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JANUARY, 1883.

THE USE OF THE TUNING FORK IN THE DIAGNOSIS OF EAR DISEASES.

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The tuning fork is mainly used in differentiating between middle ear and labyrinth desease, Many varieties of forks are used, and the number of facts connected with the subject is so great that it would be foreign to the purposes of this book, to go into details. It will, however, be sufficiently developed, it is hoped, so as to be available in ordinary practice. *The kind of fork* more generally used, is the one known as Politzers, and is a "middle C" of 512 vibrations per second. It is of large size, being 8 inches in length, the prongs of which are 3/8 of an inch in width and 7-16 of an inch in thickness. It gives a powerful resonance, which is quite necessary in many cases of obtunded sensibility of the nerve. Clamps may be used, which prevent the harsh metallic sound of the over tone, which is a fourth above the ground tone of the instrument, it also adds greatly to the power of the undulations. By successively moving the clamps from the extremity of the instrument to the opposite end, the pitch becomes about twelve tones higher, any intermediate tone being produced by fixing the clamps in the proper position. This is of great advantage and makes a number of forks of different pitch somewhat unnecessary. It will often be found that some of the fibers of Corti are destroyed, or at least are not active, when the fork vibrating in unison with such fibers would not be heard, hence the desirability of tun-

ing forks of different pitch. Many aural surgeons, however, of large practice use the tuning fork without clamps. Dr. Blake of Boston has devised a hammer, one face of which is tipped with rubber. It is attached to the base of the fork by an elastic wire handle, which moves up and down through its point of attachment. By drawing the hammer away a certain number of inches, each time a blow is given, great uniformity of resonance is gained. It is possible, however, to secure a sufficiently uniform blow by striking it on the knee, while the leg is flexed upon the thigh, or even extending the palm of the hand and striking it upon its fleshy part. It is unnecessary to enlarge here on the desirability of great simplicity in instrumentation. The fork may be applied to the front teeth, the forehead, temples, vertex, mastoid processes, and also held near the ear. *In the normal* ear the tuning fork, when placed on the central incisors is heard equally well in both ears; the same is true if placed on the vertex or on the center of the forehead. If placed on the mastoid process it is heard better in the ear of the same side. If the patient has his tympani inflated with air the tuning fork is not as well heard. Urbantschitsch states in his work on the ear, that in some elderly people with normal hearing the bone conduction is defective. [Politzer]. It is heard longer when placed near the meatus than by bone conduction, that is, when placed on the teeth, etc. This is best tested by holding the fork on the teeth until no longer heard, when it will be distinctly audible placed near the meatus. This is explained by the fact that the most natural hearing is through the air in consequence of the mechamism of the tympanum. E. H. Archer has discovered that if the meatus is stopped up by the finger or covered by the hand even, that the tuning fork is heard better as well as longer in that ear. If the finger is pressed too far into the ear, however, it spoils the test; this latter observation is made by Dr. J. A. Andrews, in the New York Medical *Journal* and *Obstetrical Review* for February 1882, and has been verified by myself. Many explanations are given for this improved hearing when the meatus is closed, but the one given by Politzer and Mach seems the most satisfactory, namely, by stoping the ear the sound waves are *hindred from their passage outward to the open air*, and also are *reflected inward*, so that the nerve receives an augmented impression. This test requires to be made with the greatest care to prevent deception. If the tuning fork is placed on the vertex, or in the center of the forehead, or between the central incisor teeth, and the patient with closed eyes states by a fall of the hand, the precise moment at which it is not heard in either ear, and the hands fall simultaneously, we shall be quite sure that bone conduction is equally good in each ear. This test may be done with the ears both closed. Naturally this would prove that bone conduction was the same in each, and it would be left for the voice or watch to test whether the hearing was perfect.

When there is some defect of the hearing from *desease located in the meatus or middle ear*, the tuning fork is better, or longer heard in the affected ear, for the same reason that it was in the ear which had been previously stopped with the finger, and the fork *may* if there is considerable middle ear disease, *not be heard better* when held close to the ear. This, however, is comparatively rare, the tuning fork *generally* being heard better in the air even in middle ear disease, than by bone conduction, although there is not the same difference between bone conduction and aerial conduction as in a normal ear. Again, it is better for the patient to signify the comparative length of time he hears the tunning fork in each ear, it being more exact than to ask if he hears it better in one than in the other. It has been found in doubtful cases that if the fork is laid a little to one side of the medium line that it assists to confirm an opinion. For instance the patient thinks he hears the fork best in the right ear, and it is then moved to the left side a little, and if he still hears it as well in the right ear or even hears it equally well in both ears, there is then no question of his hearing it better in the right. If the suspected ear is closed and there is little or no increase in the length of time of hearing it, evidence grows stronger of middle ear disease. When both ears are simultaneously closed and the nerves are active, there ought to be very little difference in the length of time the fork is heard, unless we accept a condition hereafter explained as intermitted bone conduction. *As to the mode in which the tuning fork vibrations through the bones, reach the nerve.* There is no question but that sonorous impression may be carried direct from the skull to the labyrinth; in fact this is, undoubtedly, self-evident. But it seems to be proven by a case reported by Lucae in the Arch. f. Ohrenh, XVI., p. 88 and alluded to by Knapp, in the T. A. O. S. '80, p. 408, in which a case of congenital absence of the external and midule ear, with only the acoustic nerve and cochlia in a normal condition, had *good* bone conduction on that side, but considerably *better* on the other side, which was normal.

A much more important part of the vibrations, however, reaches the nerve by means of the apparatus of the middle ear. A better way to put the idea perhaps, would be to say that the membrane and orricula are much more readily thrown into vibrations than the immovable petrous bone, surrounding the nerve. Other evidence of the agency of the middle ear and its mechanism in carrying undulations to the labyrinth, will appear in the article devoted to intermittent bone conduction.

When the deafness depends on disease of the parts *beyond the external and middle ear* the tuning fork is heard badly or not at all in the

deaf ear, when placed at any of the central positions we have indicated. If it is a case with little difference in the hearing of either ear, the maneuver previously referred to of moving the fork beyond the middle line will aid us. If there is *any* hearing in the suspected ear it will be *increased* by stopping the meatus, although the increase may be very slight indeed, in many cases. This is on the principal that stopping the ear adds to the number of vibrations falling upon the nerve, and consequently increases the hearing, if there is no hearing, there can be no increase by closing the meatus If there is hearing by bone conduction, then there will be *better* hearing when the fork is placed near the meatus, as in middle ear disease it may be heard *worse* under the same conditions. The explanation of this has already been given and may here be repeated in this statement; if the middle ear is normal, the tuning fork is best heard near the meatus, but if it be diseased it *may be* best heard by bone conduction. If both ears are stopped the tuning fork will probably be heard best in the good ear, if it be a case of nervous deafness. Then in general terms the tuning fork will be heard by bone conduction, *better* in the bad ear in middle ear disease, and *worse* in the bad ear in labyrinth disease. In many cases of middle ear trouble combined with labyrinth disease the diagnosis will be very difficult indeed and all the rules laid down must be applied, which will require great ingenuity and judgment on the part of the Surgeon. The subject is still further complicated by recent developments pointing to what has been called intermittent bone conduction. This has recently been studied by Burkner in the A. f. o XIV. 96 and by Dr. J. A. Andrews in the N. Y. Medical *Journal*, and Obstectic *Review* for February 1882. The main points seem to be as follows:

1. A patient with *catarrhal otitis*, obstruction of the tube and collapsed membrana, with defective aerial conduction, *also* has bad bone conduction, but, on inflating the tympanum and restoring the position of the membrana to the normal, or at least a bettered one, which, probably improves the aerial conduction, and also improves the bone conduction, which may be better in this ear than the normal fellow, in accordance with the *rule*. This condition may return to the former state, if the tube again becomes closed with collapse of the membrana.

2. Pressure upon the round or oval windows, from fluid in the tympanum, masses of inspissated secretion, as dried flakes of mucous, pus, bloodclots, etc., which interfere with both bone and aerial conduction, but on the removal of which, restoration of both forms of conduction results.

3. Excessive hyperaemia of the tympanum, may interfere with both bone and aerial conduction, and on the subsidence of which these functions may be restored.

4. Anything, whatever, that interferes with the free vibration of the membrana tympani, the membrane of the round windows, the ossicula, including the impacted bone of the stapes in the oval window interfers with bone conduction, which may be improved by the removal of the hindrance to free vibration of these parts.

In connection with this subject of intermittent bone conduction, it may be interesting to discuss briefly the condition of the organ of hearing, when its function has been interrupted by some disturbance situated in the tympanum; whether the lowered hearing is due to pressure on the labyrinth fluids, and in its turn on the ultimate nervous apparatus, or to the non vibratibility of the ossicula and membranes, so that a diminished impulse is conveyed to the acoustic nerve. I am aware that I have held the opinion that pressure on the nerve was the principal cause of deafness. (T. A. O. 80.). Pressure of the finger on the eye will cause temporary diminution of sight, which is restored directly on removal of the pressure, although it is not *instantaneous*. Whether this would be the case if the pressure was continued for days or weeks, I am unable to say; probably not. In the ease of the ear, the hearing is restored instantaneously on inflating the tympanum, even though this condition may have been present for weeks together. The observations in intermittent bone conduction, seem to point conclusively to the fact that absence of free vibratibility of the ossicles, the membrana and the membrane ot the round window is the main cause of defective hearing. To test the bone conduction with utter thoroughness, would seem to require tuning forks representing every tone which is audible to the normal human ear.

CONTINUED AND ESSENTIAL FEVERS OF COLORADO.*

By B. P. Anderson, M. D, Colorado Springs.

Mr. President:—To conform strictly to a report of the varieties of "Continued or Essential Fever of Colorado," there would be required at the hands of the reporter, a paper of such voluminous proportions, as would occupy too much valuable time in its perusal; I have, therefore, deemed it best not to weary the Society with any lengthened description of the history, etiology, &c., of those types, or classes of fevers usually encountered, whose nature, terminations and treatment there exists but little diversity of opinion, but have thought it more important, practically, to confine the report to an obscure type of Fever, *I think*, we often meet with here, and in calling your attention to this type, popularly

*Read before the Colorado State Medical Society.

termed "Mountain Fever," I am fully aware of the universal discrepancy of opinion which obtains, and the great number of skeptics I must encounter, who doubt that any such special disease ever had an existence: who deny that it is of sufficient moment to be entitled to a distinct nomenclature, and who only hold to the belief that the disease *per se*, exists only in the mind and imagination of the laity. I do not hope to produce any convincing proof, or advance any original theories in support of a specific fever depending for its causation and origin upon the direct influence of the climate, but shall hope to promote a discussion which may lead to a clearer understanding of this much mooted question. But before entering upon a discussion of the subject it will not be out of place to enquire briefly into the nature of the Pyrexial state, and consider a few of the views entertained regarding the causes inducing the production of body heat. The phenomena characterizing a fever has been the subject of observation, discussion and investigation, since the time of Galen, and the subject elicits as much interest and importance at the present day, as in his time, especially so as regards Etiology. Two theories have been advanced in explanation of Hyperpyrexia—one that the rise of tempr., which is termed fever, is due to excessive oxidation going on in the various tissues of the body, the other theory maintains that the cause consists in retention and not in excessive heat production. Both views claim its partisans; both theories are held to be correct solutions of the phenomena, but there are those who claim the first as the only cause explaining fever. Dr. H. C. Wood, a strong advocate of the oxidation theory, says: "That had not so high an authority as Traube espoused the theory that the elevation of tempr. in the febrile state, is due to increased retention rather than to increase production of heat, it would seem scarcely worth while to prove that the chemical movements of the fever patient were vastly above normal."

Bristowe, and other recent writers, consider excessive oxidation the most important factor in the production of Hyperpyrexia. Wintermatz, on the other hand, while endorseing, to a considerable extent, the oxidation theory, says: "That there can be no doubt that the diminished discharge of heat is largely instrumental in causing an elevation of tempr.;" and he considers the coldness of the extremities, and of the surface of the body generally, in the early stages of fever, prove that there is diminuition in the amount of heat discharged."

In the past few years, and very recently, Lenator, Leibermeister and Leyden, of Germany, Burdon Sanderson and Bomyman, of Great Britain, Pennaud, of France, and H. C. Wood of our own country, have devoted much time and care to the investigation of this question. After the most patient and accurate study and investigation, with carefully con-

ducted experiments, they have arrived at the conclusion, that a healthy person on full diet, produces a greater amount of heat in a given time, than one with fever on such a diet as fever patients are allowed. The conclusion of these observers presents a very interesting question: "Why, if the healthy system on full diet, produces more heat than the fever patient, the tempr. of the former remains invariably at 98° F., while that of the invalid rises often to 107° during fever?" In the case of the healthy subject the apparatus for the repression of the inordinate heat production and heat dissipation, is in perfect order, permitting the constant but equable escape of heat from the body as rapidly as formed, while in the case of the fever patient the same apperatus, the ganglionic and vaso motor systems, are in a state of complete derangement, not only failing to repress undue heat production, but by spasmodic action on the circulatory system causing extreme vascular contraction, heat retention, and diminuation of radiation, which constitute what is denominated fever.

It is unnecessary here to enter into a detail of the various chemical changes which occur during the development of heat, or the behavior of the nervous system, the sympathetic system, etc., and I have briefly alluded to the two most important theories advanced, explaining the cause of Hyperpyrexia, the one, that of retention of heat and not excessive oxidation, being probably the most important factor in the duration of the subject of this report.

The term "Mountain Fever" has gained a popularity which cannot easily be put down, and physicians, as well as patients, have acquired the habit of using the name in alluding to cases of fever, whether they believe in the actual existence of such a disease or not. It is obviously important to investigate for or against the validity of the claim to the name, and the presence of the disease as a fever suigeneris, or whether the term is a misnomer, and the fever a myth, entitled to no special consideration. From the answers to the circular letters sent to members of the profession throughout the state, by Dr. Jesse Hawes, and detailed in his report upon Malaria, read before this Society at its last meeting, held in Leadville, it seems that the majority repudiate the name and existence of Mountatn Fever; the majority holding to the opinion that the so-called malady should be classed as a Remittent, a Malarial, or a mild Typhoid. Here I must exemplify the old adage, that "doctors disagree," and must express a difference of opinion in that, I believe, we observe in this region of country a continued fever, possessing peculiarities which entitle it to a special classification, whether we call it Mountain Fever or not. If there does exist such a fever, having a distinct symptomatology, the pathological evidence remains obscure, and in regard to