THE TREATMENT OF OTOSCLEROSIS.

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AT the International Otological Congress in Paris in 1922, I read a paper on the Treatment of Otosclerosis. It lies buried in the Archives, and as it received no other publicity, I make no apology for quoting from it here.

It is an everyday observation that infective processes lasting a short time, are accompanied by acute inflammation, while in those lasting longer, the inflammation is less active, and may indeed, in very protracted ones, be scarcely noticeable. This relationship is so constant that it is not too much to assume that there is a direct causal connection between the degree of inflammation and the length in time of the process. In other words, the acuteness or chronicity of an infection is a function of the degree of irritation excited by the infecting organism, and this in turn appears to depend partly on the quality of the toxin excreted by the microbe, and partly on the irritability of the tissues of the host.

An acute infection, therefore, is acute because the local annoyance is great enough to bring about a determination of blood to the affected part: and the business of this increased blood supply is to fight and kill the invaders and so bring the process to an end. Similarly, a chronic infection is chronic because the local annoyance is much less; and it often looks as if a tacit agreement were arrived at between the invading and defending forces to the effect that if the former do not create too much disturbance no determined effort will be made at their eviction.

In olden days, inflammation was looked upon as an evil thing: we now know it is the rampart that protects us from being eaten alive. From this view we may conclude that cure is often delayed through insufficient inflammation, and that it is reasonable in such cases to excite it artificially. The old practice of cauterising depends on this for its success. No one supposes that by it all the microbes are killed *in situ*. Cauterisation irritates the tissues so that a local inflammation is excited, and the conditions of an acute infection are mimicked.

This practice of curing chronic infections by exciting acute

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inflammation is as old as medicine itself. Its beginnings were of course crude, and were represented by the hot iron—an instrument that has not yet been beaten out of the field. With the growth of knowledge other things were employed, until to-day we are provided with an armoury of the most varied character. We have only to remember that anything that can cause tissue destruction will, when mitigated, serve as an irritant, in order to realise how wide is our choice. Of these chemicals, in an unending series, light, heat, cold, X-rays, and radium may be mentioned. But whatever means may be selected as best suited to the need of the moment, it is important to remember that the underlying principle is in all such cases essentially, or at any rate predominantly, the same, viz., the production of a suitable degree of local inflammation.

The principal immediate cause of deafness in otosclerosis is a hindrance to the passage of sound-waves to the cochlea, caused by disease in the joint surrounding the foot of the stapes. While the difficulty of following step by step the precise changes that occur during the progress of the disease is very great, the lesion is well known to consist histologically of a bony deposit uniting structures that ought to be freely movable. Concerning its ultimate cause or causes, authorities are not yet agreed. Perhaps it would be truer to say no authority has yet arisen. Be that as it may, the probability that this change is brought about by a micro-organism is, I think, very high; and is certainly more than high enough to justify an attempt to treat on that hypothesis a disease for which, as most otologists admit, little or nothing can be done.

Assuming, then, that the malady is an infection, the problem of treatment on the lines above indicated, narrowed itself down to finding an irritant suitable for provoking inflammation at the seat of the disease. It was essential that the degree of reaction could be regulated precisely, so as to avoid unbearable pain or any destructive effect on very delicate tissues. After a good deal of consideration both as to materials and methods, I determined, in 1916, to try intra-tympanic injections of iodine, using the tincture in various dilutions. After prolonged trial I found 15 per cent. a useful strength: one that, while producing a lively reaction, was not intolerable, and if not used at too short intervals was unlikely to cause local damage.

The method of injection was as follows:—A specially constructed and very simple syringe was employed. This

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consisted of a teat made from $\frac{1}{4}$ in. rubber tubing with a moderately thick wall, and a long needle, over the proximal end of which the teat, when filled by means of a pipette with solution, is pushed. Into the point of this needle a smaller one is soldered. This latter is the portion which traverses the membrane, and is therefore as fine as possible. Holding the teat between the thumb and index finger of the right hand the injection is made behind the malleus, the desired quantity of liquid being squeezed out by compressing the teat. This can be done with the greatest delicacy. (This instrument is now obtainable from Messrs Mayer & Phelps.) The act of puncture is nearly or quite painless, but immediately after injection the vessels of the drum dilate, pain develops to its maximum in about a minute and then slowly abates for about a quarter of an hour, when it quite clears off. The reaction

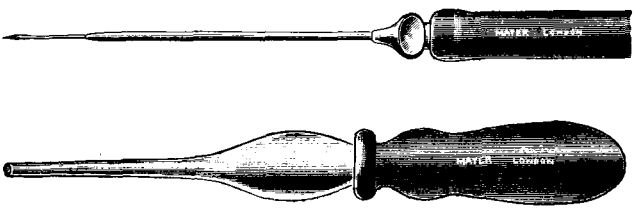


FIG. 1.

lasts a number of days and at the end of a fortnight has quite passed off, no trace being left of the puncture.

In the paper above referred to, I wrote:—"Bearing in mind the essential chronicity of the otosclerotic process and the fact that the pathological changes are to a large extent bony, it will be conceded that sudden and dramatic improvements are hardly to be expected. Nevertheless, my experience leads me to hope and believe that treatment on these lines, if undertaken when the disease is incipient, will not merely preserve but in time improve the patient's hearing. I have found that in long-standing cases such treatment is worthless or nearly so."

After a further six years' experience of the method, I endorse this view. The improvement in hearing in early cases has often been very great while the old ones get little or no good. Bearing in mind the profound, if somewhat cynical, comment of the late Dr Earl of Dublin on a supposed miraculous cure—"You can, of course, cure any disease if you only make a wrong diagnosis"—let me say that I do not

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regard any case as coming under the heading of otosclerosis unless it conforms to the following signs and symptoms:—

(1) Slow onset.
(2) Tympanic membrane normal in shape and colour.
(3) No improvement on inflation.
(4) Negativity or low positivity for Rinné's test.
(5) Raising of the lower limit of hearing.

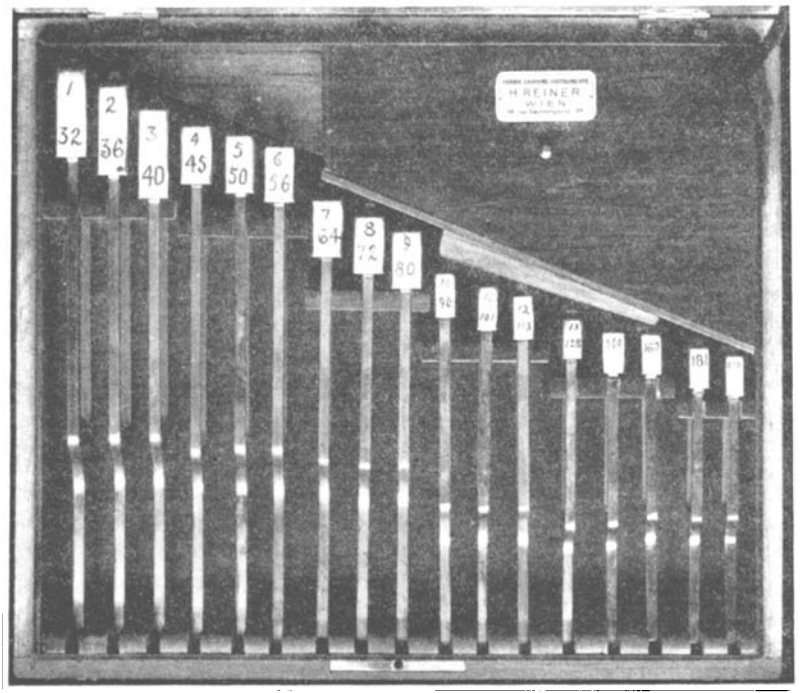


FIG. 2.

I have modified the details of the treatment in certain directions. Instead of tincture of iodine I now employ liquor iodi B.P. diluted to one-tenth its strength. I consider this is somewhat more stable than the tincture, but even this inclines to weaken with keeping and should only be made up in quantities to last not longer than a week. Injections are made not oftener than once a fortnight, this ensures that the effects of the previous injection has quite passed off and renders muco-purulent catarrh a remote possibility. One of the dangers of too frequent injections is that a local necrosis

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of the membrane may be caused leaving a perforation which may be troublesome to heal. I have made injections twice weekly without this happening but as I now know, this is much too often.

It is in early cases that one gets good results, and of course the earlier the better. It is, however, rare for hearing to be fully restored, but that any marked improvement ever takes place in this intractable malady is satisfactory. It appears to me that when improvement does take place, we may be reasonably sure of its permanence.

In measuring the degree of middle-ear deafness, most observers depend on Rinné's test, the hearing distance for the voice, and the watch or acoumeter. It is strange that though in middle-ear deafness it has long been known that the lower limit of hearing is raised, no systematic observations on its degree have, as far as I know, been made by any observer, still less has it been used as a measure of the acuteness of hearing. Yet I consider it of the very highest importance, for this test is qualitative, while all others are only quantitative.

My observations go to show that the progress of otosclerosis is accompanied by a perfectly steady upward retreat of the lower limit of hearing. While this is true of each particular case, it would be wrong to assume that cases are parallel to each other in every respect and that, supposing we were given the lower limit of any one, we could predict for that case the precise degree of negativity of Rinné's test. On the contrary, two cases may each have a lower limit of, let us say, 64 vibrations per second and one may show Rinné's test as—10 and another as—20, and at higher degrees of deafness the discrepancy may be even greater.

For convenience of observing this limit, I have had constructed for me, by Reiner of Vienna, a series of tuning-forks beginning with C_{32} and extending upwards for about two octaves and a half. The last fork of the series has a frequency of 202 vibrations per second. This range is large enough though none too large for everyday cases.

Instead of dividing the octaves as in the ordinary diatonic scale, where the seven intervals are sometimes whole tones and sometimes semitones, I have had the divisions all made equal, *i.e.*, six whole tones to the octave. The value of each interval is therefore the same. By these instruments it is a matter of

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the greatest simplicity and rapidity to determine the pitch at which the patient ceases to hear. Accuracy of observation is further assured by the well-known fact that, with low pitches, it does not greatly matter whether the fork is struck with great, or moderate, force. For though in dying, the law of logarithmic decrement is still obeyed, the loudness is sustained almost evenly for a reasonable time instead of falling rapidly as in the case of high-pitched forks.

C_{32} is properly regarded as the lowest useful note for examination. People do not complain of middle-ear deafness until that note and generally others have been lost. Nevertheless, it is useful to have a lower fork for use in suspected cases. A patient deaf in one ear will inquire anxiously concerning the possible implication of the other. I know of no more delicate or certain test than a very low tuning-fork, say 24 per second. It looks as if the lower limit begins to fail before any other sign of deafness makes its appearance. If a patient with middle-ear deafness in one ear, can hear very low pitches in the other, I feel confident in saying that not only has the good ear escaped, but that it is unlikely that it will be attacked.

Many years ago, on the same principle, I tried radium emanations. I obtained the material from the Royal Dublin Society's Radium Institute, where they were kind enough to put it into a specially constructed spherical glass bead: but probably from inadequate screening, I found it had too severe an effect on the tympanic membrane, and I gave it up. Some three years ago I again tried it after it had been suggested by Drs Stevenson and Wilson, using 8·5 to 10 mgrms. of radium element in platinum containers of 0·5 mm. and 0·6 mm. thickness, with better results. I still use both the iodine and radium methods, but am not yet in a position to dogmatise on their relative merits. My impression is that in early cases iodine gives better results, and in old-standing ones radium. But much work has yet to be done before reliable conclusions can be arrived at, and to this end the testimony of many other observers is necessary.

The object of this paper will have been attained if otologists think that a case has been made out for the rational treatment of a disease that has hitherto been somewhat of a reproach to our specialty. The number of cases that come to one while they are still in their early stage, are, in my experience, quite few. People do not complain until they have something to

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complain about, and the disease is so insidious that patients are reluctant to think that anything serious is wrong until tests show deafness to be well established.

Otosclerosis, as is well known, runs in families; and if we could overcome the fatalism of the public in accepting the incurability of "family deafness," children or adolescents might be brought for examination before things have gone too far to save useful hearing. If the deep note test is applied, there should be no difficulty in determining whether the disease has started or not; for in an early case, long before any inconvenience has been caused, or even suspicion aroused, a note or two will have been definitely lost.

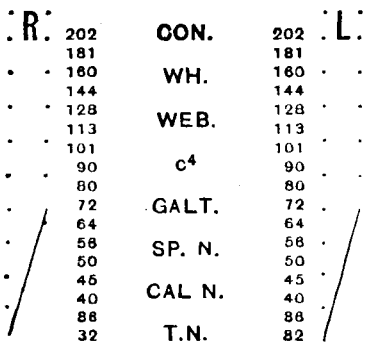


FIG. 3.

I have found a rubber-stamp, as illustrated, a great convenience for note taking. These are obtainable at Humphries in Dame Street, Dublin. The numbers are the frequencies of the tuning-forks above mentioned. The dots to the right and left of the numbers represent Alexander's diagram for Rinné's test. The second vertical line in each case represents the time the tuning-fork (middle C. 256, v. p. s.) is heard by bone conduction: and the first line which is four dots longer, the time heard by air. The intervals between the dots represent ten seconds, from which it will be seen that, in a normal case, for my tuning-fork, which is 14 cm. long, 12 mm. broad, and 6 mm. thick, air conduction is 40 seconds longer than bone. The contractions between the figures stand for conversation whisper, Weber's test, c^4 2048, Galton's whistle, spontaneous nystagmus, caloric nystagmus, and nystagmus after turning.

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Fig. 4 represents the findings in a supposed case of right middle-ear deafness and left cochlear deafness.

A glance at the diagram shows among other things that in the right ear bone conduction is lengthened by 10 seconds,

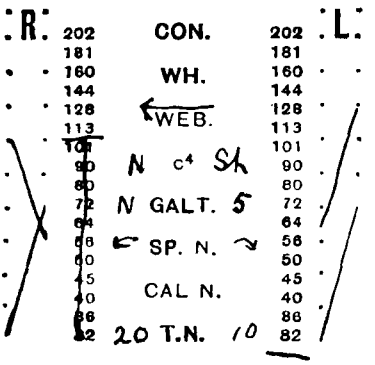


FIG. 4.

Rinné's test strongly negative, and the lower limit of hearing raised to 113 vibrations per second. Weber's test is seen to be lateralised to the right. In the left ear bone conduction is greatly shortened, while Rinné's test remains fully positive and the lower limit is at normal level. Nystagmus after turning is 20 seconds for the right ear (*i.e.* after left turning), and 10 for the left.

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