and so on; but whichever sound the child chooses the substitution is usually consistent for a period of some weeks or months. The last single consonant sounds to be acquired and finally differentiated are "h" (which is a mere breathed sound) and those forming the group represented in ordinary script by the letters "z," "zh" (as in "pleasure"), "v" and "th" (voiced, as in "mother"), and their unvoiced equivalents "s," "sh," "f," and "th" (as in "thing"). These sounds appear to give the child considerable difficulty, and even when they have been acquired they are often interchanged; thus "father"="farver," "another"="anozzer," "thing"="fing," "finger"="thinger," "five"="thithe" (sometimes "five"="pibe," another auditory confusion), "sweeties"="feetie," "sixpence"="thikthpenth." Of all the sounds the unvoiced "th" ("thing") is the last to be fully appreciated. It is so rare before 5 years of age that of my 650 cases only 20% of the girls and 9.7% of the boys used it correctly. There could hardly be a prettier demonstration of the auditory basis of speech than this, since we know from Harvey Fletcher's investigations that the phonetic force of the voiceless "th" is the least of all the speech sounds, being 680 times less than that of the vowel sound "aw" (paw).

While the child is still in the process of differentiating these last two sound groups (the "r, l, w, and y" group and the "s, f, th" group) the first attempts at double consonants are being made. At first all double consonants are reduced to one single sound; thus "train"="tain," "cream"="keam," "please"="pease," "pretty"="pitty," "bridge"="bid," "spoon"="poon," "star"="tar," "school"="kool," "jam"="dam" (the letter "j" is really two sounds—d-zh), "chip-chop"="tip-top" (ch is really t-sh). In other words, the child once more at first chooses the sound which is easiest to hear and uses it alone; but as he becomes aware of the presence of a double sound an interesting fact emerges. He will usually make use of his habitual single substitutions in these double sounds, so that "three"="fwee" or "fyee," or even "flee," "tree"="klee," "drink"="dyink," and "scream" becomes the wonderful tongue-twister "thkleam."

Speech Development

It has been pointed out that the initial consonant sounds appear before the central and terminal ones. This observation applies to all sounds which are difficult to hear and includes even weakly stressed syllables and vowels. For instance, the neutral sound which ends so many of our spoken English words (china, motor, paper) is often not appreciated for a considerable time. But the child is so conscious of the cadences and rhythm of speech that he will invariably leave a space for the unspoken sound, which might be compared to the rest in music or, perhaps more accurately, to the metrical pause in prosody, since there is seldom an actual break, but rather a lingering over the preceding vowel. Thus I have many times recorded this gradual evolution of the words "pussy cat":

pu: pu	pu: i tat
pu: pu ta ("a" as in "hat")	pu: i cat
pu: i ta	pussy cat

These patterns of speech development are so constant, the cases of anatomical defect are so rare (with the exception of malocclusion of the jaws, which I have noted elsewhere as being closely associated with defects of "s" in slightly older children), and the child's tongue finds it so easy to perform athletic feats impossible to the adult, whose phonetic habits are firmly established, that I cannot believe these substitutions are due to any muscular incoordination. I feel sure they must be true auditory confusions. The fact that nouns and verbs are the

first grammatical entities to be acquired also points to the auditory basis of speech, since not only are they focused upon the child's attention because they are associated with his bodily activities, but they also receive greater phonetic emphasis than any other parts of speech. Harvey Fletcher has shown that good hearing over the upper frequencies of the speech range (i.e., 4,096 to 8,192 cycles per second) is necessary for the accurate appreciation of the sounds "s," "f," and "th" in nonsense syllables. My own observations on the speech of various groups of school-children indicated that both the child with impaired hearing and the mentally retarded child had difficulty in distinguishing these sounds—the first because he is *physically* incapable of appreciating their upper components, the second because he is *functionally* unable to recognize fine distinctions, although his actual hearing for pure-tones may be normal. Just as his muscular control is clumsy and his mental processes immature and slow, so are his speech patterns infantile in character.

This interesting question therefore arises: Are these consistent patterns of speech occurring in the normal course of development the result of some structural immaturity (analogous to the hypermetropic eye of childhood) in the auditory nerve itself or its association areas; or are they the result of a psychological immaturity—in other words, of that faculty of attention and discrimination which is listening? I incline to the latter view, since I have observed many times how rapidly these infantile habits of speech improve when the child is introduced to the salutary influences of community life in a nursery school. In my experience baby speech most commonly persists in the neglected child, in the spoilt only child, and in the adored youngest of large families. The only child of intelligent parents usually acquires perfect speech very early; but the over-indulged child, to whom everything is given if he merely points and whose parents consider his defective language to be unique and charming, and the neglected child, to whom nobody troubles to talk, these have no incentive to improve their articulation. I have observed the same "environmental" retardation occurring, even more dramatically, in the case of twins. In their small world nobody else matters but one's twin and one's mother, and between them they establish a rudimentary vocabulary which is sufficient for their entire nursery existence, and which is often so completely unintelligible to the rest of mankind that it has been thought that they have evolved a new language. On phonetic analysis, however, I have always found that the words used are recognizable but degenerate forms of normal infantile speech. The best remedy for all these children—neglected, isolated, or over-indulged—is daily attendance at a nursery school. It should be remembered that this intellectual neglect may occur in hospitals and in residential nurseries although the child's physical needs receive devoted attention. Nurses in charge of young children should never be allowed to forget their responsibilities towards the child's mental growth.

Speech Therapy

The question of formal speech therapy in the absence of gross anatomical defect, such as cleft palate, does not usually arise before 5 years. The child who by 2½ years has not made any attempt to develop normal speech, however slowly, along the lines indicated above should be suspected of deafness or mental retardation and the appropriate expert consulted. But there can be no more question of teaching the child to speak before he has made his own spontaneous efforts than there can be of teaching him to walk before he has made an attempt to stand and to crawl. The child should be presented with good models and should be encouraged to speak in every possible way by being played with, spoken to, and, just as importantly, listened to. For this reason the play methods of the day nursery school, where the child is provided with toys, creative material, new experiences, and intelligent guidance, are usually of the utmost benefit to his linguistic and therefore his general intellectual development. When infantile habits of speech persist after 6 or 7 years old the assistance of an experienced speech therapist becomes essential, or the child will stabilize his defects so that they become increasingly difficult to correct. Moreover, his scholastic progress, especially in the linguistic subjects, will be seriously delayed. The child who does not readily respond to this expert teaching should be examined by the school

medical officer with a view to determining whether his intelligence quotient and his hearing for pure-tones are normal.

Summary

The speech of 650 children under 5 years old was examined and phonetically recorded. A consistent pattern of speech development was observed. The auditory implications of this speech pattern are discussed.

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Nova et Vetera

THE SAN JUAN EARTHQUAKE

A MEDICAL NARRATIVE

Early last year the British press contained brief references to an earthquake that had occurred in San Juan, Argentina. The scantiness of the information available at a time when most space in the general press is necessarily reserved for war news lends particular interest to an account¹ of this disaster by Dr. Carlos I. Rivas of the Instituto de Clínica Quirúrgica of Buenos Aires. At first glance one is struck by the familiarity of the scenes depicted in the accompanying photographs. A whole street lies in ruins, with nothing standing but a few sections of wall. Another picture shows the crushed remains of a car buried under a pile of masonry. In a third, two rescue workers stand by an excavated corpse.

San Juan is a town with a population of 20,000, the capital of the province of the same name. It is west and slightly north of Buenos Aires, and about 700 miles away. On the evening of Jan. 15 a brief report was received in Buenos Aires that there had been an earthquake at San Juan; few details were available. On the following morning it was heard that the incident was serious, and that many injured were in urgent need of attention. An emergency scheme was quickly improvised, and on the next day a train left Buenos Aires carrying 20 doctors, 30 nurses, and abundant surgical equipment. At the same time a team of 20 surgical specialists, including Dr. Carlos I. Rivas, assembled at the El Palomar airfield, where they were joined by General Perlinger, Minister of the Interior, and took off for Mendoza in two military aircraft. On arrival at Mendoza, about 100 miles from their ultimate destination, they learnt that "the extent of the tragedy is not yet known, but each fresh news seems more unfavourable."

The rest of the journey was made by road, and as they approached the outskirts of the city they were greeted by a sight which the cinema had made familiar, but which they had hardly expected to see for themselves—an exodus of survivors in columns which grew more dense as the city limits were approached. Further on they were confronted by an incredible spectacle. "The San Juan earthquake involved the complete destruction of the city." As the car lurched through streets covered with debris, exclamations of amazement escaped from the lips of the surgeons, but soon they were silent—"all their energies concentrated in their eyes." Freak effects were to be seen—a dining-room exposed, with a meal uneaten and undisturbed on the table. At last they reached the Hospital Rawson, which was found to have been partly destroyed. Patients had been transferred to the hospital garden, where they lay in bed surrounded by relations and friends. The medical staff had been continuously engaged in administering first aid to an ever-growing stream of injured survivors. A little further, on a smooth lawn, lay hundreds of corpses in rows, many of them in grotesque attitudes, while survivors seeking missing relatives or friends moved among them in an anguish of fearful expectation.

It was clearly impossible to establish a suitable medical organization in such surroundings, and the party therefore chose a building in a reasonable state of preservation—the Colegio Nacional—and, with the aid of six soldiers, worked desperately to transform it into an emergency hospital. From a photograph reproduced by Dr. Rivas this seems to have been done very efficiently. This preliminary task was completed by 8 p.m., and by midnight, when the additional medical personnel arrived by train, a hundred patients had been treated. With the arrival of these reinforcements, available personnel was organized into five surgical units, who set to work on a constantly renewed emergency hospital population of 120 patients. The principle adopted was to give whatever attention was needed to

render each patient fit for transportation as quickly as possible to a suitably equipped surgical centre elsewhere. As would be anticipated, there was a predominance of fractures of the lower limbs and of chest injuries. Lesions of the vertebral column were fewer.

After several days of uninterrupted work, some hundreds of cases had been dealt with and the work of the Buenos Aires mission was completed. Although the thousands of dead, and the hundreds of wounded evacuated to Mendoza and now enjoying rest, food, and medical attention represented a solution of the medical problem, Dr. Rivas says that the members of the mission were acutely aware that a far greater social problem remained. As the surgeons gazed at a convoy of men, women, and children leaving their desolated town to start a new life in some unfamiliar place, they did not know whether to be moved more by compassion for their misfortune or by admiration for their stoicism.

This account by Dr. Rivas is not intended to be anything but a personal narrative. It gives no details of treatment or of the lesions encountered, and does not refer to the auxiliary services—emergency food and water supplies, clothing, and rest centres—that a totally devastated town might be supposed to require. There is only a passing reference to an event which further clouded an experience already full enough of misfortune—an accident to one of the planes which cost the lives of some of Dr. Rivas's surgical colleagues. Nevertheless the reader is left with the impression that the surgeons who were called upon so dramatically to help in this unpredictable disaster brought to their task a high degree of fortitude and resource.

N. HOWARD JONES.

MEDICAL EDUCATION IN THE U.S.A. BEFORE THE CIVIL WAR

Medical Education in the United States Before the Civil War, by Dr. William Frederick Norwood, with a foreword by Prof. Henry E. Sigerist, is published in Philadelphia by the University of Pennsylvania Press, and in London by the Oxford University Press (price 36s.). This volume of just over 480 pages with its extensive bibliography is an important contribution not only to the story of American medicine but also to the cultural history of the United States. It surveys the rise and progress of the American system of medical instruction and the institution of medical learning up to the time of the Civil War—a period of gradual progress in raising the standards of professional education, for it saw a renaissance begun at Harvard in 1771 and emphasized many years later at Johns Hopkins.

The author in his review of all the colleges throughout the U.S.A. has been thorough. We cannot find any that have been omitted. During the first two centuries of colonial history, instruction by apprenticeship was the prevailing system. Ere long European influence began to bear fruit. London, Paris, and especially Edinburgh, were attractive to young Americans after 1750, who on their return became preceptors and lecturers. In the first medical schools there was generally a provision for the M.B. degree as well as a doctorate, but as so few of the baccalaureate candidates ever returned to qualify for the advanced degree it was abolished in the second decade of the nineteenth century in favour of the M.D. After several years of struggle Elizabeth Blackwell in 1847 gained admission to Geneva College and graduated two years later. In 1850 forty women entered the Pennsylvania Women's Medical College, from which Dr. Ann Preston accepted the chair of physiology and hygiene and thus became the first woman medical professor. By 1865 four medical colleges for women had been established. The most significant event of this period was the founding in 1847 of the American Medical Association. It was conceived as an instrument of reform and charted a course for the elevation of medical education; it rescued the early American profession from being largely empiric.

Dr. Norwood has paid much attention to documentation while maintaining the interest of his story. His book will be found valuable in exploring the subject of the medical birth of a nation.

The old Foundling Hospital, established in 1740 by the philanthropist Capt. Thomas Coram, has had many medical friends. Some years ago the boys and girls and those in charge of them moved from the large site in Bloomsbury to new quarters at Berkhamsted in Hertfordshire. It is a sign of the times that the Foundling Hospital Schools are in future to be known as the Thomas Coram Schools, Berkhamsted.

¹ Rivas, C. I. (1944). *Bol. Inst. clin. Quirúrg. B. Aires*, 20, 585.