The nature and causes of catarrhal, "throat", or hereditary deafness : an explanation of paracusis willisii the mechanism of aural accommodation, the regulation of labyrinthine fluid pressure, the tightening of relaxed tympanic membrances and joints, the relief of tinnitus aurium with the description of a new method of treatment and some illustrative cases / by Charles J. Heath.

With the Author's compliments.

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AN EXPLANATION OF PARACUSIS WILLISII.

THE MECHANISM OF AURAL ACCOMMODATION
THE REGULATION OF LABYRINTHINE FLUID PRESSURE
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With the Description of a New Method of Treatment
and
Some Illustrative Cases

An Address delivered before the West Kent Medico-Chirurgical Society at the Miller Hospital, Greenwich, March 4, 1910.
(Revised, and Amplified by the addition of numerous Explanatory Notes.)

BY

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Do not bind me by tradition,
Nor say what others do.
I saw my work ahead,
And did begin.

THE NATURE AND CAUSES OF CATARRHAL, "THROAT," OR HEREDITARY DEAFNESS

IN PERSONS MOST OF WHOM HEAR BEST IN A NOISE (PARACUSIS WILLISII)

There are far too many deaf people in this country. The majority of them derive no benefit from treatment and have *paracusis—i.e., they are able to hear better in a noisy place than in a quiet one.* This condition is especially noticeable in a moving train or omnibus, or in a factory where machinery is in motion. In such surroundings patients with this kind of deafness can, indeed, often hear even better than those whose hearing is normal, though some of them seem unaware of this fact.[1]

[NOTE 1.—Some deaf people are unaware of their ability to hear better in a noise, through want of careful observation, others through the belief that it is customary to speak louder in a noise, or through different conditions or stages of disease in the opposite ears.

The well-known difficulties which have been experienced when attempting to improve the hearing of patients with this kind of deafness have resulted in a common belief that no treatment is likely to do it good. Though its cause has never hitherto been satisfactorily explained, yet paracusis has long been observed to be such a bad sign in a case of deafness, that a prominent specialist formerly on the staff of an Ear Hospital, and now in charge of the special department at a General Hospital, recently informed me, that if deaf patients on consulting him were found to have paracusis, he told them not to come to him again as such deafness was incurable.

Drug treatment has been tried for it. Such drugs as quinine and pilocarpine have, indeed, an effect, yet one that is usually only temporary, is always uncertain, and often pernicious.

NOTE 1—*continued*

Thus paracusis may be observed in one ear and not in the other. In a quiet room paracusis can often be demonstrated on a deaf person by applying a watch to the ear, and then placing a deep-toned vibrating tuning fork on the vertex,* this often brings on a reflex-protective muscular action of the tympanic muscles, and if the hearing is thereby improved the patient may be regarded as having *paracutic* deafness.]

[* Bárány has recently devised a "noise machine" which can be used for this purpose against a chair on which the patient is sitting; it is, however, too noisy to be used in contact with the head or ear.]

This evening I propose to describe some methods of treatment by the aid of which, as my cases will show, it has been found possible to deal effectively with *paracutic* deafness (as we may term it), no matter how intense it may have been, or how long it may have lasted.

These patients often go to one aural surgeon after another, in search of relief. The measures hitherto employed, however, have tended rather to aggravate than to improve the conditions responsible for the deafness; they were instituted in consequence of a general belief that deafness, when accompanied by paracusis, is the result of a stiffening of the tympanic joints.[2] Teaching in

[Note 2.—If paracusis were indeed due to rigidity of joints, some at least of the great number who every year have undergone treatment by inflation and massage would have been cured of this symptom as soon as these structures became obviously relaxed by treatment. *I have neither seen nor heard of a single instance of cure by such measures*, though I have observed the drum-heads and joints of a great many unduly relaxed by these unnatural and disturbing procedures. The ear is not so constituted as to withstand such violence. The tympanic joints and membranes are far too weak to tolerate such strains, and in many cases they have thereby been loosened to such an extent as to be quite useless. Deafness has consequently increased, and paracusis has remained. The explanation which I will give of the *cause* of paracusis, and the success

accordance with this belief has consequently been in vogue for many years, though treatment founded on it has uniformly proved ineffective. For more than a generation the profession has been practising this ineffective, this unfortunate treatment.[3] I shall bring conclusive evidence to prove that paracusis is not the result of any stiffening of joints; that, far from this being the case, it is, on the contrary, usually associated with their undue mobility, amounting, indeed, occasionally, to *extreme relaxation of all the tympanic structures.* Such a

NOTE 2—*continued*

of the treatment I have accordingly devised for the cure of the deafness which accompanies it, will enable the reader to understand why it is that paracusis persists even after the *hearing* has been restored or greatly improved, by the remedy I am about to describe.]

[NOTE 3.—*Unfortunate* because perpetual failure to cure by such treatment has led the Otological world to believe that deafness of this kind is incurable. It is of necessity incurable by measures, which, as I will presently prove, are unsuitable for this sort of deafness. Any disease may prove refractory when inappropriate remedies are applied. If the old pathological teaching were correct—viz., that paracutic deafness is due to stiff joints, then the *loosening* treatment of the past thirty or forty years, which was founded upon it, *could not have failed so completely as it has.*]

condition must obviously be aggravated by the treatment which has been recommended, and hitherto practised, for it has mainly consisted either in distending the tympanum with air, thereby stretching still more the relaxed membranes and joints, or in shaking them up by vibrating massage, when, as a matter of fact, *they were already far too loose.*

Having effectively treated a large number of these cases, I feel justified in asserting that the association of paracusis with deafness does not necessarily render the prospect unfavourable. The ability of these patients to hear perfectly in a noise proves that *the hearing apparatus is, under these circumstances at all events, working well.* It also suggests that the difference between the condition of the ear in a noisy place in which a *paracutic* can hear, and in a quiet one in which he cannot, may be very little. That significant fact has given encouragement throughout my investigations.

This ability to hear better in a noise than otherwise was termed *paracusis* by Willis, who first drew attention to it, and attributed it to *looseness of the drum membrane.* It has since been called after him *paracusis Willisii.* Though a loose drum-head may help to cause deafness, I will presently explain why this condition *alone* is not the cause of paracusis. The relaxed condition of the drum-head *which is the rule in patients with paracusis,* and which

therefore led Willis to regard as the cause of it, is, however, usually associated with an increase in the mobility of the hammer bone, to which it is extensively attached. An excessive movement of one or of both of these structures can often be demonstrated with the aid of the pneumatic speculum. It can also be seen that the hammer bone, though unduly movable, is usually less so than the membrane. It is therefore probable that the latter, which in its vibrations pulls the hammer with it, may occasionally be responsible, in some degree, for the relaxation of the joint between that bone and the anvil. Nevertheless great mobility of the hammer can only occur when the ligaments holding it in contact with the anvil bone are relaxed, for the latter has other attachments, and the relatively large articulation between these two tiny bones, is, to all intents and purposes, the most important joint in the ear; yet its ligaments are extremely frail and therefore easily stretched. I have observed and demonstrated that the comparatively motionless drum-head (drum-membrane or tympanic membrane, as it is also called) can be moved to some extent by muscular action alone, though its movement is more often due to the influence of air vibrations. As it is the function of the lower end of the hammer to accompany it, the movements of this bone somewhat resemble those of the pendulum of a clock. The lower end of the anvil is not

equally free to move, for by a curious and miniature articulation, the action of which has never been fully explained, it is attached to the stirrup bone, the footpiece of which is fastened to the membranous oval window (fenestra ovalis) closing one of the two apertures in the otherwise bony capsule of the labyrinth, *which contains the real organ of hearing.*

Study of the tympanic mechanism affords evidence that the two tympanic muscles, the tensor tympani at one end of the chain of bones, employed mainly in regulating the tension and therefore the position of the tympanic membrane, and the stapedius muscle at the other end, similarly controlling the membrane of the oval window, have, in addition to those important duties and under the reflex influence of *ordinary* sounds, a certain amount of balancing or opposing action on each other, through the medium of the chain of bones. These muscular forces, though apparently somewhat conflicting in their action, are harmonised in their effective ratios by the controlling influence of centrally organised reflex nervous impulses, which are regulated in accordance with and in response to impressions arriving mainly from the labyrinth. They are thus delicately adjusted in gentle tonic opposition,[4] and by in-

[Note 4.—The muscles supplied by the facial nerve, and those whose action is opposed to them, seem

hibition or stimulation are rendered variable in the alternating incidence of their dominating action. They therefore have an effect which may be compared to the neuro-muscular mechanism which reflexly controls the size of the pupil under the stimulus of light. This arrangement in the ear should therefore also be named *accommodation—aural accommodation*. It would take too long on the present occasion to describe fully this accommodation by the ear. I will, however, just mention that, as in the eye, it clearly has a protective purpose.

The physiological arrangements in the tympanum being similar to those elsewhere, and the two tympanic muscles being opponents in their action, then it follows that their nervous requirements should be, and they are, derived from different sources.

These delicate tympanic adjustments, however, are deranged by the pathological changes I have mentioned, and will presently more fully describe, as taking place when the drum-head and joint are stretched. *These structures often yield under ordinary tympanic strains* when their fibrous parts are atrophied and thus weakened by catarrhal disease ; they may be

NOTE 4—*continued*

always to be more or less in action ; they do not rest so much as other muscles. They seem to have more tonus, *e.g.*, those that raise and lower the upper eyelid.]

similarly stretched *by frequently and forcibly distending the tympanum with air*, and also *by the striving action of the two opposing muscles*, when their action, (which is protective to the labyrinth) is reflexly *stimulated to excess by a loud noise*. These muscles are not in such direct opposition as are the weights at the ends of the beam of a pair of scales. Their forces are co-ordinated mainly through the medium of a slight twisting movement of the hammer bone, which, suspended by its ligaments, articulates with the anvil above, and is imbedded in the drum-head below. Thus these structures together comprise the fulcrum, and the stability of each is essential. Excessive movement of the hammer, in whatever manner it may be caused, leads to relaxation both of the joint and the membrane and produces an unstable fulcrum. The result of this relaxation is, that the tensor tympani when in ordinary action (*i.e.*, not unduly stimulated by a noise) pulls on tissues which neither adequately resist its powers, nor on account of the relaxation of the joint, are able fully to transmit them to the opposing stapedius. Removal of proper control of the latter muscle by the tensor, through the medium of a soundly-jointed chain of bones, results in derangement of the balance of accommodation between the tympanic and labyrinthine muscles; consequently the tension of the tympanic membrane, and of the membrane of the labyrinthine (oval) window, cannot be varied in that precise manner,

which is necessary in order to ensure their responsive vibration in accordance with sounds of different kinds, such accordance being necessary for good hearing. Further, the contraction of the stapedius now inadequately controlled exceeds its proper limits, and leads to stretching of the membrane which surrounds the footplate of the stirrup bone in the oval window of the labyrinth. It is mainly due to relaxation of this membrane, resulting, as I will show, in deafness due to diminution of the integrity, that is of the *resilient tension* of the labyrinthine capsule at this important part, which permits of that *better hearing in a noise*, to which Willis, long ago, gave the name *paracusis*. The better hearing being chiefly due to *the stronger reflex action of the stapedius muscle in a noise*, its action being to increase the tension of the oval window and thus to facilitate its vibration and therefore the transmission of sounds.[5]

During my study of this subject I have often induced these accommodating and protective, though hidden, muscular movements, with the object of investigating their various purposes. I have observed, and demonstrated to other surgeons, the *visible* tightening of the drum-head, and also variations in the power of hearing due to alteration of

[NOTE 5.—Parts which are intended to vibrate must be subjected to a certain amount of tension.]

the position of the stirrup and oval window (and consequently of the tension of this, the only muscularly movable part of the labyrinthine capsule), which were brought about by the muscular action I had induced in the tympanic cavity of one ear of a *paracutic*, in reflex response to sounds acting directly on the other ear alone.[6] I have also

[NOTE 6.—Such a demonstration of the movement of the drum-head in consequence of muscular action, can be carried out thus: the surgeon who is the observer should examine this membrane (which must be a relaxed one in order that its movements shall be sufficiently pronounced to be easily visible to the naked eye) through a pneumatic speculum. The speculum should be made to fit the meatus closely, so that no ordinary sound waves can enter the ear under observation. When it is desired to observe the movement of the drum-head, an assistant is required, to hold and strike a small gong or bell near the *other ear* of the patient. This ear being exposed to the sound, its muscles are reflexly tightened as a natural action which is protective to the labyrinth, and the muscles of the ear under observation, *accustomed to act with those of its fellow*, are also reflexly brought into action,* and in doing so, one of them, the tensor tympani, tightens the drum-head. The membrane appears to tighten at the same moment as the gong is struck, so rapid is the reflex. These muscles might be said to conform to "Broadbent's law," if that law can legitimately be applied to a condition of health.]

[* The pupils also act thus in harmony.]

observed and demonstrated similar though slighter improvements in the hearing power, similarly induced, in certain patients whose drum-heads, hammer, and anvil bones have been removed from both of their ears by operation on account of disease, only the stirrup and its muscle still remaining effective in the tympanum. Under such circumstances any improved hearing could not possibly be due to an altered condition of the drum-head or joints, for those structures had been removed. As I shall prove later on, it may as well be asserted now, that the improved hearing of those patients, as of others, in a noise, is chiefly due to the action of the stapedius muscle in pulling on the stirrup and tightening the oval membrane, thus increasing the tension of this movable part of the labyrinthine capsule, for there is some deficiency in its tension, in paracutics, *except when they are exposed to a noise.* I attribute the improved hearing in a noise to a *tightening* of the oval membrane, such a tightening being necessary in order to render it capable of vibrating properly and thus transmitting the sound waves from the bones or air on its outer side to the labyrinthine fluid within.

Now there are various ways in which this combination of paracusis with deafness may be caused. One is by frequent and energetic blowing of the nose while holding it tightly in the handkerchief. Deafness thus produced is by no means rare, though this

habit has not hitherto been regarded as a possible cause. The drum-heads and tympanic joints in many deaf people, though weakened and somewhat relaxed by the changes I will presently describe, would not have become sufficiently stretched to cause deafness but for this forcible distension of the tympanum.

Let me give an example. A boy (Master S.), æt. 10 years, was brought to me suffering from deafness with paracusis. The rest of his family had excellent hearing. He also suffered from nasal irritation due to enlargement of the turbinal bodies, and the resulting discomfort led to the constant and vigorous use of the pocket-handkerchief, and consequently to *violent distension of his ears*. His mother said: "he blows his nose more than anybody I ever met." On examination it was found that the tympanic membranes and joints had become much relaxed by this pressure, though he was younger than those in whom such conditions are usually to be observed.[7]

Another instance is that of a lady, who to my knowledge had had good hearing, and in whose

[NOTE 7.—Though this patient was exceptionally young to be afflicted with this kind of deafness, it should be pointed out that many of the ear troubles of youth (especially those briefly associated with earache, and discharge) which in the past have been considered trifling, are in reality responsible for a very large proportion of the deafness which supervenes in later life.]

family there was no deafness. She had suffered from "hay fever" for several summers and had become deaf. Her deafness also was associated with paracusis, and accompanied by relaxation of the drum-membranes and joints. This condition was undoubtedly the result, as in the boy just mentioned, of distension of her ears by frequent and forcible use of the pocket-handkerchief.

These two cases may be regarded as examples of deafness much increased, if not entirely caused, by the repeated and vigorous use of the pocket-handkerchief — *i.e.*, *pocket-handkerchief deafness.*[8]

While such frequent distension of the tympanum with air may be responsible for paracutic deafness in a certain number of people, this habit alone does not appear to be the most frequent cause of this trouble. In the majority the conditions indicate more than a mere flaccidity of membranes and a simple relaxation of joints: an actual change in drum-head structure is perceptible, a change which apparently involves all its com-

[NOTE 8.—Our ancestors used no handkerchiefs, and suffered less from ear troubles than we do. Further, the distension of the tympanic membrane, which results from frequent and forcible blowing of the nose while holding it tightly, is often accompanied by distension of the alveoli of the lungs, and, if persisted in, leads to emphysema.]

ponents. The change is often obvious, the membrane becoming unduly thin and often transparent, there is a loss of substance and therefore of strength. For a reason which I will explain later there is atrophy, yet not precisely of that kind which is associated with fœtid ozena, nor indeed is the nasal mucous membrane necessarily dry, *though it may be so.* Atrophy (less marked in the drum-head, than in other tympanic structures), nevertheless, appears to be the most frequent cause of this combination of deafness with paracusis.[9] Examination will practically always disclose the fact that patients with deafness of this kind, though they may often be unaware of it, have catarrh of the mucous membrane lining the nose and throat. *This is a constitutional condition,* and prone, therefore, to affect the lining of the middle ear also, for this cavity is but a lateral extension from the nose. Catarrh in these cavities, though at first usually associated with swelling and increase in the secretion

[Note 9.—Apparently this atrophy affects the drum-head least of all the tympanic components, for the structure of the mucous inner lining of this membrane does not permit of such a thickening in the early stage of aural catarrh as occurs in the more vascular parts of the tympanum. Consequently gross changes are more evident elsewhere in the cavity; indeed, in some of these cases, the drum-head itself has a practically normal *appearance.*]

of mucus, causes in course of time some degree of atrophy and relaxation.[10] Further

[NOTE 10.—In a large proportion of these patients there is visible, indeed obvious, atrophy of the mucous membrane of the nose and naso-pharynx, and *increase in the viscidity of the mucous secretion, accompanied usually by a considerable diminution in its amount.* With tympanic structures in a similar condition faint sounds impinging on the drum-head may not be transmitted as far as the labyrinth, and so the two muscles may not be reflexly brought into play, their action only being ensured when louder sounds, which, by causing greater excursion of ossicles, reach the labyrinth, and stimulate the muscles reflexly through it. With the reflex muscular action induced by the louder sound, there is increased tension of the oval window as well as of the drum-head and the intermediate bony chain, and consequent improvement in transmission of sound to the labyrinth—*i.e.*, better hearing. This lack of muscular action in paracutic cases during slight sounds (which in ordinary life comprise the majority) means less frequent muscular movement, and it is in harmony with our experience elsewhere, that lack of use leads to atrophy of muscle and therefore to diminution of muscular tone. Deficiency of tympanic muscular tone I have long regarded as being included in the complex change which results in that form of deafness which is associated with paracusis. Further, even before atrophy follows the stage of swelling, and while swelling is still in evidence, some muscular atrophy due to immobility of the tympanic apparatus in

the nasal discomfort, simulating obstruction on account of slight anæsthesia of the mucous mem-

NOTE 10—*continued*

consequence of this obstructive swelling, may take place through lack of exercise, muscular exercise only occurring during loud sounds. Theoretically massage should improve muscular tone, and consequently the hearing, *and it may be so for a short time;* unfortunately, however, in the ear, the only method of applying massage has the effect of relaxing the weakened joints and membranes still more, and no improvement in muscular tone alone will entirely compensate for these changes. It is obvious that a weakening of the joints of the ear must result in a relaxation of the medium through which the two muscles oppose, and through which, therefore, they should regulate, each other. Such a relaxation entails a derangement of *aural accommodation*, and therefore defective hearing. A very large number of patients who have been treated by massage and have honestly believed that their hearing was at first improved thereby, have later discovered that its effect was actually harmful; and some of them, who have come to me for treatment of their paracutic deafness, have told me so. *The swelling of the mucous membrane* which also occurs in aural suppuration, in addition to *stretching the joints and membranes*, is an obstacle to muscular action and consequently diminishes muscular tone. These are strong reasons for not permitting this disease to persist until permanent relaxation, and consequent paracutic deafness, are inevitable. Further, the suppurative process, if allowed to persist, causes per-

brane,[11] frequently leads to such use of the pocket-handkerchief as the atrophied and weakened tympanic structures are unable to resist, or sometimes, indeed even to feel, for there is generally some anæsthesia of the middle ear also. This I have often proved by observing the movements of the drum-head while the patient, though unable to feel that he was doing so, was distending the cavity.

The combination of symptoms associated with this form of deafness is too constant to be merely accidental. The combination I refer to is usually this: paracusis, a free—unduly free—Eustachian tube with nasal catarrh, a loose and thin drum membrane, a loose hammer bone, together with a negative Rinne test, and a structurally sound labyrinth, *as far as we are able to test it.* Some of these patients complain of a noise in the head or ears, and there is usually a deficient secretion of wax. A considerable proportion of the patients

NOTE 10—*continued*

manent injury to the secreting surface of the lining mucous membrane; the result is either a deficient secretion, or an alteration in its character, whereby it is (through its increased viscidity), rendered less perfectly adapted for the lubrication of the delicate tympanic mechanism, the mobility of which is consequently impaired, and deafness is the result.]

[NOTE 11.—Wingrave pointed out this anæsthesia of the nose.]

whose ears thus become diseased, have a history of dyspepsia or constipation, of gout or rheumatism. Others are chilly mortals, with defective cutaneous circulation, needing hot bottles near their feet at night, and many have suffered from sore throats or chilblains in childhood.

The final stage of many of the cases of aural as well as of nasal catarrh being atrophy of mucous membrane, this condition, and the relaxation I have mentioned, are usually responsible for most, if not for all of these altered tympanic conditions. It is also interesting to observe that this atrophic change may characterise the final stages of aural catarrh of both the suppurative and non-suppurative varieties. Apart from the liability of suppuration to destroy the drum-head, the ossicles, or life itself, there is a greater affinity between it and non-suppurative catarrh than has hitherto been recognised. Either may follow the other, and occasionally they may be associated for a time in the same ear.[12] In

[NOTE 12.—*e.g.*, Acute inflammation, causing interference with drainage through swelling of the mucous membrane, and consequently perforation, taking place in an ear which was previously the seat of chronic non-suppurative catarrh, the acute symptoms afterwards subsiding, and the perforation healing, leaving the chronic catarrh unaltered. I have observed this in each ear of one patient, with an interval of ten months between the attacks; the infection on the first occasion was pneumococcal, on

each there is microbic infection;[13] both kinds are at first marked by increased discharge, though

NOTE 12—*continued*

the latter it was mixed. This patient has catarrh of the ear, nose, pharynx, larynx, and trachea, which appears to be constitutional and hereditary,* for her mother suffers in a similar way, and has likewise a ruddy complexion. This young patient is becoming deaf, and I attribute this, partly to frequent use of the pocket-handkerchief in consequence of the discomfort arising from the nasal catarrh, and partly to the catarrh itself. It has often appeared to me that many of the so-called suppurating ears should really be regarded as non-suppurative catarrhs, in which the drum-heads have become accidentally perforated (as in this case) and have failed to heal.]

[NOTE 13.—This assertion is not made without evidence. In order to settle this point, I have carried out bacteriological examinations of middle-ear mucus (the tympanum being approached through the cranial cavity in order to avoid the possibility of contamination) of patients with healthy ears who have died suddenly through accident or hæmorrhage, also of the healthy ears of many of the lower animals immediately after death: *all were infected with micro-organisms, mostly of the pyogenic kinds.*† The mere presence of a

[* For I have not found vaccines effective in this form of either the nasal or the tympanic catarrh.]

[† These examinations were conducted by skilled pathologists, and in many of them control examinations of the opposite ears were carried out by different observers at my request.]

this usually differs in character and route;[14] both are usually accompanied by nasal disease; in both there is increased vascularity; and usually in both deafness: finally, either may recover spontaneously. Years after a suppurating ear has ceased to discharge, and the perforation healed, I have found atrophy in it leading to deafness and paracusis, and in the other ear of the same patient I have observed paracutic deafness of an apparently identical kind, due also to an atrophic termination, not however of suppuration as in the first ear, but of

NOTE 13—*continued*

pyogenic micro-organism, therefore, does not appear more likely to cause disease in a healthy ear than in a healthy nose or windpipe. *Something else is required to start disease.* The inhabitant of a town in dusty weather probably draws pyogenic organisms into nasal and bronchial channels at every breath, yet healthy, well-drained mucous membrane is usually an adequate protection, and transmits the organisms to the stomach, which is the *great destructor* of such things, though the leucocytosis of healthy mucus may assist somewhat in the process. In these days of imperfect digestion, however, few mucous membranes produce a perfectly healthy and defensive mucus.]

[NOTE 14.—In suppurative cases the discharge takes place entirely or chiefly through the perforated drum-head, instead of through the Eustachian-tube as in non-suppurative catarrh.]

the so-called dry catarrh, as in Case 4, to which I will presently refer. Aural catarrh in its early stages, whether suppurative or non-suppurative, being accompanied by increased vascularity, swelling, and softening, causes relaxation of the fibrous tympanic structures. When the active stage of these two diseases is over, vascularity and swelling are removed, to a variable extent, by Nature's efforts alone. This removal may be deficient, leaving undesirable thickening and obstructive stiffening of joints; it may be of about the right amount, and result in the restoration of practically normal conditions and fair hearing; or, finally, the removal may be excessive and lead to atrophy and relaxation of ligaments and membranes and consequent loss of the resilient continuity of the tympanic chain. This is by far the most frequent termination, and the one which I propose chiefly to discuss this evening, as it is helpful in explaining the cause of paracusis, a matter which has been in doubt as long as this name has been in use.

Now if the process ends thus in atrophy, the drum-head may lose some of its original fibrous constituents. The result is a weakening, and consequent liability for it to yield under the strain to which these membranes are exposed. The other fibrous and membranous structures in the tympanic cavity undergo a similar change, the ligaments and the oval window thus

become weakened. The neighbouring Eustachian tube also becomes unduly patent in consequence of the atrophy which is the usual conclusion of catarrh of its lining mucous membrane.[15] Even during the reaction which follows the treatment presently to be described, and which has often been effective in restoring hearing, a similar excessive absorption of the new structures in the drum-head has occasionally been observed. In these cases Nature, while removing the softer elements, has shown no discrimination, and has removed at the same time the new fibrous tissue which had resulted from an inflammatory process, induced by my treatment, for the express purpose of exciting fibrosis: she has carried away in the customary clearance something which might have been left to the patient's great advantage. It is, in truth, difficult to put the brake on Nature's proceedings, and to arrest them exactly at the stage most suitable for our purpose.

A remarkable example of the weakening of the drum-head through atrophy was recently brought to my notice.

A Welsh International football player was advised to consult me by Dr. Pryce Jenkins, who deals with

[Note 15.—This enlargement of the tube permits of greater intra-tympanic air pressure, when the patient is using the pocket-handkerchief. It also allows of the escape of a certain amount of atmospheric tympanic moisture, *i.e.*, lubricant. Deaf

so many football accidents. During last season, 1908-9, this athlete was playing in a match and came into collision with an opponent. He was struck on the back of the shoulder-blade. His head was not touched. Yet the drum-head of his right ear was split. There was a tiny hæmorrhage, which could be seen, and he was able to blow air through the opening for a few days. The rupture healed within a week. Last October (1909) he turned a somersault when playing again as a "three-quarter-back," and pitched squarely on his shoulder-blades, his head escaping. He continued on the field; yet after the match it was found that he had ruptured the drum-head of each of his ears; there was again slight bleeding,

NOTE 15—*continued*

patients whose Eustachian tubes are in this condition often talk in a low tone. It would appear as if the sound of their voices entered their ears through the Eustachian tubes and consequently seemed louder to them than to others.* The ear is the only accessory cavity communicating with the nose which is not intended to be permanently open to the air. The maxillary antrum, the frontal and sphenoidal sinuses, and the numerous ethmoidal cells are always in free communication with the air passing through the nose. Why is the ear an exception, and why has it muscles for occasionally opening its orifice, and a resilient cartilage for helping to keep it closed at all other times? Nature is usually purposeful. It is sometimes difficult, however, to recognise her objects.

[* There is, however, another explanation—bone conduction.]

and air could be blown through the openings until the membranes healed, a few days later. Dr. Pryce Jenkins was a witness of both of these accidents.

With the pneumatic speculum it is easy to demonstrate that the membranes of this man's ears are too thin and too loose—they are atrophied, they have not the strength they should have, and as there is deafness with paracusis, it is probable that all his fibrous tympanic structures are similarly weakened. Whether his thin and loose drum-heads were torn in consequence of violent contraction of the tensor tympani muscles, or from pressure of the sudden rush of air from the lungs (all of which could not escape through the nose or mouth), it is difficult

NOTE 15—*continued*

Possibly there are two reasons for the special arrangements which are made for the ear. First, it may be so arranged in order to prevent the varying pressures of air in the naso-pharynx, which occur during the act of swallowing and breathing, from interfering with the hearing, as it undoubtedly would, by exercising occasional pressure on the inner side of the membrana tympani in opposition to sound waves pressing on its outer surface. Secondly, such frequent, even if but slight, accessions and recessions of warm air, would tend to absorb and carry away some of the surface tympanic moisture, which is required for the lubrication of the structures of the tympanic mechanism.]

to say with certainty. Yet it is well known that air pressure (as from a blow on the ear), may rupture even a strong drum-head.

Another case which illustrates the absorption (or atrophy) of essential structures at the conclusion of prolonged disease may be mentioned, as in this instance also it led to paracutic deafness. One afternoon last year (1909) I performed two conservative mastoid operations on a patient while he was under one continuous anæsthetic, for both ears were diseased. Within ten days of this double operation the perforations of his drum-heads on both sides were healed, though they had been giving passage to offensive discharge for thirty-six years: the hearing was also completely restored. For several months this satisfactory condition continued, the hearing then became rather less acute, and has since remained so. Even now he is not considered to be deaf, and Sir James Sawyer, who saw him recently in Birmingham, wrote to me: "His case is a very strong one in proof of your work. I see you have given him the *eveillé*[16] aspect which only those have

[NOTE 16.—A doctor from the Provinces, whose personal acquaintance I had not previously made, called on me a short time ago regarding a patient of his on whom I had recently carried out treatment for paracutic deafness. He said, "Not only can she hear better, but *she has lost the worried*

who hear comfortably." It was observed during the gradual clearing-up of the inflammatory thickenings associated with suppuration, that this removal was carried to excess and went so far as to weaken the tympanic structures, and this

NOTE 16—*continued*

and anxious look she formerly had, having been deaf for forty-four years, whereas now she is giving dinner parties and going to theatres like other people."* The strain on the nervous system of a deaf person who is trying hard to hear, is often too serious to be ignored. Many patients thus afflicted, both men and women, have informed me that *after listening intently for some time they get pains in their heads and feel quite exhausted.* One, when writing to me said: "None but the *really* deaf realize what it is to have to be always on the strain, I have to be, and I would rather do a long day's work *alone*, than *have to listen for two*

[* This patient underwent continuous treatment for three months. Prior to this she was so deaf, that my loud shout right into her ear was scarcely heard, she would consequently turn round and ask if I had said so and so. Now, while I am conversing with anyone on one side of my study, she hears from the other side, and joins in the conversation. The *air conduction*, before treatment, was practically gone; *bone conduction*, however, was in a fair condition, and this encouraged me to persevere. She was so anxious to recover her hearing, that she said she was willing to go on as long as I held out any hope. Her private medical adviser, who had read my address on the treatment of this kind of deafness, strongly advised her to persevere.]

weakening, leading to relaxation, has resulted in very slight paracutic deafness. His drum-heads now are loose and obviously too thin, and the presence of paracusis renders it more than probable that the membranes closing the oval windows of

NOTE 16—*continued*

hours." Some of the patients who have consulted me, have been so worried and ill through deafness, that I have declined to treat them until they have undergone a rest-cure. Defective sight, and the pain which accompanies the use of the eyes for reading, in *some people*, is known to be due to weakness of the intra-ocular muscles, this condition is called accommodative asthen*opia*. The defective hearing of many people is also more or less due to weakness (loss of tone) of the intra-tympanic muscles. This condition I propose to call accommodative asthen*otia*. When, in a noise, these intra-tympanic muscles (which are not under full voluntary control) are reflexly driven to extra exertion, they work more effectively and tighten the relaxed vibrating membranes. Hearing is thereby improved in many deaf people. This improvement is known as paracusis Willisii. Some improvement of the hearing of patients who suffer in this way, may be brought about by an improvement in the general health, the tympanic muscles participating in the general well-being. Deafness of this type is therefore most often noticed in those who are not robust. There are too many delicate people in these days, there is room, therefore, and indeed need, for a considerable improvement in the physical vigour of the inhabitants of this country.]

his labyrinths are similarly weakened by atrophy, and have consequently yielded under the strain to which they also are exposed. This diminution of tension on labyrinthine windows can usually be demonstrated by one or other of the three tests I employ—the "passive congestion" test, the "active congestion" test, and the "muscular" test. Let me now describe them as they were practised on this patient.

And first the "passive congestion" test. When the patient was seated on a chair, a careful observation of the hearing was made. His body was then bent downwards until chest and knees were in contact. After a short interval to give time for the veins to fill, the hearing was again tested: it was found to have improved, and to have returned to the high standard observed soon after the operation. This test brought about some vascular congestion of the head, and consequently an increase of pressure on the cerebro-spinal fluid, which, communicating freely with the perilymph in the labyrinth, raised the pressure in the latter cavity, thus tightening the relaxed windows there, *by fluid pressure from within*. The result of this tightening was an improvement in the hearing.

Next, as to the "active congestion" test, which this patient observed for himself while taking exercise. It was practised thus: the hearing was first accurately observed; he was then asked to

run up and down stairs; this caused quick and vigorous action of the heart, and before it had subsided another observation of the extent of hearing was made. Again it was found to have improved, and to have returned to the excellent condition that was noticed for some time after operation. The improvement observed during the second test, as in the first, was due to increased pressure in the labyrinth, in consequence of increased blood pressure in the head, and the increased labyrinthine pressure, by tightening the relaxed window of the cavity, rendered it a better medium for the transmission of sound from the air outside to the fluid within.

My attention has recently been called to a case in which the rise of blood pressure resulting from the drinking of alcoholic stimulants, has had an effect on the hearing similar to these two congestion tests. A patient with paracutic deafness recently informed me that he acquired the habit of taking whisky frequently during business hours, in consequence of the improved hearing which he observed to follow the drinking of spirit.[17] Another very deaf patient who has

[NOTE 17.—*Some* deaf paracutics hear worse after taking alcoholic drinks and better after coffee. Those who have exhibited this phenomenon, and have come under my observation, are not yet sufficiently numerous to justify me in attempting to formulate a satisfactory explanation of this phenomenon.]

paracusis and knows of my interest in the matter, recently wrote to me from the country to say, that the night before leaving town he dined at his club with a friend, and drank wine; half way through the dinner he heard perfectly, but that at the end of the meal, and afterwards, he was very deaf. Evidently the alcohol raised his blood pressure and through it that of his labyrinth early in the evening, though as soon as the abdominal organs made their usual and large demands for blood for the purposes of digestion, systemic blood pressure (which includes that in the head) was lowered and his hearing consequently became worse.[18] When, however, he got into a cab to go home, his hearing was at once restored by the action of his stapedius muscle, which was reflexly stimulated by the noise of the rumbling vehicle.

These examples of improved hearing in consequence of a rise in the blood pressure, suggest that the temporary improvement in the hearing which is known to result from the administration of strychnine to some deaf people with low blood, and therefore labyrinthine, tension, may possibly be due, partly to a cardiac stimulation, and consequent augmentation of labyrinthine pressure, and partly to an improvement of tympanic muscular tone,

[Note 18.—This is the stage during which some people become sleepy after meals.]

rather than to increased functional activity of the labyrinthine structures alone, as was formerly believed.

On the other hand, the bad hearing of some people who have paracusis, and of many other deaf persons who have not, can be observed to be worse when they are fatigued. Thus, fatigue of the heart, by lowering the blood and labyrinthine fluid pressure, leads to further impairment of the hearing.

These congestion tests, depending as they do on a rise of general or local blood pressure, cannot always be carried out. The "muscular" test, however, can be adopted when the others may be undesirable or impracticable.

This test, which was suggested to me by observations which I made during a long study of the causes of paracusis, is the most important of all. It is therefore the one I usually employ. I have named it the "muscular" test, depending as it does upon muscular action—*i.e.*, the contraction of the stapedius muscle. The action of this little muscle is to pull the head of the stirrup bone backwards and to tighten the membrane of the oval window. This direct action, however, is somewhat altered in consequence of the lateral resistance offered by the incus. In spite of the small size of the stapedius, it works so advantageously in consequence of the leverage afforded by its movement of the stirrup, that its power of tightening the window is considerable, and

scarcely any obstructive tympanic condition (save the *very rare* bony fixation of the stirrup), is capable of completely arresting its action. In people with paracusis the tension of the relaxed labyrinthine window is reflexly raised by this muscle in a noise to that pitch which is necessary for better hearing.

In the patient referred to (on whom the double conservative mastoid operation was performed) all these tests were positive—*i.e.*, each of them resulted in improved hearing. The improvement in each case appeared to be due to *a tightening of the membrane of the oval window*, brought about either by raising the labyrinthine pressure (*i.e.*, *pushing from within*) or through the action of the stapedius muscle (*i.e.*, *pulling from without*). In this individual all these tests appeared to act like paracusis in a noise.

The improvement in the hearing produced by the muscular test, is, in my opinion, the equivalent of paracusis, though brought about in a voluntary and not an involuntary manner. I am aware of no way in which true paracusis can be produced except by contraction of the stapedius muscle.[19]

[NOTE 19.—The following quotation from a letter which I recently received, will show how much the action of the stapedius may improve the hearing. It runs thus: "I am attending a typical case. She shows

I do not agree with the prevalent view, that the improved hearing is the result of a violent shaking up of stiffened ossicular joints by noisy atmospheric vibrations, and shall presently give some convincing evidence in support of my opinion.

When the healthy ear is exposed to a loud noise, the tensor tympani muscle contracts forcibly, the stapedius contracts in a like manner, partly for the purpose of defending the sensitive labyrinth from injury by violent vibrations, and partly to resist and thus steady the contracting tensor by opposition. While these structures are in such a tense condition, the hearing is impaired, and the labyrinth (the most delicate and important part of the ear) is protected, *if the noise is not too prolonged*.

Though we have little voluntary control of the stapedius, I have observed,[20] when contracting the facial muscles (which are supplied by the same nerve, the facial nerve) that it is generally possible to induce

NOTE 19—*continued*

the muscular (orbicularis) test to an unexpected extent, being capable for some two or three minutes after, of hearing at six inches a watch previously absolutely inaudible."]

[NOTE 20.—Since writing these lines I have observed that Lucæ made the same observation.]

this little muscle to contract with them. This contraction can be brought about more readily in company with the muscles around the orbits than with those about the mouth. Observation of the amount of contraction of the orbicularis will enable the surgeon to estimate the extent of stapedial contraction. Individuals differ in the amount of nerve energy which they can emit, and the resulting muscular action will likewise vary. During the strong contraction of the orbicularis muscles, the rumbling vibrations of stapedial action can usually be *heard* by the patient, who will be able to *feel* that these vibrations synchronise with those of the former muscles, if he places his fingers at the same time over his orbits.

Now should a patient when forcibly contracting the orbicularis muscles (*i.e.*, by strong closure of the eyes, causing deep wrinkling of the skin all round the orbits) be able to *hear* the stapedius muscles in action with them, the surgeon would be justified in considering the muscular test reliable in that individual. I have been able to carry out this test with a positive result, and thus temporarily improve the hearing of some deaf people who have undergone the radical mastoid operation on each of their ears. I have two such patients, ladies. In a train or a motor-car they are able to hear actually better than those who have normal hearing (*i.e.*, paracusis), though at other times they are

deaf. Such facts are in strong conflict with the long accepted teaching that paracusis is due to the shaking up of stiffened bones and joints by powerful atmospheric vibrations, for those structures were long ago removed from the ears of these patients by operation, they can no longer be shaken up, they are gone. Yet paracusis has remained! Therefore the structures must have remained which are responsible for that phenomenon. As the drum-heads were also removed by those operations these cases prove that paracusis cannot be due, as believed by Willis, to looseness of that membrane.

These two patients afford strong evidence that paracusis is not so much due to the structures which are essentially tympanic, as to those which more directly affect the labyrinth. What are they? There is now enough information available to encourage an attempt to answer that vexed question. Though the causes may possibly vary a little in different cases, in these two at all events, as nothing else is left in the tympanum, the structures in question can be no other than the stirrup and its muscle the stapedius. As long as the function of these two structures is unimpaired and they are free to move, and by their combined reflex action in a noise, to tighten a labyrinthine window which happens to be relaxed, then the movement of these two tiny structures may cause that improvement in hearing known as paracusis, no matter if all other tympanic

structures be stiffened,[21] or loosened, or removed, as is the case with regard to the ears of the two individuals just mentioned. These two patients, though their drum-heads, anvil, and hammer bones have been removed on account of disease, and though they have only those structures left in the tympanum which are *directly* concerned with raising (not lowering) the tension of the labyrinthine window, can yet hear better in a noise than those who have perfect ears. Such cases not only help to explain the cause of paracusis (a matter which has been in doubt for centuries, indeed as long as the name has been in use), but afford unshakable evidence of the prime importance of the labyrinth, and of the fact that hearing depends essentially on the integrity of that organ and not directly on the drum-head.

To carry out the "muscular" test, you let the patient hear the watch or tuning-fork as far as he can, and then bring his stapedius muscles *momentarily* into action in the manner I have described. Should the test be "positive" the

[NOTE 21.—Though I have occasionally observed paracusis in cases in which the hammer was obviously fixed,* this occurrence has been rare. The presence of paracusis in such cases, however, proves that the stirrup, at all events, must have been free.]

[* Usually the result of long-past suppuration.]

watch or the tuning-fork at once appears louder, or, if inaudible before, may be heard at the moment of contraction of the muscle. In either case it is evident that the tympanic transmission of sound has been improved. This is proof of the absence of that condition which is known as "fixation of the stirrup in the oval window," showing as it does, that this bone *must have been moved*, and pulled until its marginal membrane became tight enough to neutralise the action of the muscle. This tightening of the bony-membranous medium lying between the air without and the perilymph within, is necessary in order to permit of its action as an effective vibrating transmitter of sounds.

The answer to the question whether a person whose drum-membranes have been destroyed by operation or by disease can or cannot hear a little, depends mainly upon the state of the labyrinth. No person can hear perfectly whose drum membranes are destroyed, and people in this unfortunate condition whose labyrinthine windows are not in good tension can scarcely be said to hear at all, except in a noise, for they have lost their means of accommodation. More or less deafness therefore must always remain after removal of the drum-head for the cure of suppuration, whether by the proceeding which is known by the names ossiculectomy and otectomy, or by the radical mastoid operation. You cannot hear

well, with a drum, if the labyrinthine window is relaxed. You may hear without a drum, though *never perfectly*, if the membrane of this window is in good tension and *moist*;[22] but it rarely is in good tension when the stapedius works unopposed in consequence of removal of the drum-head and tympanic bones, and therefore of the controlling action of the

[NOTE 22.—*Moist.*—There is greater facility of movement in those animal structures which are moist than in those which are dry, for they become less flexible when dried. In health all the intra-tympanic structures are moist. If the oval window becomes dry its mobility is impeded, and the hearing therefore impaired. Removal of the drum-head during the radical mastoid operation permits of evaporation of tympanic moisture, and therefore permits also of the stiffening of tympanic structures and the deafness which result from it. This loss of moisture, however, is *only one* of the causes of the deafness which follows that method of operation. In my method of mastoid operation this principle is recognised, and the drum-head is retained, consequently the loss of hearing through tympanic evaporation is prevented. Tympanic moisture is essential to the perfect lubrication which is necessary for perfect hearing. Not only the insides of tympanic joints and ligaments, but their outsides require to be moistened in order to be sufficiently flexible for perfect hearing. In catarrh, *proportionate surface moisture is diminished*, and, the secretion being less watery, is necessarily more viscid. Viscidity of mucus is an obstacle to the fine mobility of

tensor tympani which was previously transmitted through them. Deafness, usually accompanied by paracusis, therefore, is the rule when drum-head and ossicles are removed. This fact was indeed my chief reason for designing and instituting a conservative operation in which these important structures are retained. I named it the "conservative mastoid

NOTE 22—*continued*

mechanical structures so light as those in the tympanum, and lack of fine mobility means loss of acute hearing. The small works of a watch require a lubricant as liquid as water, whereas the lubricant of the wheel of a railway carriage is thick like butter, and if applied to a watch would stop it at once, its application to the mechanism of the ear would stop its working too, and cause deafness. The stapes and the incus are most affected by viscid secretions, on account of their proximity to the tympanic walls, and *any restriction of their mobility from this cause must necessarily affect the whole chain*, and therefore be a cause of deafness and paracusis. Tympanic catarrh is not to be cured by simply blowing air into the cavity, nor is nasal catarrh to be cured by blowing the nose. In fishes nature has provided no drum-head, for none is required, as they live in water. The labyrinthine window, therefore, is always moist and flexible. All the most delicate structures in the body which are intended to be moved with a minimum of opposition or friction are either moist, or actually suspended in fluid. If the iris were dry, it would not expand and contract under such slight muscular forces as are available in the eye. It must be moist to be of any use.]

operation," designed as it was to preserve all the structures essential to perfect hearing.[23]

Dr. Ballenger, Professor of Otology at the University of Illinois, promptly adopted the measure, and after an experience of ten operations read a paper before the Chicago Medical Society, entitled "The Heath Mastoid Operation whereby the Disease is Cured and Hearing Restored." In that paper he strongly advocated the operation, recorded an improvement in the hearing of every case, and emphasised the safety of the method as compared with the old one. In the discussion which followed, Dr. Frank Allport (the only surgeon present who had actually seen this operation performed by me) said: "I presume I should not discuss this paper, as I have never performed a Heath operation. I had the pleasure last summer, however, of seeing Mr. Heath do some of this work, and on the whole was pleased with it and resolved to try it when I returned home. I therefore purchased all his essential instruments, but have never used them, being influenced perhaps by the fact that the London aurists are quite generally opposed to the operation."[24]

Opposition, however, has never prevented the adoption of any safe and necessary surgical pro-

[NOTE 23.—British Laryngological and Otological Association, *The Lancet*, December 15, 1906, and *British Medical Journal*, January 5, 1907.]

[NOTE 24.—*Illinois Medical Journal*, March, 1908.]

ceeding, and this conservative operation has already been the means of saving the hearing of a very large number of people, and if regularly performed at the proper time would prevent the loss of hearing in nearly all. In the recently published Annual Report of the Cheltenham Ear Hospital which I now pass round, which is the first to give detailed information, you can see that my method (there described as "Heath's conservative mastoid operation" [25]) was adopted in ninety-two per cent. of all mastoid operations performed at that Institution last year, and without any mortality.[26] This great change from the radical to the conservative operation

[NOTE 25.—I gave this operation the name "conservative." It has since been variously named, though none of the newer names are appropriate. By some it has been called "modified radical," an unsuitable and misleading title, as it is not in any sense a radical measure. Dr. Geo. L. Richards, of Fall River, U.S.A., Editor of the Otological Section in the *Medical Annual* of this year, writes: "The conservative radical mastoid operation first brought to general attention by Heath is beginning to have numerous advocates, one of the latest being Mahu of Paris," &c. I hardly seem to recognise my method when so named: it is paradoxical, and more suitable as a description of a political coalition than of a surgical operation.]

[NOTE 26.—No Schwartze (or cortical) operations were performed there last year. My method was adopted in all cases of acute mastoiditis.]

has taken place rapidly, for it is little more than two years since I demonstrated the method of performing this safe[27] and precise operation before the

[NOTE 27.—Between my introduction of the conservative operation at the Throat Hospital in 1906 and resignation from the Staff of the Institution I performed 360 mastoid operations there, within a period of about four years, with one death (meningitis). Two-thirds of these operations were carried out by my method (conservative); the rest were radical operations. Practically all these patients underwent operation on account of conditions indicating danger to life, these dangerous conditions being demonstrated to the Post-Graduate class before and during the operations. The average duration of the disease in these patients was six years. The Hospital accommodation was far too limited to allow of frequent admissions with the object of preventing the loss of hearing only, though, when operating to save life, the hearing was, whenever possible, preserved by the adoption of the conservative operation. Occasionally, for lack of beds, some of my patients were sent to and admitted into other Hospitals for operation. (I am indebted to Mr. George Badgerow, F.R.C.S., surgeon to the Hospital, for these details.) Besides those undergoing the *so-called treatment* by drops (in reality "marking time" to see if Nature were capable of effecting a cure without operation), I frequently had fifty patients who had long passed their probation, and who were on the register for admission in order to undergo operation. As a rule only two of these, and those in pain and danger, could be admitted each week. I had therefore to regularly examine the

surgeons of that Hospital, which they have since practised with conspicuous success; and little more

NOTE 27—*continued*

whole batch in order to ensure the admission only of those who were in most need of relief. One afternoon three acute cases attended for the first time; each brought a note from a doctor asking me to take charge of them; they were admitted immediately for operation. For want of beds, all chronic, and therefore less urgent, cases, were on that occasion necessarily excluded.* *There is serious need for more beds to enable the surgeons of the London Ear Hospitals to do justice to those who come to them for relief.* On the one hand, however, we have the Committee of the King's Hospital Fund, as stewards for the charitable rich, demanding amalgamation of the Ear and Throat Hospitals in the interests of economy, and for years withholding large sums of money which they have rightly ear-marked for these deserving institutions, and which, if properly expended, would greatly add to their efficiency. On the other, we find reluctance or inability of the larger of these Hospitals to absorb the smaller ones; doubtless because their Committees realise that they have not enough beds for the work of their own surgeons. The result is that the sufferers, for whom the money was subscribed, often become permanently and incurably deaf through delays, and some of them have been

[* In the vacation month of August, when some of my Hospital Colleagues have been absent on leave, and their beds in the wards lying empty, I have occupied them with my patients and performed as many as seven mastoid operations in a morning, and on one occasion thirty-three in a month, in the endeavour to diminish the number in need of operations and waiting for relief.]

than three years since I first regularly introduced it, and published my reasons for its introduction, as well as a brief outline of the measure, in *The Lancet*.[28]

NOTE 27—*continued.*

known to die before admission. It thus comes about that the money, which belongs to the poor in the form of enlarged and well-equipped Hospitals, is withheld by conflicting though apparently honourable opinions. The result is bad for the individual and bad for the State, for it leads to the production of deaf men. It should be remembered that the services of these surgeons are gratuitous, and it is not too much to demand that their work should be rendered more efficient by adequate accommodation, so that the greatest benefit to the community should accrue at the least expense to the State. If the State paid these surgeons for their work, the State would ensure that they had room to work: their knowledge and skill would not be allowed to lie fallow. Considerations of humanity demand that greater accommodation should be promptly provided.

There are times of stress and danger
When soft words are out of place.]

[NOTE 28.—August 11, 1906. This was my first published description of the operation, and of my justification for its introduction. As stated in that article, however, Case 10 referred to a patient on whom I operated by this method in May, 1902.* This patient was exhibited before the Otological Society in 1903.† The hearing and tympanic integrity were

[* In-patient Register, Hospital for Diseases of the Throat.]

[† See Trans. Otol. Soc., Vol. V., p. 2.]

Two patients whose ears afford examples of the effect of this operation, and who return to their homes next week, are here to-night for your examination because *they also have slight paracusis.* This is due to the atrophy *which often follows suppurative disease also.* The ear of one of these patients had been discharging for thirty years before operative treatment. The two provincial aural surgeons (one of whom I am pleased to see here this evening) who had charge of them, transferred them to me, in order that they might undergo the conservative operation of which they had had no experience.[29] You now can observe in each of the

NOTE 28—*continued*

there shown to have been completely restored. This patient, being the first to undergo this operation, was exhibited, among other occasions, at a meeting of the West Kent Medico-Chirurgical Society, when I discussed this subject in my Presidential Address (see *British Medical Journal*, July 13, 1907).]

[NOTE 29.—For it had not then been described in any text-book. In a paper recently read before the Yorkshire Branch of the British Medical Association by Mr. Adair Dighton (Aural Surgeon at the Scarborough Hospital), a brief description is given of my method of operation, and some of its advantages were pointed out in the following words:—"The advantages of the operation are many, the chief being: 1. The restoration of hearing; 2. The preservation of the drum and ossicles (without these structures perfect hearing has never been observed);

ears referred to that the drum-head has been retained, the discharge from the tympanum has ceased, the perforation has healed, and that the hearing has returned, and all this repair has taken place in the three weeks which have elapsed since I performed those operations.[30]

When, in a paracutic, the three tests which I have described can be properly carried out, they are usually in accord, and result in improved hearing in consequence of tympanic and labyrinthine changes, just as they are brought about reflexly in paracusis. These and other observations have led me to the

NOTE 29—*continued*

3. The absence of risk of injury to the facial nerve; 4. Its applicability to all cases, if taken in time; 5. The avoidance of disfigurement" (*Medical Press and Circular*, January 11, 1911). Mr. Dighton informs me that within eight months he performed over forty mastoid operations, all of them by my method. His experience of the effect of these operations upon the hearing agrees with that of Professor Ballenger, for he adds "in every case the hearing was considerably improved."]

[NOTE 30.—Though I have often observed perfect restoration of the hearing after the conservative mastoid operation, I have never known it to follow the radical removal of the drum and bones. The best hearing I have recorded after the conservative operation (*The Lancet*, August 11, 1906) was exactly six times as good as the best I have ever observed after the drum and bones have been removed.]

definite opinion that it is the involuntary or reflex action of the stapedius, which, acting on a relaxed oval window, is mainly responsible for the altered conditions which lead to that change in hearing power known as paracusis, and that the voluntary action of this muscle is the cause of the improved hearing during the muscular test. Experience of a large number of paracusis cases has convinced me that "bony fixation of the stirrup," though often diagnosed, must be extremely rare. Such a fixation, if it were present, would absolutely prevent that movement of the bone which certainly takes place during the two muscular (voluntary and reflex) modifications of the hearing which I have just described.

Study of this subject has led to another interesting observation—*viz.*, that many people who are slightly deaf, can be demonstrated to hear better, and are aware of an improvement in their hearing, during the application of these tests, though they may appear to have no paracusis. Evidently the *tension* of the labyrinthine and tympanic structures of these people is not at "concert pitch." An improvement in the hearing during the application of the muscular test can also be demonstrated in many healthy ears. This shows that the ordinary working tension of the tympanic structures of those ears is not sufficient to permit of the most acute hearing, though it may be as high as they will tolerate for long periods.

I mentioned just now that violent blowing of the nose might give rise to conditions resulting in deafness with paracusis. I will here describe another method by which somewhat similar conditions may be brought about. An abundant appetite, which is gratified largely with animal food in persons taking but little exercise (especially if they are exposed to cold winds and dust), often leads to catarrh of the nose and throat, whence it is prone to extend to the ear. A frequent termination of such a process is atrophy, and this leads to relaxation of some of the structures concerned with accommodation. In spite of a certain amount of catarrh in the ear some people can hear fairly well; others, in whom the change is more advanced, are hard of hearing. The latter can often hear quite well while motoring (paracusis), though for some time after getting out of the car they may be more deaf than usual. At such a time I have heard a motorist say that his head had a "wooden feeling." This phenomenon is apparently the result of a labyrinthine change—*i.e.*, a sudden fall in the tension of a part of its wall (the oval window) due to cessation of the reflex contraction of the stapedius muscle as soon as the motorist gets off the vibrating car. The muscle is tired, it has become fatigued as the result of contraction which may have lasted for hours in the moving car. Reflexly, as in a noise, this muscle will work

longer than it can be induced to work voluntarily, because of fatigue of those other muscles in company with which, in the latter case, it is brought into action. Now it is evident that such a prolonged uncontrolled contraction of this muscle, pulling on and tending to stretch the oval membrane, must in time, in some people, have a permanently relaxing effect on that structure. Even in healthy ears such a stretching may happen, and does, in some whose occupations entail prolonged exposure to loud noises. This change appears to take a part, and a great part, in the production of that inveterate form of ear disease which is known as "boiler-maker's deafness." The difference between motor or factory deafness, and "boiler-maker's deafness" is mainly one of degree. Though in the late stages of the disease in boiler-makers there appears to be greater deafness, due possibly, though *not certainly*,[31] to greater changes in the sensibility of cochlear structures. Relaxation of the membrane and joint, it will thus be observed, by impairing the accommodation, and interfering with the transit of ordinary sounds and stimuli to the labyrinth, may lead to degeneration of that important organ.

The responsive and harmonious (*accommodating*) alternation in the controlling action of the tympanic

[NOTE 31.—Because some of them can hear in a noise.]

muscles is deranged, even in healthy ears, when they are exposed to *very loud noises*. Each muscle then appears to work in defence of its respective sphere of influence. It is a case of Greek meeting Greek, a tug-of-war.[32] And what is the result? *Some damage to both if the exposure be prolonged.* After prolonged exposure to loud sounds each muscle will be found to have injured its own dominions: the tensor to have relaxed the main tympanic joint, and to some extent the drum-head; the stapedius to have stretched the membrane of the oval window.[33] The future individual action

[NOTE 32.—Still there is some regulation and harmony in the conflict. Yes; *harmonious conflict* appears best to describe the situation.]

[NOTE 33.—I have observed unnatural mobility of the stirrup, due to atrophy and relaxation of the membrane of the oval window, in cases of nerve deafness, the latter apparently resulting from long-standing *low tension in the labyrinth.* In one notable case of this kind (observed at the Throat Hospital) the stirrup was so movable in the window, that it appeared to have no restrictive attachments. In this case the atrophic weakening of the oval membrane was remarkable. The tension on the labyrinthine fluid appeared also to be much diminished,* for had it not been so, it

[* As, in healthy conditions, the labyrinthine fluid communicates freely with that of the cerebro-spinal cavity, their pressures are about equal, *i.e.*, they are *about as great as the venous pressure in the skull.*]

of these muscles is thus impaired, as well as their mutual control; for, situated as they both are in bony tunnels, the limit of their effective contraction is soon reached. Once the drum-membrane has become relaxed, the strain on the joint is enormously increased by leverage. The joint is the more important part of the fulcrum, for through it, if at all, must be transmitted the force which the tensor tympani opposes to the stapedius. It is evident that the action of the stapedius is protective to the labyrinth under ordinary conditions, though

NOTE 33—*continued*

would either have afforded some resistance to my movement of the bone, or would have replaced it after I had displaced it with the point of a probe, instead of which, the tiny ossicle remained in whatever position it was placed, just like a paralysed limb. Though there was neither discharge nor perforation, yet before operation the labyrinthine fistula test was applied; the result was that the patient fell off the chair momentarily unconscious, so severe was the vertigo. There was also some nystagmus, though its character was not accurately observed during our efforts to restore the patient. It seemed certain, even then that such results could not have occurred but for a great relaxation of the membrane of the oval window. At the subsequent operation this condition was verified. As there was no suppuration there was no suspicion of labyrinthine fistula, and none was present, yet such a case shows the possibility of error in this respect.]

when, through exposure of the ear to loud and long-continued noise that muscle is driven to extra exertion, the high tension of the window which it causes, not only leads to injury of this structure, but if prolonged, appears to lead to some degeneration in the sensibility of the labyrinth itself. [Here we have an example of a structure, provided partly for protection, transformed by excessive use into an instrument of destruction.]

This degeneration will probably continue unless arrested by some re-establishment of the controlling and protective muscular accommodation. Later on I will explain how this has been effected, and has already resulted in the restoration and preservation of hearing in a large number of people.

Wise Nature, when constructing this wonderful and delicate organ of hearing, made some provision for its defence against the injury to which it is liable from exposure to loud noises.[34] This defence, un-

[Note 34.—The powerful reflex and defensive muscular movements, which in a healthy ear in a noise, render the tympanic mechanism too rigid for perfect hearing, are in the relaxed atrophic conditions of *late catarrhal* cases the means of *improving* the hearing (*paracusis*) by tightening the tympanic structures, and in *early catarrh* of overcoming the immobility of these structures which is due to swelling of tympanic mucous membrane. This swelling interferes with the proper position and mobility of the stapes and

fortunately, is not effective under all the trying conditions of modern life. This is mainly in consequence of the weakness of the ligaments of the tympanic joints. These miniature articulations, held by the most slender of ligaments, and therefore admirably adapted by their mobility for the easy transmission of ordinary sounds,[35] are incapable of acting efficiently

NOTE 34—*continued*

incus, for these are the two bones which from their close relation to the tympanic walls are most affected by swelling of the mucous membrane covering those walls. Whatever may be the cause of it, immobility of either of these bones must affect the whole chain.]

[NOTE 35.—The study of the mechanism of the tympanic cavity, or middle ear, as an engineering proposition, reveals many matters of interest to the mechanical engineer. In the tympanum he will find that Nature has forestalled, and still surpasses, his efforts to solve a problem—the transmission of power with a minimum of loss—that is, with a maximum of efficiency. In that cavity he can observe the equivalent of a *cardan shaft*, with its *universal joints*, interposed for the purpose of compensating, as far as possible, for the necessary physiological variations in *alignment*, thus diminishing friction and consequent *loss of power*. There are to be found the earliest examples of *light reciprocating parts*, such as engineers have found necessary, and therefore adopted, in modern high-speed engines, with the object of *diminishing the loss of power*. There, too, is to be observed the most *sensitive* and most efficient system of *governing*

as a medium for transmitting the conflicting strains which arise when the tympanic muscles, in their endeavour to protect the labyrinth from the injurious effects of loud sounds, are driven to violent opposi-

NOTE 35—*continued*

(reflex muscular), with *governors* controlling the mechanism at each end, *i.e.*, where the power is received from the air (the drum-head) and where it is utilised (the oval window of the labyrinth). Governing so complete and sensitive permits of that instantaneous *acceleration* which is the very essence of the *flexibility* of an engine. In the tympanum again is to be found the most complete *lubricating system* ever devised, the *viscosity* of the lubricant in each case being automatically adapted to the *bearing*, *fed* as required, and made on the spot. Not only are the hidden joints or *bearings* suitably lubricated, but the outer surfaces of the flexible ligaments are rendered more flexible by lubrication, by moisture; and, to ensure *economy of lubricant*, the tympanum itself is constituted as, and is the first example of, an *enclosed crank-chamber*. In addition, this chamber is provided with a moist atmosphere, thus ensuring the *surface lubrication* of every part within its walls which does not provide its own: the effect of this arrangement is similar to that of a modern *splash lubrication*. Part of this elaborate and efficient lubricating system, however (*i.e.*, the atmospheric or surface moisture), is deranged by a change in the character of the lubricant through catarrhal disease of mucous membrane, causing increase in the *viscosity*, *i.e.*, *viscidity*, of the lubricating mucus, friction is

tion, for under such stress the delicate ligaments are especially liable to injury. Nothing will give and take so harmoniously as muscles in properly co-ordinated physiological balance. In defensive and

NOTE 35—*continued*

consequently increased, mobility is correspondingly diminished, power is thus lost in transmission, and proportionate deafness results. Removal of the drum-head during the radical mastoid operation permits of evaporation of the surface lubricant; this leads to desiccation of the mucous membrane and diminution of its elasticity: the result is loss of power, and therefore of hearing. When devising my method of mastoid operation (as I have stated), these facts came under consideration, the drum-head was consequently retained, loss of elasticity through evaporation of lubricant thereby prevented, and the hearing therefore preserved. As the tympanum is so constituted as to require moist air within and sound without for its efficient working, Nature has made suitable provision and placed it where each has access; no alternating tidal currents of air, such as must pass through the breathing channels, however, are possible in this cul-de-sac, consequently loss of power (*i.e.*, of hearing) through evaporation of lubricant, is prevented. If the power (or sound vibration) which is received by the drum-head from the vibrating atmosphere, is diminished, or lost, during its transit to the labyrinth (the only place in which it can be utilised) then deafness must result. The transmission of power without loss is *still one of the great problems* of engineering—it is the *greatest of all the problems of otology*, because *nearly all deafness is due to loss of*

striving action the tympanic muscles are not so adjusted; they then chiefly act upon and injure the frail attachments of the structures which they individually control.[36]

Changes in the tension of the oval window have such an effect on the sensibility of the labyrinth, that the hitherto recognised methods of examination may prove misleading, and may induce the surgeon to attribute to cochlear defects, certain signs, which, in reality, are merely the result of this

NOTE 35—*continued*

power in transmission, in other words to *obstacles to accommodation*, that is, to the *regulated and easy passage of sound vibrations along the chain of bones and membranes within the tympanum or middle ear, to the labyrinth*, for the latter is very rarely at fault and may be regarded as the retina of the ear; accommodation being the function of the tympanic mechanism, and, like defective sight, *defective hearing is most often due to defective acommodation.*]

[NOTE 36.—Though the nature of their attachments, the great diversity in their dimensions, and the indirect method of their connection, indicate that they are not in full and direct opposition, it yet appears necessary that the tensor tympani and the stapedius muscles should be (and in point of fact they are), to some extent, opponents in their action. If it were not so, they would be exceptions to the physiological law, that all muscles have opponents. I can find no evidence that the muscles in the ear do not conform to this law.]

altered (usually reduced) tension. Some of the patients, whose hearing has been restored by the treatment I am about to describe, have stated that their disease had previously been diagnosed as *nerve deafness*, whereas *their ability to hear well in a noise* should have raised the question of the propriety of such an opinion. The majority, however, have been told that their deafness was caused by *otosclerosis*, yet they have been relieved by the *same remedy*.[37]

[NOTE 37.—If the disease had indeed been otosclerosis, *my remedy would not have been effective*. I have long observed that there is a great diversity of opinion in the diagnosis of ear diseases by different individuals. There appears to be no other branch of medical science in which prominent and experienced men vary so much in their opinions as in Otology. *Clearly there is something wrong with the teaching.* This opinion is endorsed in a letter which I recently received from the senior surgeon of a Provincial Eye and Ear Hospital. In the letter I have substituted capital letters for names, and the italics are mine. It runs thus: "Thanks for your monograph on the treatment of paracusis, which I have read with deep interest. I have, as perhaps you may be aware, given up aural surgery, having as much eye work to do as I can possibly manage, and Mr. X. now looks after the other branch. But I do remember this, that the teaching of Otology in the text-books is *far from complete and often misleading;* there has been need of new work, of pioneer research, and many things which have hitherto remained obscure have required

Here let me briefly refer to a labyrinthine complication, which, though not often met with, should be mentioned—viz., high tension. In some labyrinthine conditions which are associated with tin-

NOTE 37.—*continued.*

illumination. Therefore I must heartily congratulate you upon having been instrumental in bringing into favour two most important advances in aural surgery, perhaps the most important which have been made in our time; namely, the conservative mastoid operation,* which, I need hardly say, is invariably adopted where possible by your disciple Mr. X. at the Y. Eye and Ear Hospital, and more recently still, your theories regarding, and successful treatment of, paracusis.' It is also endorsed by the writer of a letter, of which the following is the important part: "I am very interested in your Address, for in common with most general practitioners I have long recognised the really disappointing results of sending our deaf patients to see an ear specialist. All are ordered some form of spray or atomiser and to inflate the Eustachian tube: this with variations is the rule everywhere I find. The result is the same, 'nil,' and then your patient complains that you have sent them. Perhaps you can tell me of someone near me who is doing as you suggest, because if my deafness increases very much I should have to discontinue practice which would mean ruin to me. I can never understand why the profession is so bound by text-books and averse to trying new measures."]

[* The writer had several times attended my clinic at the Throat Hospital for the purpose of seeing this operation formed.]

nitus and vertigo, some amount of obstruction appears to obtain,[38] which may reasonably be regarded as somewhat analogous to the state of the eye affected by acute or chronic glaucoma. The labyrinth, like the eye, is too delicately organised to tolerate excessive pressure with impunity, and its capsule is even less capable of yielding to the strain.

The case I am now about to relate to you has a most important bearing on the subject of my

[Note 38.—Increased intra-ocular tension (glaucoma) seems to be far more frequent than high tension in the labyrinth. High pressure within the latter cavity, *i.e.*, sufficiently pronounced to cause severe tinnitus and vertigo or Menière's symptom-complex, is not of frequent occurrence, apparently because the communication between the cerebro-spinal fluid and the perilymph is large, and therefore not easily obstructed. I have recently measured the freedom or size of this communication, or rather the amount of fluid it is capable of transmitting under ordinary cerebral pressure. In a patient on whom I operated for the relief of chronic aural suppuration, with undoubted symptoms of labyrinthine fistula (one, larger than, and including the whole of the oval window, being found at operation), the trans-labyrinthine flow of cerebro-spinal fluid into the meatus was found to be at the rate of ℥i in 65 seconds, roughly about a pint in three hours. This flow, though gradually diminishing, went on for several days, without ill-effect; ultimately, when the patient recovered, there was a considerable restoration of hearing—in fact, this proved to be the

address, though the patient had neither paracusis nor loose drum-heads.

In 1907 a doctor recommended a lady to consult me about an ear trouble. This lady had not long before suffered from influenza and suppuration in the ear, perforation, and discharge. The suppuration had ceased, and the ear was dry, though a large perforation remained. In his letter the doctor asked if my method of mastoid operation would

NOTE 38—*continued*

better ear for air conduction. The presence of such a large communication between the fluids in the labyrinth and in the cerebro-spinal cavity as this case proves to exist, indicates that the labyrinth is not meant to sustain greater pressure than the brain.* It also shows that the pressure within this cavity should be as stable as that of the blood, and vary only with vascular pressure—*i.e.*, with the muscular force of the heart. I formerly believed that the movement of the stirrup inwards or outwards was capable of raising or lowering labyrinthine pressure. In the light of my observations regarding the rapidity of interchange between labyrinthine and cerebro-

[* The freedom of this communication explains how the exposure of the labyrinth to sepsis through *disease*, entails a risk of fatal meningitis. The liability to this serious danger will show how important it is to arrest aural suppuration before the labyrinth becomes thus affected. By the performance of a radical mastoid operation this can be done, but the hearing will be injured; by the performance of my conservative operation it can be done *without injury to the hearing*.]

close the perforation. Experience of the healing of many perforations after this operation led me to reply that "I hoped to be able to induce it to heal without operation." I set about it thus:

Five small glass-stoppered bottles were procured. Into the first were placed *equal parts* of blistering fluid (Liq. Epispasticus) and compound tincture of lavender (the latter being used partly on account of its colour); into the second bottle one part of

NOTE 38—*continued*

spinal fluids, I can no longer hold that opinion, for it was founded on observations made on labyrinths removed from the body, in which the free interchange with the cerebro-spinal cavity present during life, and which I have just described, no longer existed. In health any excess of fluid pressure within the labyrinth leads to the passage of perilymph into the cerebro-spinal cavity, and any deficiency is supplied therefrom. The quantity, however, which can be displaced by the stirrup, acting under stapedial or other muscular force, *is so small* that any excess or deficiency thus brought about can be compensated for in from 1/100 to 1/200 of a second, *i.e.*, instantaneously: there can therefore be no compression of fluids in the healthy labyrinth, and further, fluids are practically incompressible. If, however, the customary communication were in any case restricted, and the transfer of fluid thereby delayed, it appears that the stretching of the round window of the labyrinth would be capable of temporarily compensating for it, thus preventing any serious increase or diminution of pressure.]

blistering fluid *to* three of the tincture; the third received one *to* five; the fourth, one *to* seven; and the fifth, one *to* nine. Thus the five bottles contained the blistering fluid and tincture in the proportions of one *in* two, one *in* four, one *in* six, one *in* eight, and one *in* ten respectively. This mixture I will call "paint."

At first the drum-head was lightly touched every day with a tiny cotton-wool mop saturated with the weakest paint (1 in 10). After reaction to this irritant had rendered the membrane more vascular a stronger paint was used. (There is in different individuals a great variability in the rapidity of inflammatory response to this treatment: therefore the greatest caution must be observed as to the strength of the paint employed.) The strongest paint is only required when granulation tissue has been formed on the membrane. Within a fortnight a wet and whitish epithelial film formed daily on the membrane. This was as regularly removed with a dry cotton-wool mop, and to the moist surface thus exposed a paint of the strength which appeared suitable was applied. The drum-head gradually thickened. It became red and gave off a small amount of discharge, with a fœtor which further experience has shown to be characteristic. Numerous bacteriological examinations of this effusion have led to the opinion that this odour is due to a butyric change in the

epithelial elements. At the end of four weeks the membrane was much altered, the swollen upper part (in reality a mass of granulation tissue[39]) reached almost to the arched floor of the meatus. By varying the strength of the daily applications according to requirements, it was maintained in this softened and vascular condition for another month, and at the end of that time the perforation had healed.[40] The upper half only of the structure was treated, as it has a more generous blood supply, and will therefore tolerate these measures with less risk of perforation, than the lower half. Experience also showed that treatment of this part affected the whole drum-head. The patient was kept under observation for a fortnight during the consolidation of the inflamed tissues, and was then discharged with a sound ear and restored hearing.

The information acquired by the study of this instructive case prompted me to reconsider a subject which has proved a perennial problem—the difficulty of tightening loose drum-heads *such as those*

[Note 39.—As the amount of granulation tissue increases, the sensibility of the drum-head diminishes.]

[Note 40.—By similar treatment I have been able to bring about the repair of a drum-head which was ruptured by a blow on the ear, and which for many weeks showed no sign even of a commencement of repair.]

which are often to be observed in deaf paracutics. The following questions naturally arose. Will these loose and thin membranes tolerate measures of this kind? Can such treatment be safely applied to them? It was difficult to foresee any reason why they should not, if the strength of the application in use, and if the whole proceeding, were suitably and cautiously graded. There was a possibility, too, that the inflammatory process, if maintained for some weeks, might extend through the drum-head and along the short neck of the hammer to the relaxed joint, and result in the formation of some useful and strengthening adhesions there.[41]

[NOTE 41.—It is better to have a stiff joint here, than one which is too loose; a stiff joint may transmit the muscular power of the tensor, and also sound vibrations, a joint which is too loose is not likely to do so. In health the movement of the hammer is the cause of the movement of the anvil, and thus of the transmission of sound waves to the labyrinth. It is better that these bones should be fixed together and thus be capable of combined movement only, than so loosely connected that one may be moved without the other. In health also the incus, with a joint at either end, is practically a *cardan shaft* (as in some motor-cars and boats) with its two universal joints, and its purpose is to transmit the sound from the hammer and drum-head where it is received, to the stirrup and oval window where it is utilised, the joints compensating for the altered position of the hammer and stirrup when either is moved by its own muscle.]

Further, it appeared that inflammation thus induced might lead to an actual increase of scar tissue which, combined with its property of contracting, might result in a strengthening, as well as a tightening, of the loose and weakened structures. Finally, it was anticipated that, if the drum could thus be restored it would vibrate again as in healthy ears, and that those vibrations through the medium of the strengthened joint would be transmitted to the labyrinth, and result in improved hearing.

During this treatment, and for some time afterwards, it appeared undesirable that anything should be permitted which would be likely to interfere with the contraction of the old structures thus softened, or of any new elements formed in the drum-head and joint. It has been my custom therefore to prohibit the common practice of holding the nose tightly while blowing it into the handkerchief. Such a proceeding, by distending the membrane and stretching the joint and tensor tendon, might obviously retard or prevent contraction.

Long or noisy railway journeys during treatment, and *more especially immediately afterwards*, should also be discouraged; for the reflex and powerful protective action of the tympanic muscles in a noise, must interfere with that continuous contraction of the new inflammatory tissues which is necessary for the relief of deafness of this nature. Further, while under treatment, the patient should

be allowed to run no risk of catching colds, influenza, &c., as there is already some reactionary congestion of the middle ear and any access might lead to otitis media, though when such a condition has arisen it has usually run a simple and rapid course to recovery, and *the onset has proved beneficial to the hearing.*

Opportunities soon arose of testing the opinions I have expressed, for some of the vast number who suffer from deafness with paracusis are constantly undergoing treatment. Save that the paint used contained no blistering fluid, but was a less irritating coloured solution of cantharidin,[42] which,

[NOTE 42.—A standard solution of cantharidin is made thus:—Cantharidin gr. 1, Potassium hydroxide (used in order to keep the cantharidin in solution), gr. 1, water 300 minims. This solution contains the same amount of cantharidin as blistering fluid does. Equal parts of glycerine and water are used when diluting this solution to the proper strength for use, the glycerine being used because it delays the drying of the paint when it is applied to the drum-head. It should be mentioned that reaction to the painting is more vigorous and more rapid in warm than in cold weather. Occasionally, though rarely, the epidermis is so resistant to penetration by paint made in this way, that in some cases I have been compelled to return to the blistering fluid (Liq. Epispasticus B.P.) in order to *start* the inflammatory reaction, which subsequently has always been easily sustained by the use of the cantharidin paint.]

by containing an equivalent amount of this active principle was equal to the other in its ultimate effect, the treatment of loose drums was carried out as in the patient just referred to.[43] It was at once successful, and Case 1, which I will presently recite, was the first patient treated in this way.

Unless there is considerable reaction the paint should be applied daily in order to keep the membrane moist, for if allowed to dry, the resulting epithelial film being transparent will usually be found most difficult to remove. When not removed it interferes with the daily treatment and renders it ineffective. Further, the close adhesion of this film to the drum-head will cause it to act like a splint (just as a dry film of collodion does), and thus prevent that contraction of the membrane which is a primary object of the whole proceeding. The surgeon when painting the drum, should ensure that the saturated mop is not brought into contact with the meatus, else it may cause an excoriation, and if the outer half of the passage be thus irritated, it may lead to the production of a furuncle.[44] In some

[Note 43.—Further experience has shown that it is unnecessary to induce a large amount of granulation tissue, and that *long duration of inflammatory action* is of more importance than an abundance of granulation tissue.]

[Note 44.—*With all treatments, there are certain disadvantages.* Those associated with this one I

people the irritation of the meatus caused by the presence of even a small amount of discharge will lead to this condition. It is therefore desirable, when the meatus is small, to protect it by smearing

NOTE 44—*continued*

would, if practicable, gladly eliminate, excessive reaction, resulting from a desire to avoid *tediously prolonged treatment*, being the chief. This may occasionally cause a local dermatitis. *On very rare occasions*, or if the patient catches cold, the additional inflammatory swelling, by interfering with drainage, may lead to otitis media.* If the latter condition, however, should arise and not be permitted to continue too long,† the *increased inflammatory vascularity* which

[* The patient referred to in Note 16 (as already stated) was treated for three months continuously. The result was successful, though she had been extremely deaf for forty-four years. For a short time during treatment she had otorrhœa; this, however, did not interfere with her general health, or with the treatment of the other ear. As soon as the discharge diminished, treatment of that ear was resumed, and the perforation healed rapidly.]

[†This rare event, however, can be dealt with on the usual lines, and should not be allowed to interfere with treatment, The removal of adenoids for the cure of deafness is far more often followed by otitis media than my treatment of paracutic deafness is, yet who would suggest that the removal of these growths should be discontinued. Does a Dentist hesitate to stop the cavities in decayed teeth because occasionally he finds one which is unusually sensitive and intolerant? No, he treats them on certain lines until he finds an exceptional one, to that he gives exceptional attention and treatment. 'Tis so done in all branches of medicine.]

with some bland ointment before painting the membrane.

From this description you will realise how diversity in the size and shape of the meatus, and the variable thickness and vascularity of the membrane in different patients, may render it extremely difficult to properly regulate and observe the treatment. Hence none but the aural surgeon should undertake it, as trained hands are essential, yet

> He must have gentle fingers,
> And a touch,
> Fitted for such a task.

NOTE 44—*continued*

it induces, proves beneficial, and hastens the cure by the more rapid formation of strengthening articular adhesions. Having in the last five years carried out treatment of this kind on a great number of patients, I have learnt what the difficulties are, and with experience they are rapidly diminishing. What are the alternatives, however, to this treatment? Hitherto, an absolute helplessness. An impotence which it was impossible for me to contemplate with equanimity. For the usually increasing deafness has led to the gradual isolation of the individual, to the loss of social intercourse and much else. Among those who *must* work, it has led also to anxiety concerning, and to the actual loss of, employment, to poverty, to a perpetual search for relief, and occasionally to the expenditure of the last penny in the quest. Such are the alternatives to this remedy, for *no other has proved effective in deafness of this common and increasing kind.* There-

The painting usually causes so little discomfort that it does not interfere with the occupation of the patient if one ear only is treated at a time. A pear-shaped plug of absorbent cotton-wool should be inserted at the conclusion of the daily treatment.

The patient should be warned that during the process the hearing of the ear under treatment will be temporarily worse.

The instruments which have been found necessary, and which I have designed for this work, are lying on the table.

NOTE 44—*continued*

fore, in suitable cases, I feel compelled to carry out this treatment and to deal with the known difficulties on the *rare occasions on which any arise*, and not to follow *the old custom of treating by a method which has never succeeded*, or telling the patients "*the disease is incurable*"—*i.e.*, leaving them in the lurch. Helplessness, almost as complete as that which I have just described, characterised the treatment of discharging ears, until I introduced the conservative mastoid operation (for drops and powders do not avail in any difficult case). Now, by the *properly-timed adoption of that safe operation*, disease can be arrested and the hearing of nearly all such cases restored; there is therefore no longer any excuse for dallying until suppurative disease has destroyed an ear, for then nothing, not even fifty operations, will restore it. *Yet thousands of ears are destroyed by this disease in London alone, every year, over 90 per cent. of which might be saved by the timely performance of conservative mastoid operations.*]

Besides the patients already mentioned, there are others here who have not yet been treated. Their ears afford examples of the conditions I have described, and their hearing is therefore *likely* to be restored by this treatment; *we cannot, however, guarantee or ensure a cure in any individual case.*

CASES.

Case 1. (Mrs. G.).—This lady, the wife of a medical man had been deaf for fourteen years and had undergone much treatment without obtaining any relief. The deafness had slowly increased, as is the rule when aural accommodation is impaired. Her condition was a typical one of this kind of deafness. Shortly after the commencement of treatment a small perforation appeared;[45] this

[Note 45.—A prominent American Aural Surgeon, recently visiting this country, called on me at the Throat Hospital and saw my treatment of these cases. He asked for, and received, a copy of the short pamphlet I had written for teaching purposes. On my next visit there he made the following statement to me:—"I have been reading your pamphlet, and it has cleared up a case which has puzzled me for years. I was once treating for deafness a Judge of the High Court of the State in which I live. He also had paracusis. I tried all the remedies recom-

closed rapidly when the membrane became vascular. The ear was treated for two months, and at the end of that time her hearing was decidedly better. Further improvement resulted from the contraction of the new tissues in the drum. Conversation was no longer carried on by shouting into her ear, nor by lip reading, a method of communication she had been forced to acquire. It is two and a half years since that treatment was carried out, and having recently examined her I find that the improvement has been maintained.

This was the first patient on whom this treatment was tried. Therefore, before commencing, I clearly explained to her husband (who, being a doctor, was able to understand them) my views regarding the nature of the disease, and the probable effect of the treatment I proposed. I also informed him that I had never yet tried it in a

NOTE 45—*continued*

mended in books for such cases, yet could do no good. My patient was on the point of resigning the Bench, when he took a chill, had inflammation of the middle ear, bursting of the drum, and discharge. It lasted a few weeks. When it had dried up and the perforation healed, his hearing had returned. I could never understand why his hearing returned until I read your article. Now I see that you are able to bring about a similar cure but more gradually by your treatment."]

similar case. He replied that, as she was considered incurable by the several Otologists he had consulted, he would be glad if the trial were made.

This first case was most encouraging, for it showed that the treatment, the principles of which I had evolved in theory, was likely to prove effective in practice.

Case 2. Master S.—(One of the two patients already alluded to, whose drum-heads had become relaxed in consequence of violent blowing of the nose while holding it.) This boy, æt. 10 years, before he was brought to me had been deaf for at least three years, and had undergone two operations for adenoids, without any improvement in his hearing. His parents had previously taken him to several Otologists, by the last of whom he had been recommended to consult a well-known Professor abroad. After examining him and recording the condition of his ears and nose I asked his father to bring him to me on his return from abroad. When he came back, his parents said that the deafness was considered incurable and that they were accordingly advised to let him be taught lip-reading. Having removed an obstruction from his nose,[46] and ordered that it was not to be

[Note 46.—When one-sided nasal obstruction has been observed in these cases the deafness has most

held while the pocket-handkerchief was in use, I began the painting of the drums. Before this treatment, he was unable to hear the small watch at all, and the loud one was heard at a distance of not more than five inches from either ear. After treatment he could hear the loud watch at 150 inches from one ear, and at more than 100 from the other, and the small one, which previously could not be heard, was audible at twenty inches and seven respectively. The contraction of the new and old tissues in the membrane resulted in further improvement, and when tested two months ago the small watch was heard when thirty-three inches from the better ear—*i.e.*, 33/50 of perfect hearing. I have therefore recently given the worse ear another course of painting with the object of bringing it up to the level of the better one. This has already brought it up to 25/50, and as contraction has yet to take place further improvement may be anticipated. (A recent observation has shown that there has been further improvement in both ears—viz., to 36/50 in one ear and 40/50 in the other).

NOTE 46—*continued*

often been found to be on the same side. Obstruction in the nose leads to irritation there, and frequently to inordinate use of the handkerchief; doubtless the strain on the ear is greater on the side where the exit of air is impeded. This strain has, as I have mentioned an injurious effect on the tympanic structures.]

Case 3. (Dr. P.).—This medical man, æt. 46 consulted me in the long vacation of 1908. While in practice and subsequently he had frequently taken expert advice. One ear had been useless for twenty-eight years, and the other (while capable of use) had done double duty. The hearing in the latter ear gradually diminished until it failed completely five years ago. He then sold his practice. My notes make mention of the fact that for two years he had been at Oxford in order to take a degree with the intention thereby of following some other calling. He had all the symptoms I have described, and was so extremely deaf in both ears that I was compelled to communicate with him in writing. There was also marked nasal catarrh. I painted both drums on this occasion for two months with some slight benefit; it just enabled him to hear one shouting into his ear. In May of last year (1909) he returned and was treated for another month. In the long vacation he came to me again and was treated for two months more. At the end of that period his hearing had considerably improved and conversation was easy. The contraction which followed the later treatment resulted in the restoration of his hearing in both ears.

Without consulting me on the matter he purchased another practice and has resumed medical work after an absence of five years. Though living some distance from London he has come here this evening

for your inspection, and to listen to my remarks on a subject in which he is naturally interested. In addition to the quality of his hearing, which you can test with watch and whisper or the acoumeter on the table, you will be able to observe the new fibrous tissue in his drum membrane whereby it has been strengthened. This is most visible near the centre, where the circulation is least active and where therefore the new structures are least liable to removal. The improvement in his hearing will doubtless be maintained, for during the two and a half years which have elapsed since I initiated this treatment no relapses have occurred. I have advised him, however, as I advise all patients with this kind of deafness, *to desist from the practice of holding the nose tightly when blowing it.* Those who have once known the great affliction of severe deafness are not likely to disregard this precaution, for as it was possible to produce, so surely is it possible to reproduce this sort of deafness.

The effect of repeated applications in Cases 2 and 3 indicates that this treatment is cumulative in its action.

Case 4. (Mrs. E.)—This lady, æt. 35, living in the country, could hear a little with her left ear by the aid of a long flexible ear trumpet, which she carried about with her. With the right ear she

could hear nothing. In spite of being so deaf, she could still hear in a train with both ears without the trumpet. There was atrophy leading to relaxation and paracusis in each ear. The right one, which was quite useless in consequence of old standing *dry catarrh*, was treated first. Within three weeks of the commencement of the painting and while the reaction was at its height, she could hear conversation.[47] Also for the first time for years she was able through the telephone to hear her husband in the city from her house in the country. It is worthy of note that the second ear, which was subsequently treated, and which had at one time been the seat of *long standing suppuration*, was also amenable to this remedy. This case affords an interesting example, in the opposite ears of one patient, of a similar atrophic termination of two different diseases, culminating in paracutic deafness.

Case 5. (Mr. F. F.)—This patient, æt. 30, had suffered from deafness with paracusis on both sides for many years. Both ears were treated for two months. The result is that the hearing of one is practically unaltered, while the other has improved from 12/50 to 47/50—*i.e.*, to practically perfect

[Note 47.—It is exceptional for patients to hear better (as this patient did) during the active stage of treatment.]

hearing. Treatment having been but recently carried out, there is a possibility of the contraction leading to improvement in the other ear.

Case 6. (Miss H.)—This lady, æt. 32, had suffered from deafness for eighteen years, and had been treated in this country and abroad. There was marked nasal catarrh, and a history of indigestion and anæmia when younger. All the symptoms I have described were present. The small watch was heard at five inches in the left, the better ear; on the right side it was not heard either on or off contact. She had paracusis in both ears, though it was far more noticeable in the left, the better one, the tightening of which has increased the hearing from five to twelve inches; and as this drum-head has not been completely tightened, another course would probably improve her hearing still more. However, with the present improvement she is satisfied that she hears well enough for all purposes. I do not think this tightening process would restore the other ear. There she requires an operation for the removal of tympanic structures other than the stirrup, and the application of the pressure wicks to that bone (in the manner which I will presently describe) in order to raise the tension of the labyrinthine window of that side, for it appears to be too relaxed to permit of good hearing, even when the stapedius is acting strongly in a noise. In this

ear the disease is too far advanced to be restored by the mere tightening of tympanic structures, and that fact should be a warning against allowing disease of this kind to progress to such an extent.

Case 7. (Miss S.)—This patient, æt. 27, a South African lady, had been deaf for many years, and had undergone prolonged treatment. In one ear the membrane was adherent through suppuration due to scarlet fever in childhood. The other ear was almost typical of the disease I have described, the bone and membrane being very loose, and paracusis well marked. The large watch was heard at two inches from the ear damaged by scarlet fever, and at three inches from the other. The small watch was not heard at all in either ear. By treatment she has been enabled to hear the large watch at thirty-six inches from the ear the drum of which was previously loose. There is time for further improvement, as complete contraction has yet to take place. The other ear which was fixed by adhesions has improved but slightly.

Case 8. (Mr. R.)—This patient, æt. 30, who came from the West Indies, had undergone much treatment and been deaf for many years. His mother is similarly afflicted. His case was almost typical of this disease, paracusis being well marked. In both ears the membrane and joint were

relaxed; there was also occasional tinnitus. The large watch was heard at five inches from the right ear and three from the left, the small watch only on contact on both sides. After treatment, and before full contraction had taken place (as he was compelled to leave for home), the large watch could be heard at forty-two inches from the right ear and eighteen from the left, the small watch being under repair, could not be used.

These cases are derived from my private practice. I have but recently instituted this treatment at the Throat Hospital because it needs daily attendance, whereas I only attend Hospital once a week. They are brought to your notice because they are of that large and unfortunate class hitherto considered beyond remedy. Prior to their visits to me they had been treated in this country, or abroad, or both, and had all been pronounced incurable. By treatment such as they formerly underwent, which was of the kind hitherto universally advocated, they were of course incurable. Had they consulted me more than four years ago it is probable that I should have done them no good.

It is about four years since I devised this treatment, and I have since been investigating its effect and various uses.[48] Some of my deaf patients

[Note 48.—*Noises in the head* (*tinnitus*), *which may be loud enough to prevent sleep and interfere with hearing, may also be due to catarrh*; it is,

who were formerly considered beyond remedy have recently come under similar treatment and have been restored. Others, who were not relieved

NOTE 48—*continued*

however, usually relieved by this treatment. A few extracts from letters received from Provincial and Foreign Aural Surgeons may be of interest, as giving their experiences regarding the effect of my remedy on this troublesome symptom, *as well as on the deafness which accompanies it.* The italics are mine. Dr. W. N. Robertson, President of the Ear and Throat section of the Australasian Medical Congress (Sydney, September, 1911), when referring to an early edition of this address, says: "I am writing to thank you for the help it has been to me in the treatment of these intractable cases; the results have been so striking that I feel I would like to bring up the subject at our Congress." In a more recent letter, giving details of cures he had accomplished with this treatment he writes: "I am quite sure your method is the thing in an otherwise hopeless case. One great point is that your theory prevents quite wrong treatment. I find best results in the younger patients; none at all have been worse, several have been very little improved, and some are very good indeed. *I find all spontaneously report improvement in tinnitus.* I am satisfied that you have solved a problem that has baffled Otologists for all time. I may say that I continue to use your method in my mastoid cases with much satisfaction." (The writer of those lines was one of the first Australian surgeons to adopt my conservative method of mastoid operation in order to prevent the destruction of the hearing by suppurative disease.) In a

by a first course of "painting," have had their hearing return after a second or a third. This appears to indicate that though we may by these local

NOTE 48—*continued*

letter written since the Congress (of which no official report is yet issued), he says: "One Member read a paper on two cases of paracusis treated by your method. He got excellent results. Six other Members spoke of getting satisfactory results, though most had given it only limited trial. My first case is still my best. By the watch, hearing has increased from three inches to ten feet. It wants a lot of patience, unfortunately." Yes, patience is required in carrying out this treatment, as the damage which may be done to an ear by disease lasting from *five to fifty years*, is not likely to be repaired *rapidly*.* Further, the old and painful treatment by catheterisation was often carried on as long as my method requires to be, yet always failed to cure. Dr. Percy Jakins, Surgeon to the Central London Ear and Throat Hospital, informs me that he has not only succeeded in tightening relaxed drum-heads and joints, and thus curing *paracutic deafness and tinnitus* by my method of treatment, but has taught others how to apply this remedy, and that they also have succeeded. He adds that he has never seen such cases cured by the old treatment. In a recent communication regarding this treatment, Dr. James Harper, of Glasgow, who had charge of my patients at the Throat Hospital when he was House Surgeon there, wrote thus: "Those who have tried it know its

[* I have already referred to a patient cured after forty-four years of deafness (Note 16); she underwent *three months' treatment*.]

applications set up an inflammatory process, and thus increase the amount of fibrous tissue in the drum-head and joint, we unfortunately are unable to

NOTE 48—*continued*

great value. I have had several, which can only be described as marvellous results. One patient, a lawyer, had to give up business through deafness; he can now hear my watch at the other end of the room." A Provincial Surgeon, to whom I demonstrated the method of applying this remedy, writes: "Have you noticed that after painting the drum two or three times in some cases the peculiar *noises in the ear disappear*?" The same surgeon, reporting further progress, says: "One of my cases has made a complete recovery, deafness a thing of the past, and all the *uncomfortable noises quite gone*." Mr. Adair Dighton, of the Liverpool Eye and Ear Infirmary, writes: "I am still having good results with your paracusis treatment, both in *deafness and tinnitus*." The late Dr. Eugene Yonge, Physician of the Manchester Hospital for Consumption and Diseases of the Throat, who came to me for instruction in, and to whom I referred several cases for, this treatment, wrote recently: "Results are so good that one wonders how it was that one clung to the old superstition so long! Patients take readily to the treatment, and I have had no trouble." A Provincial Surgeon, who had twice visited me for instruction in this method of treatment, writes (about a patient he had referred to me for decision as to whether she was a suitable case for, and therefore likely to be relieved by, it): "I am very pleased to tell you that I have had

ensure that this increase shall be enduring, and that the newly-formed tissue will not be removed during the consolidation which naturally follows treatment.

NOTE 48—*continued*

complete success in Miss F.'s case. She hears perfectly well from the right ear. I intend to leave the left for three weeks before commencing treatment. She has had only twenty-four applications, and none stronger than one in four." An American Surgeon, who had but recently tried my method, when reporting to me, wrote thus: "Of course I am rather inexperienced in this treatment as yet, and expect to improve as time goes on. One case in four weeks heard the watch which had not been heard for five years, other cases improved to the voice. On the whole, I consider it has all been very successful." Another writes as follows: "Whatever may be the ultimate opinion of your work, it is bound to have a great effect on the treatment of the future." The most distressing case of *hyperæsthesia* of the ear which has come under my notice was completely relieved by this treatment after drugs had failed. When this unfortunate person first came to consult me he was so much upset by the noise in the streets that he was in tears. Within ten days the hyperæsthesia had abated under treatment, and at the end of three weeks musical sounds, which for a time had appeared to be discordant to his educated ears, were properly heard and appreciated. The complex symptom (tinnitus vertigo, &c.) associated with Menière's name has also been relieved by this treatment, and the hearing improved.*]

[* One of the senior surgeons of an Ear and Throat Hospital in the West of England, when recently writing to

Such occasional complete removal explains how this remedy may be effective on the first occasion in some people, whereas in others a second course or

NOTE 48—*continued*

me on another matter, concluded thus: "It may interest you to know that I have treated several cases of tinnitus and paracusis by your method, and in some of the cases with great success. In one case, in which *the tinnitus was associated with vertigo*, the relief was very marked." Though not independent medical testimony, like the foregoing, the following case of labyrinthine disease is of such importance that it is entitled to insertion. A lady, the wife of a prominent official in India, was recommended by her doctor there to consult me in the hope of relief from tinnitus with vertigo (Menière's symptoms) and extreme deafness. While residing in London she had some of the most severe attacks I have ever witnessed, on one occasion being found unconscious on the floor of her bedroom where she had fallen while dressing. On my arrival at her hotel she appeared more dead than alive, and could neither move nor speak. Though by no means sanguine or even hopeful of cure, yet short of a dangerous operation upon the labyrinth (which was never suggested, and would have left absolute and permanent deafness) I felt confident that an active course of the paracusis treatment, which I have just described, afforded more probability of relieving the organ than any other remedy, and it was therefore adopted. This patient's letter, written from India seven months later, will show what the result has been. It runs thus: "I have waited to make *quite* sure, of what I know will be good news to you. Of course to me it means what only men like you realise, because you see the suffering it causes. I have waited, as you told me it might be months before I had any improvement, and now your treatment is showing results. I can now hear my husband's voice, and keep up a conversation with my children, for you must know that about August

even a third may be required.[49] The presence of new tissue appears to be tolerated if it be maintained in position for a considerable time by protracted applications, and *if not removed soon after treatment is concluded, it appears to be permanent, and any improvement in the hearing also.*[50] Treatment for short periods—*i.e.*, under six weeks, has occasionally been effective, though not so uniformly as when a full course has been given. This remedy should be applied as soon as paracusis is noticeable, and not delayed for many years during which the disease may have seriously progressed.

In no case has the paracusis disappeared in spite of restoration of hearing. This indicates that but

NOTE 48—*continued*

last, just as I left home, I was reduced to carrying about tablets and everyone wrote to me. I could not hear my pair trotting on hard roads, or my brother in the motor, now all are heard as I have not heard for years, and the hearing is improving every day—*no* noises now." The rest of the letter refers to social matters. There has been no recurrence of the vertigo.]

[NOTE 49.—It is a well-known medical fact that effusions have a greater tendency to organisation and persistence in some individuals, than in others.]

[NOTE 50.—A patient who was treated by me about a year ago, returned ten months later to report that his hearing had returned in that ear. This was the longest delay in contraction which has come under my observation. He had been deaf for eleven years.]

little change has taken place in the condition of the labyrinthine window, and that any improvement in the hearing must be attributed to *beneficial changes in the tone or tension of other parts of the vibrating and transmitting apparatus, and diminution of tympanic catarrh,*[51] *which are brought about by treatment.*[52] The effect of these alterations, as was anticipated, is to produce better hearing by enabling more sound vibrations to be conveyed to the labyrinth.[53]

Though these applications readily induce vascularity in the drum membranes of some people, in others it is not so, and in the latter two or three weeks may be required to produce a safe and

[NOTE 51.—The daily swabbing of the naso-pharynx with a solution of chloride of zinc, gr. x. to gr. xxx. to the ounce, *is often effective in relieving the post-nasal catarrh.* Patients have frequently referred to the relief it affords.]

[NOTE 52.—It is also probable that the effect of the paint, as a counter-irritant so near the labyrinth, may, in irritable conditions of that organ, have a considerable effect, *e.g.*, the case of labyrinthine vertigo just mentioned.]

[NOTE 53.—The prolonged and active vascularity, *i.e.*, the improved nutrition of the part which it induces, appear also to have a beneficial influence on the health of the tympanum generally, this of course includes the lubrication of the cavity.]

protective reaction.[54] Such a diversity in the readiness of response to irritation appears to account for the early vascular reaction occasionally observed in aural suppuration, which may, and often does, prove to be a most effective defence against bacterial attacks, attacks which in other ears less readily defended lead to rapid and occasionally to complete destruction of the drum-membrane. For

> There's no protection
> 'Gainst infection
> Like the thing
> Which blood can bring.

The evidence which I have accumulated has convinced me that some people who have atrophic ears, and therefore a tendency to paracutic deafness (the commonest form of "family" or "throat" deafness), may delay, and occasionally even prevent its onset, by giving up the practice of compressing the nostrils when blowing the nose. This so-called "family" or "hereditary" deafness appears to result from a catarrh of the throat (naso-pharynx), nose, and ear, a condition which is to some extent constitutional, and is apparently associated with an inherited imper-

[NOTE 54.—Experience has shown that the deafer the ear and the more advanced the atrophy, the longer the drum-head takes to become vascularised. In such advanced conditions more time and care are required during the early stages of treatment in order to ensure the gradual induction of vascular protection.]

fection of digestion,[55] not necessarily painful, and of which, therefore, the patient may know nothing. The mode of termination of this catarrh in atrophy relaxation and deafness I have already explained.

All forms of catarrhal ear disease appear to be increasing, and this one which in some cases is due to heredity,[56] is yet influenced by surroundings and the nature and amount of food. In this country the diet is usually too rich,[57]

[NOTE 55.—Like "poor man's gout," catarrh, and therefore catarrhal deafness, may result from imperfect digestion.]

[NOTE 56.—A South African gentleman once brought his son, aged 12 years, to me and said: "I am deaf, my father was deaf, here is my boy, what is going to happen to him?" After examining the lad, and receiving certain replies to my questions concerning his diet, I replied: "His digestion is defective, and if he goes on eating for the next ten years as he is doing now, he has every prospect of being deaf too, for he already has nasal catarrh, and rich diet will probably increase it and thus cause deafness."]

[NOTE 57.—As long as many people feed their children on rich food, in the belief that the richer the diet the better for the individual, and the bulk of the population of a country congregate in cities, catarrh will increase and deafness too. There is a prospect, therefore, that communities may ultimately exist in which deafness will seriously prevail. A deaf man once said to me, "The only thing I look forward to in the day is my dinner." There are many like

and our city atmospheres are surcharged with

NOTE 57—*continued*

him, and places which "do you well" are popular: consequently deafness will increase until some means are found for ensuring the suitable feeding of young folk. A great number of people are not endowed with such vigorous digestive powers as enable them to take rich food with impunity. *Given the opportunity all classes are alike.* Catarrhal deafness, however, being often due to rich food, is proportionately more common amongst the rich than the poor.* Twenty-five years ago I observed the love of rich food in the *manual* labouring class (for in these days we all belong to the *labouring* class) in one of our chief colonies. The lowest wage there was 7s. 6d. a day, and meat, being cheap (1½d. to 2d. a pound), was consumed freely three times a day. The result was often an overworked kidney a gouty heart, and a worn out man at forty years of age. (The digestive and excretory organs of some people are not equal to the task of clearing the system of the results of wear and tear, and *an abundant diet of animal food.* Under such conditions there is an accumulation in the system, and *catarrh is probably the first noticeable manifestation, and therefore often to be observed in young people*, though there may be no striking symptom to call attention to it.) Thirty years ago, an outlying part of these Islands, which I often visit, held a finer and healthier race than at present, because a diet of potatoes, porridge, butter-milk, an egg now and then, and an

[* For the same reason hyperostosis in the meatus is far more common amongst the rich than the poor.]

irritating dust from traffic and from factories.[58]

If the movable tympanic structures (other than the stirrup and its muscle) are found to be so disorganised, or to interfere so much with labyrinthine function as to constitute an actual hindrance rather than an aid to hearing, they should be removed, just as the lens and iris are, when they become barriers to sight. Those other parts, which in consequence of the presence of paracusis are known to be capable of work, can then be brought into use for the benefit of the patient. I may

NOTE 57—*continued*

occasional whisky at market, was the rule. I saw no bad teeth, no anæmia, or indigestion then; they can be observed everywhere now, because tea is *always ready*, and *bought* bread and butter require no preparation. This change is largely due to increase in prosperity, that is in wealth; and though desirable for some reasons, it has not improved the race. Among a certain class there I have often observed that more time and trouble are devoted to the preparation of the food of the pigs and calves, than is expended in preparing that of the household. Plain living, good digestion, pure air, suitable clothing, exercise, and shelter, conduce more to the health of a community than high living and high wages.]

[NOTE 58.—Those, who in youth frequently suffer from colds in the head, are prone to become deaf in middle age. Any nasal defect, or abiding cause of irritation or recurrent "colds," should therefore receive attention with the object, partly at least, of preventing ultimate deafness.]

remark in this connection that far better hearing, due to an alteration in labyrinthine conditions, can be produced in some people who have paracusis and no drum-heads, and in others whose drum-heads are extremely relaxed or, being otherwise diseased, have been removed for the purpose,[59] by the use of artificial

[NOTE 59.—I have done this with most satisfactory results, though it required a radical mastoid operation, specially designed, and the after-treatment to be so ordered, as to ensure that the wick can subsequently be placed in position on the stirrup without difficulty, or else the patient must always be near the surgeon in order to hear. I have also designed a single instrument, which can be carried in a thermometer case, for the patient to use both for making and inserting these wicks. (Since the delivery of this address Mr. Wood has called my attention to the fact that Mr. Yearsley had previously designed a somewhat similar though less portable instrument, which, however, was neither intended, nor is it suitable, for the making of these firm conical wicks.) One of the two ladies I referred to just now (as having paracusis on both sides, after the radical mastoid operation on both ears) was treated in this way. She was referred to me for operation on the second of her ears by a Continental Professor of Otology who had observed the result of my operation on the first one. Though no one whose drum-heads have been removed has perfect hearing, and consequently this patient, when her ears are unaided, is deaf, she yet is enabled to hear fairly well when the stirrup is tilted and the window thus tightened by the wicks which she

membranes or wet cotton-wool wicks, with the object of exercising pressure directly on the stirrup and oval membrane, and thus increasing the tension of this part of the capsule of the labyrinth. The improved hearing thus brought about may be regarded as paracusis induced by artificial means. I have often

NOTE 59—*continued*

places in her ears, there wedged between the anterior meatal wall and the stirrup, where they are out of sight. This lady is a great traveller, whereas if she were unable to treat her own ears she would be compelled to stay at home. This paracutic case is of some importance, in that it was the first in which I *seemed* to obtain definite confirmation of my suspicion that the deafness of some or all *paracutics* was partly due to deficient labyrinthine tension. Though this case *appeared* at first to support that theory, it was probably an erroneous view, and that the improvement in hearing was really due to the action of the wick in producing increased tension of the labyrinthine window, so that it would vibrate in such a manner as to more effectively influence the labyrinthine contents. For with the existence of such a free communication between labyrinthine and cerebro-spinal fluids as I have already described, labyrinthine pressure *must be constant or vary only with that of the blood.* Therefore in the case of this patient inadequate tension of the oval window appears to be chiefly responsible for the deafness, for the direct and firm pressure of the rigid wick, the reflex action of the stapedius in a noise, and its direct action in the "muscular test," are

taught patients how to make and apply these drums and wicks. Then, if necessary, they can change them daily. When extra pressure is thus applied these people can hear, and they know when the wick or drum is rightly fixed, from the labyrinthine feeling which they experience, even before they test their hearing. Whether there is a natural or artificial drum

NOTE 59—*continued*

each capable of improving her hearing, by raising, as they do, the tension of the oval membrane. This lady has lost the drum-heads and bones of her ears on both sides. She is therefore deaf in both ears. Yet in a noise she hears well on both sides; she has therefore paracusis in both ears. She has, in each ear, only the stirrup bone and stapedius muscle to produce this better hearing in a noise: therefore in a noise those structures are capable of improving the hearing. By the firm pressure of wicks on her stirrup bones, she, or I, by raising the tension of her labyrinthine windows, can also improve her hearing. Therefore her hearing is improved by raising this tension; therefore this rise of tension is necessary to improve her hearing, whether brought about by voluntary or reflex muscular (stapedial) action, or by the pressure of wicks. Therefore the tension of this structure is definitely too low to allow of perfect hearing in this paracutic, and is doubtless so in all. In such people a rise in the tension of this part is necessary to enable them to hear, consequently a rise must take place in paracusis (*i.e.*, the stapedius must raise it). Briefly, *the tension of this membrane in paracutics is too low, and a rise takes place when paracusis is*

in the ear or not, there can be no perfect hearing without adequate tension of this part of the labyrinthine capsule. Occasionally, as I have shown, increased blood pressure acting through the cerebro-spinal fluid, may exercise sufficient pressure on the oval window to tighten it to that degree necessary for good hearing.[60]

NOTE 59—*continued*

observed, and this rise is sometimes the chief and sometimes the sole cause of the improvement in the hearing. The remainder of the improvement, if any, is probably due to the reflex action of the tensor tympani on the other relaxed tympanic structures (in those patients who still possess them) bringing them more into that slightly tense and therefore resilient condition which is necessary for their easy vibration and consequent transmission of sounds. Some electric aids to hearing seem to owe part of their effect to a similar tense *paracutic* (muscular) action set up reflexly by the noise which they make. The second lady patient I referred to, previous to my attending her, underwent operation and skin-grafting. The grafts, however, interfered with the application of wicks; consequently she remained very deaf until I removed the graft from one of her ears and applied a wick: this immediately improved her hearing.]

[NOTE 60.—Nature is not purposeless in her architecture. It is not without purpose that she provides a reservoir which, though communicating with the distant endolymph in the labyrinth, is situated far away within the cranial cavity where it can be

In these sedentary, dyspeptic, and neurasthenic days, besides a lower temperature than appears to have been the rule when the "normal" standard was fixed, low blood pressure is also a very prevalent condition and contributory cause of deafness. By its lowering of cerebro-spinal, and consequently of labyrinthine pressure, it affects the hearing in a great number of people whose accommodation is impaired. They therefore can only hear either in a noise, when the stapedius tightens the oval window *by pulling from without*, or when their blood pressure is elevated by

NOTE 60—*continued*

affected by the pressure of the cerebro-spinal fluid, and therefore also by that of the blood; for the systemic arterial blood pressure and the pressure of the cerebro-spinal fluid *usually rise and fall together*. She also has a reason for the free communication which exists between the perilymph of the labyrinth and the cerebro-spinal fluid. It is mainly through such channels that relief to the sensitive labyrinth is usually obtained, if the pressure within its rigid walls is too high for the safety of the delicate structures which it contains. It is probable too, in some noisy and at the same time laborious occupations, such as the arduous hammering of boilermakers, that the high vascular pressure during work may prevent to some extent that lowering of labyrinthine tension by intracranial flow which might otherwise take place in such noisy occupations, and this may be one of the reasons why, in men of this calling, the labyrinth so often suffers.]

exercise, or other means sufficiently to raise the tension of this window through the medium of the pressure of the cerebro-spinal fluid, thus tightening it by *pressure from within.* This part of my subject, though it is an interesting, and may ultimately prove a fruitful one, cannot be discussed to-night.

Judging from the frequency with which patients with deafness and paracusis report that catarrh or obstruction of the Eustachian tube is considered to be the cause of their trouble, it is evident that this is a prevalent belief. I have, however, already shown that it is usually an erroneous one. In old-standing cases of deafness of this kind the tube, though feeling as if it were obstructed, is generally patent, in fact, it is actually enlarged by atrophy of its walls. When this passage is thus enlarged, forcible distension of the tympanum far more often does harm than good. For the strain must increase the relaxation of the weakened tympanic membrane, and this allows of a further unopposed muscular stretching of the relaxed joints and the labyrinthine window, thus aggravating the condition which is the essential cause of deafness.

Among those who suffer from deafness of this kind, some are accustomed to hold their noses and inflate their ears in order to improve their hearing (Valsalva's method). This, though it may be effective for the moment (like inflation

with air-bag or catheter), does ultimate harm as I have just stated, in that it increases the laxity of the membrane and joint by driving the hammer and membrane outwards, and their movement has a dragging effect on the window in the labyrinth by pulling on the stirrup, and it is the latter which temporarily improves the hearing by tightening the membranous window and thus aiding the transmission of sounds to the labyrinth,[61] in fact, its effect is somewhat similar to the action of the stapedius muscle.

Forcible attempts at inflation when holding the nose will also temporarily improve the hearing of some who have lost their drum-heads through disease or operation. Formerly I regarded this improvement as the result of a shifting of mucus from the Eustachian tube to the stirrup, where it more effectively aided the transmission of sound. Recently, however, I have observed improved hearing brought on in this way in ears which were quite dry,[62] and after careful testing have arrived at the conclusion that this temporary improvement is

[Note 61.—It is possible that the air pressure on the round window during inflation may be responsible for some improvement, though experience indicates that hearing is mainly carried on through the oval aperture.]

[Note 62.—After a radical operation and without subsequent grafting.]

the result, not of a shifting of mucus even in the moist cases, but of a brief arrest of the cerebral venous circulation in consequence of the violent expiratory effort, and this arrest of circulation raises for a short time the labyrinthine pressure through the cerebro-spinal fluid; it thus appears to be another form of the "passive congestion test," and improves the hearing by tightening the oval window by fluid pressure, from *within* the labyrinth.

I have explained how relaxation of the drum-head and main tympanic joint may impair the action of the tensor tympani muscle. The stapedius muscle may be thrown out of action in a similar way by great relaxation of the membrane of the oval window. With the tension of this window so much reduced, it is not possible to restore the hearing simply by tightening the drum-head and joint. In order to restore hearing under such conditions it is necessary to bring direct pressure to bear on the stirrup in the manner I have just described, and in this way to raise the tension of the oval membrane considerably, that is, to a greater extent than the muscle alone is capable of accomplishing.

It is sometimes difficult to determine whether deafness, in a certain case, is mainly due to a relaxation of the drum-head and joint, or of the window in the labyrinth.

If, however, with deafness accompanied by relaxation of the drum-membrane and joint indicating

atrophy the tuning fork tests prove that the labyrinthine function is not seriously impaired and the patient *is able to hear well in a noise*, the inference is that it is mainly the transmitting apparatus which is at fault, and that tightening the drum-head and joint may improve the hearing. If, on the other hand, with all the remaining conditions present the patient's hearing is only slightly improved in a noise, the probability is that the labyrinthine window, the oval one, is so relaxed, that the stapedius is no longer able to tighten it, and that the artificial drum or pressure-wick I have mentioned is probably the better remedy. Pressure on the stirrup, if it be accessible, or can be rendered so, would help to settle this point.

I recently visited a Home for the Deaf and Dumb in order to examine the ears of the inmates. Some of them could neither write, read, nor hear, even with a trumpet, and from the Principal I gathered that they had given no previous evidence of being able to hear anything. There was great difficulty in communicating with them until I brought to my aid the muscular test. With the assistance of that method of raising the tension of labyrinthine and tympanic membranes, many were enabled to hear and could repeat what I said,[63] and their condition

[NOTE 63.—The so-called deaf and dumb usually do not speak because they do not hear. Those who can hear can speak. Deafness has not hitherto been taken

indicated that treatment such as I have described might improve their hearing. The Principal, a medical man, who gave up general practice on account of deafness, and who has paracusis and the other conditions I have mentioned, is shortly to come under this treatment. At the conclusion of my investigations at this Home there was evidence that the middle ear structures of nearly all the inmates were too much relaxed to permit of hearing and that this condition was the chief cause of their deafness, for the majority of them had movable drum-heads and joints.

NOTE 63—*continued*

seriously; it is, however, a terrible affliction. The man with good ears can scarcely realise the misery of deafness. The blind are cheerful, nay happy, in comparison with the deaf and dumb. The dumb, who have been taught, can "speak" with their fingers by day, but in the dark they are alone indeed. The man who is only blind is in touch with the world. One great man, though blind, was appointed Post-master-General, another and a greater, a Prime Minister, on becoming deaf, resigned his office. This will show that deafness may be the greater calamity. A blind lady, who has lately become deaf, recently informed me, that deafness was indeed the greater affliction, as she had already found that it isolated her much more than the blindness. In early youth deafness is *far the greater affliction*, as it not only prevents instruction, but the child ceases to speak, and becomes what is known as dumb.]

The hearing of *paracutics* often varies with their general health and vigour, the consequent rise or fall in blood pressure reacting on *the labyrinthine window through the communication between the cerebro-spinal and labyrinthine fluids.*[64] This is one of the many proofs, that hearing may be profoundly affected by *very slight differences in labyrinthine pressure.* Even atmospheric changes have an

[NOTE 64.—Of course the muscular tone of the stapedius in vigorous health might participate in such an improvement by acting on the oval window and thus aiding transmission of sounds. It is evident too that the tension of this window would not have been placed under muscular control and regulation unless it were essential to the hearing and to the protection of the organ within, just as the iris guards the retina. The stapedius appears to regulate the amount of sound which is allowed to pass into the labyrinth, and is therefore the guardian of that organ. The iris has a practically identical purpose with regard to the *amount* of light which is allowed to enter the eye. Intra-tympanic muscular tone is as essential to the proper working of the hearing apparatus, as adequate tone of the intra-ocular muscles is to the working of the mechanism of the eye. The marked increase of deafness so often observed after influenza and some other debilitating diseases,* is partly due to a further diminution of tympanic muscular tone. This condition may justly be named accommodative *asthenotia.*]

[* It is often to be observed after parturition also.]

effect on the hearing of some of these patients. Many have volunteered statements to this effect. This, however, is what might well have been expected, for *variations in the weight of the atmosphere are known to affect blood pressure*, and doubtless, therefore, also react on the tension of the labyrinthine window through the medium of the fluid within, in the manner I have just described.

The loss of acute hearing is rarely complained of. Deaf patients usually desire to be able to hear ordinary conversation; when unable to do so they say that they are isolated and lose much of the happiness of life.

Conclusion.—The increase in the hearing power of deaf paracutics which can be observed to follow the administration of alcohol, strychnine, and other drugs, the results of the passive and active congestion tests, the muscular test, and of pressure by drums and wicks directly on the stirrup, *and therefore on the labyrinthine window*, all combine to prove that there is deficient tension of this part of the labyrinthine capsule in the ears of those who hear best in a noise, and are therefore said to have paracusis. These measures also prove that the rise in tension which is brought about in these various ways, is partly responsible for the improved hearing. Conversely, the diminution of hearing power which, in these patients,

accompanies fatigue with its consequent lowering of cardiac *and other muscular tone*, confirms this opinion.

The old teaching that paracusis is due to stiffened joints has frequently led to futile, and even to injurious attempts to improve the hearing by inflating and in this way shaking up the tympanic structures of patients in whom relaxation rather than stiffening was the chief cause of deafness.

I have described the methods of investigation whereby we are enabled to identify the defective parts, and have also indicated some proceedings by which their condition may be improved. My experience of the effect of treatment leads me to the conclusion that the majority of those deaf patients who hear best in a noise can, by one means or another, be enabled to hear better at all times. Patients with deafness of this kind, who have been treated by the methods I have described, have usually shown improved hearing. Mr. Walker Wood, who assists me and keeps the records, considers that the hearing of all those with relaxed drum-heads who have deafness of this type, is improved as soon as their tympanic structures have been tightened up,[65] and without some tightening deafness must continue.

[NOTE 65.—In typical cases, if it can be properly applied, this treatment is *usually ultimately success-*

When both ears are involved, that one which is the more deaf is usually treated first.

Some patients who have undergone treatment have remarked that they have lost the "deaf feeling" which they previously experienced. Others after treatment have noticed a great improvement in their ability to hear conversation, though their hearing, as far as the watch is concerned, has not improved.

As my description of the pathological conditions which are responsible for this kind of deafness is a reversal of old beliefs, my treatment is therefore a reversal too. As it has proved successful in the hands of those who have broken with tradition

NOTE 65—*continued*

ful,* though a second course of treatment may occasionally be required. There are borderline cases also in which this remedy has been tried with success, some with relaxed drums and but little paracusis, others with marked paracusis and but little change in the drum-head. It is difficult to lay down rules for all these variations; the choice of treatment should be left to the discretion of the surgeon in charge.]

[* A letter recently brought to me by a deaf patient records an exceptional measure of success. It was written by a Provincial Surgeon who desired my opinion on his case, and concludes thus: "I am pleased to report that my paracusis cases are all doing well. I can truthfully say that out of about fifty there are only three that I do not think it has benefited: some get quite better, others are greatly benefited. I shall always feel grateful to you for the immense help in teaching me your cure."]

and put it fully to the test, it is *positive evidence that the old teaching is erroneous. The negative evidence* which was previously available was overwhelming —viz., *the universal failure of the old treatment.*[66]

It is not to be expected that responsible surgeons will be constrained to continue the practice of methods which they find to be useless, or actively injurious, merely because they are orthodox.

During the prompt action required in critical surgical emergencies, or when acting in the obvious interest of helpless or ignorant patients, every experienced surgeon must occasionally have observed conditions which justified him in deciding, not to follow precedents, but to make them. New proceedings, thus inaugurated, are all unorthodox at first.

[NOTE 66.—Mr. Adair Dighton, F.R.C.S., of the Liverpool Ear and Eye Hospital, writing recently in the *Medical Press and Circular*,* on my method of treatment for this kind of deafness says: "Mr. Charles Heath, of the Throat Hospital, Golden Square, some years ago first originated, perfected, and introduced this treatment, and it has become adopted by progressive otologists throughout the world. Prior to the introduction of this treatment no one was ever cured of this form of deafness, and it was therefore considered incurable. Mr. Heath has recorded some of his cases, and I can now supplement them, having practised this treatment after seeing it carried out by him."]

[* October 4, 1911.]

As you are doubtless aware, the treatment which I have just described is founded on physiological[67] and pathological opinions which are in conflict with traditional ideas. Yet it is the only remedy which has proved effective, and it has already been the means of restoring the hearing of a great many people who have been given up both in this country and abroad, as incurable. Now which is right? This new treatment which so often restores hearing; or the old treatment, founded on the old pathological teaching, which does not? I intentionally thrust aside the accepted pathological canons when institut-

[NOTE 67.—A well-known Physiologist and F.R.S., author of a text-book, and formerly Professor of Physiology at a British University with one of the largest Medical Schools in this country, writes thus: "Accept my best thanks for the copy of your valuable booklet on Paracusis Willisii, which you have kindly sent to me. It is full of interesting and informative matter, especially, I think, from the physiological point of view, and I have nowhere found so many suggestions about the mechanism of the middle ear, in which I have always taken a deep interest. Your notions as to the compensatory actions of the tensor tympani and the stapedius are helpful and I believe sound. Your paper would have delighted Helmholtz. The application of all this to treatment is most striking, and I beg to congratulate you on such a measure of success. Your explanation of Paracusis seems to me to be unanswerable."]

ing this treatment of deafness with paracusis ; it has proved successful, *and therefore is presumably in harmony with the pathology of this disease if not with that given in the books.* I knowingly and deliberately challenged the rules of conventional pathology when designing my conservative method of mastoid operation for saving the hearing of discharging ears[68] ; and I was requested by persons who had

[NOTE 68.—The writer of the letter, part of which is quoted below, is one of the senior surgeons of a provincial Ear and Throat Hospital. He left his aural practice and came to London to study Otology afresh in my clinic at the Hospital in Golden Square. On his arrival there he found that I had relinquished my post at that institution. He therefore wrote explaining his position to me, and asking for advice. I replied that rather than he should be disappointed I would be pleased for him to see my private work, which afforded greater opportunities for teaching than my Hospital clinic. He attended for about a month. The letter begins thus: "You will probably remember my visit to you in July of this year, when you so kindly allowed me to see your work. I shall not readily forget the kindness shown to me, as well as the original and truly wonderful otological work. The more I think about your conservative mastoid operation the more I am convinced of its utility and true worth. I think I can claim now to be able to do a real 'Heath'—I say real, because I am certain many men think they do the operation and come far short of it, and that is why the operation has been adversely criticised in some

neither seen this operation nor the cures wrought by it, to discontinue its practice, as it was not an orthodox proceeding; restoration or preservation of hearing not being considered a sufficient justification for operation. Yet subsequently, when all my cases were exhibited before the British Laryngo-

NOTE 68—*continued*

quarters. Have just finished a case of old-standing suppuration with high-up perforation and very foul discharge. The result is excellent, and I would not be ashamed to show it to the originator."

This letter is an illustration of the manner in which surgery strikes the imagination even of mature practitioners. (There is a field in otology, however, for the useful application of other than operative measures, but that field, and the *duration of its safe application, are usually much restricted in suppurative cases, if the retention of the hearing is a matter of prime importance.*) This surgeon assisted at my conservative mastoid operations and observed their results. He also had many opportunities of observing the effect of the treatment I have devised for paracutic deafness, and, though he has adopted, makes in his letter no actual allusion to, it. Yet the investigations and labour entailed in solving difficult problems before the knowledge which led to the decision to institute paracutic treatment was available, was far greater than those which were required before I decided to inaugurate the conservative mastoid operation. It is the same in hospitals. The surgeon's work is more obvious, more tangible, more rapid, and therefore more

logical and Otological Association, my reason for instituting the operation (saving the hearing) was approved, and I received unanimous congratulation on the results of my operative method, which was there and then described as "a distinct advance in aural surgery."[69] Sir Spencer Wells

NOTE 68—*continued*

attractive, than that of the physician. The public has followed the profession in the belief in operations.

Another of my pupils, an elderly surgeon in large practice, is relinquishing a large general and surgical practice in order to become an aural surgeon. He came an unbeliever in my operative method, and then had no idea of becoming an aural surgeon. His visit was for the purpose of seeing an operation, which he said "they did not believe in in the North." At the conclusion of the operation he stepped forward and said "I am quite convinced." He is now an enthusiastic believer in the future, and the usefulness, of otology. In proof of these beliefs he has thrown in his lot with the practitioners of aural surgery and has joined the staff of an Ear Hospital. *He was not converted by text-books*, but by observing the practical application of some new methods of *diagnosis* and *treatment* of ear diseases.]

[NOTE 69.—*The Lancet*, December 15, 1906, p. 1666, and *British Medical Journal*, January 5, 1907, p. 19. Though I first performed this operation in 1902 and exhibited the patient before the Otological Society in 1903 (Vol. V., Trans. Otol. Soc.), still at the date of my publication of a description of this operation

broke the rules too with success, and like me was requested to cease his beneficent work, when he instituted the operation called ovariotomy, an operation which has since been the means of saving the lives of thousands of women. Fortunately, for the community, others have thrown off the yoke of convention when it was found to be harmful, and among them were the early practitioners of the operation for appendicitis. If there were no pioneers, there would be no progress.

On this occasion I am not concerned to justify, except by results, my departure from traditional practice; such cures as I have recorded are the best justification. Nor do I profess to have yet

NOTE 69—*continued*

(August 11, 1906), no text-book contained the description of any such measure,* and even now there are but few exceptions. Yet the operation *has become* universally practised; hence the community derives the benefit, and *that is the main thing.*]

[* A medical man, who had suffered nearly all his life (forty years) from *discharging ears*, recently informed me that though he had read the description of the treatment for this disease in text-books, it was not until he read my address on *paracutic* deafness that he discovered that *hearing could be restored by operation.* He has now undergone conservative mastoid operation on both of his ears at my hands, and his wife, who has suffered from suppuration in one of her ears for many years, has asked me to operate upon it.]

solved all the intricate problems which are associated with the remarkable phenomenon named paracusis.

When commencing the special study of this subject I did not hold the opinions concerning the causes of paracusis which I hold now. The evidence which has accumulated during this long investigation has compelled me to change my opinion. Before this change I was much more in favour of the loose drum teaching, than of the stiff joint[70] theory, for there is relaxation of joints and membranes rather than stiffening, in *a very large majority of these cases.* I gave up tympanic inflation and vibrating massage as useless, or even worse, years before I devised the remedy which I have described this evening, and in the interval employed treatment for the constitutional condition,

[NOTE 70.—I never accepted the stiff-joint explanation of paracusis, for my observations of the tympanic conditions present in these cases, were not in harmony with it. For some years I believed that the cause of the improved hearing in a noise was the contraction of the tensor tympani muscle and consequent tightening of the drum-head. That opinion, however, was necessarily changed when I found paracusis affecting the hearing of patients with *no drum-heads to tighten,* patients who had also lost their larger ossicles (the hammer and anvil), and therefore with *no joints to become stiffened.*]

and for the nasal catarrh. It is difficult to understand how aural surgeons could so long continue to believe in the rigid-joint explanation of paracusis, when in such a large majority of these cases the very reverse of rigidity, that is, *relaxation*, can easily be seen and demonstrated. As already stated, I have neither seen nor heard of paracusis ceasing in consequence of further loosening of those structures by the treatment hitherto advocated. The experience of others has been similar to mine.[71] The

[NOTE 71.—*e.g.*, The writer of the following letter, an American Surgeon, whose observations induced him, as mine did me, to discard the old methods of treatment because they were never effective and were often harmful: "Fortune unexpectedly has placed in my hands a copy of an address on the Treatment of Catarrhal Deafness (Paracusis Willisii) which you delivered before the West Kent Medico-Chirurgical Society at the Miller Hospital at Greenwich. The fundamental principles, elaborated by you, founded upon the structure and functions involved, convince me of the correctness of your solution of the problem. Long ago I began to advise victims of this hitherto particularly incurable condition to abandon the *secundum artem* methods which Otologists practise, because it was recognised that the difficulties were not only not bettered, but the impending deafness precipitated at an earlier date than would otherwise obtain. The result of such advice was temporary improvement in many instances, except in those cases where the

constant failure of vibration and inflation treatment to improve the hearing of these patients, should, long ago, have suggested a reconsideration of the whole subject of paracutic deafness.

Otology is a difficult science. We have need of more definite information concerning the physiology of the tympanum and labyrinth, yet great obstacles are encountered when we attempt to enlarge our knowledge. There is therefore some excuse for the backward state of this branch of

NOTE 71—*continued.*

crude and unscientific procedures had caused a stretching and relaxation of already diseased tissues. I feel that you have had the honour and gratification of inaugurating a new era in the diagnosis and treatment of this prevalent affliction, and presume to request being favoured with such reprints of articles, which you may have contributed, on this exceedingly important question. I should particularly appreciate enlightenment upon the Heath Mastoid Operation. I have only recently commenced the treatment of the tympanic membrane with the various strengths of 'Paint,' which I had prepared by a pharmacist, according to directions obtained from the copy of the very valuable address. I fully realise the necessity of acquiring applied knowledge in their use. I need not perhaps remark that the general conditions, as to systemic diseases and associated catarrhal processes in the adjacent cavities, are receiving careful attention. I have loaned the copy

medicine. Before we shall make much progress there is Otological work required which is more difficult than any that has yet been done. In a book recently published, entitled "The Physiology of the Special Senses," a hundred and eighty pages are devoted to the eye, and only a bare fourteen to the ear! Such a disparity proves that Otology is in its earliest, its barest sleeping infancy.

NOTE 71—*continued*

of your address to several of my acquaintances, feeling that this beneficent work for suffering humanity, afflicted with this type of aural disease, should have the advantage of the results of your treatment as quickly as practicable." Also the writer of this one (an Irish Aural Surgeon): "Many thanks for your pamphlet on 'paracusis,' which I found most interesting, and whose suggestions I shall at once put into practice. Inflation and massage I have long lost faith in, and you have indeed done great work if your treatment is even moderately successful in cases which heretofore were quite hopeless. Can you tell me at what London Hospital one is most likely to see your work, including the conservative mastoid operation, carried out? At the time of the introduction of your mastoid operation I visited Golden Square to obtain the technique, but you were not in London at that particular moment. I have since been performing what I hope is a 'Heath,' but would like to be quite certain of the fact." I have received many letters similar to these, all announcing that they had given up the old treatment as harmful or useless.]

Otology must wake up, must grow up, there is much to be done! Look at the thousands around us who have become deaf through recently or remotely discharging ears, or suffer from the deafness I have been describing this evening. *The majority of deaf people become so, through one or other of these two diseases.*[72] Yet I have lately found, by the prompt adoption of new and more effective methods of treat-

[NOTE 72.—A letter which I recently received from the Surgeon of a Provincial Ear Hospital will show that these two diseases *are more prevalent than all other causes of deafness*, and also to what a large extent the remedies I have devised for them *have been adopted after trial.* He writes thus: "Please do not bring out any more new treatments yet, as I cannot possibly get any more done in the day than the present *two.* Every case I am now treating has either had your mastoid operation or is undergoing your paracusis treatment."* These two measures for preventing the loss of hearing are required by such a large proportion of the population of this country, that many more aural surgeons are required than are now in practice here, if the community is to be properly served. *Far more hospital accommodation, however, is also required for the great number of patients who need such help in order*

[* If this surgeon were not successful in his treatment of deafness by these new methods, there would not be such a demand for his services as his letter indicates. Further, if my methods of treatment had proved ineffective in his hands, he would be compelled, in the interest of his patients, and for the sake of his own reputation, to relinquish their use.]

ment, founded, not on the duration or cause of the disease (often disastrously misleading guides), but on the tympanic conditions actually present and which, as I have shown,[73] can now be recognised, that it

NOTE 72—*continued*

to render them efficient members of the community. A great number of lives which should be valuable, are rendered almost valueless through deafness, yet a large proportion of deafness is preventable, far more than is at present receiving adequate treatment. The trend of the times is towards the *prevention* of disease, and *a knowledge of the best means of preventing deafness is the Otological need of the hour.*]

[NOTE 73.—To the post-graduate classes at the Throat Hospital for over two years I regularly described and demonstrated the pathological changes, which, when present in a discharging ear, indicate that the tympanic mechanism is in danger of that permanent disablement which means permanent deafness. The causes of these hidden changes and their *destructive tendency* have not been described in text-books because of the difficulty of identifying them during the performance of the old radical operation. Their identification, however, has been rendered possible by the facilities for observation of the middle ear which are afforded at a certain stage in the performance of my conservative method of operation.* The symptoms which indicate the presence of changes that are important on account of the injury they may cause

[* *The Lancet*, August 11, 1906.]

is possible to save the hearing in nearly all persons

NOTE 73—*continued*

to the hearing, are usually present earlier than those which imply danger to life, though occasionally both may be observed. I gave an address on this subject, "The Prevention of the Deafness and Mortality which Result from Aural Suppuration," before the Maidstone Branch of the British Medical Association in November, 1909. In that address I classified the prevalent symptoms, described the altered conditions in the tympanic cavity which they indicate, and explained how, if allowed to persist, they may ultimately result in destruction of the hearing. I hope, before long, to find time to write and publish that address. Its publication would answer the numerous communications which are reaching me (mostly from abroad where deafness seems to be regarded most seriously) asking for a clear definition of the conditions which, in association with suppuration, justify or even demand the performance of a conservative mastoid operation in order to prevent the threatened loss of hearing. They are asking for precise rules to guide them in this matter; they realize its importance to the community.* Since my publi-

[* No text-book tells the surgeon how to recognise the *early* tympanic changes which take place in aural suppuration; yet he must be able to identify these *early changes* if he is to know when the hearing is in jeopardy, and, therefore, when it is his duty to intervene by operation if the ear is to be saved. The young surgeon who does not grasp the pathological principles which underlie the rational treatment of aural suppuration, must have some rules to guide him.]

with discharging ears who come early under

NOTE 73—*continued*

cation of the description in 1906 a vast number of conservative mastoid operations have been performed by the aural and other surgeons who have visited the Throat Hospital to witness its performance, or have elsewhere read my published description of it. Experience has proved it to be such a remarkably safe proceeding, that there is no longer any ground for the traditional fear of mastoid operations, certainly as far as this method is concerned. *The preservation of the hearing—i.e., of the patient's prospects of usefulness in life, should therefore be given more consideration.* Hitherto it has had little, if any, in consequence of the prevailing deference to old and impotent though orthodox practice. The result of this deference to custom is that *vast numbers are yearly permitted to become permanently deaf* through the progress of this destructive disease while they are under *trusted though futile* treatment by syringing powders and lotions,* or *are actually rendered deaf* by the drastic operations which are advocated in order to arrest the disease. I refer to the radical mastoid operation and ossiculectomy, each of which entails removal of the drum-head and bones and therefore *must always leave the patient more or less deaf.* Such deafness I have shown to be preventable by timely conservative operation (*The Lancet*, August 11, 1906, and April 27, 1907, also *British Medical Journal*, July 13, 1907), and being so, *it should, it must, be prevented.* It may be orthodox,

[* See Note (*) on page 123.]

treatment. This evening I have also brought

NOTE 73—*continued*

as it is so recommended in the books, but I hold it to be unjustifiable to treat a suppurating ear with powders and lotions until it is impossible to save the hearing by any means, and then to clear out the wreckage, and thus put an end to the disease, by the radical mastoid operation, for that is usually the *funeral of an ear*.†]

[* *Futile* because these applications do not reach the deeply-seated disease. The recitation of a couple of recent examples out of a very great number which I have seen, will

[† In the *Journal of Laryngology and Otology*, April, 1912, D.s. Fraser and Milne Dickie, in an excellent article on part of the Otological Department of the Royal Infirmary, Edinburgh, which is under the care of the former, write thus: "The results obtained in regard to the hearing power after the radical operation go to show that this power is improved in the majority of cases, but, as a rule, the hearing, both before and after the operation, is so bad that it is of little practical use to the patient." The hearing is thus shown to be so bad after the radical operation, that it is the obvious duty of the aural surgeon to prevent the suppurative disease from progressing so far as to justify such a destructive measure. These cases should be treated in time to, and by a method which will, prevent the loss of hearing. The surgeon who performs a radical operation acknowledges that the ear is past saving, and that in spite of treatment the disease has prevailed and destroyed the ear. The radical operation is an attempt to make the best of a bad job. The loss of an ear through suppuration should be attributed to the want of a conservative operation at the stage when it was required and when it would have been effective in arresting the disease, *i.e.*, before the hearing has been destroyed.]

illustrative cases here to prove that even deaf

NOTE 73—*continued*

suffice to show how destruction of hearing takes place through *continued* suppuration, while the ears of patients are under *trusted though futile* orthodox treatment by drops and powders.

Miss G. (a middle-aged lady) three years ago consulted me for chronic discharge from the ear. The tympanic conditions indicated that the disease was such as would not yield to any but operative treatment, and that its continuance would lead to destruction of the tympanic mechanism and consequently to deafness. I therefore recommended conservative mastoid operation as being necessary *in order to prevent the loss of hearing*. She had an objection to all operations, and as I declined to treat her by the ineffective orthodox methods which I knew must end in deafness, I saw nothing more of her for three years. She recently returned and asked me to operate on her ear in order to put an end to the troublesome, dangerous, and expensive disease (for long treatments are expensive). I told her that there was now no chance of restoring the hearing by operation, as the disease had completely destroyed the drum-head. She replied that she was aware of these facts, but that as I had told her the exact condition of her ears three years ago, and declined to syringe and powder them for years to no purpose, she had decided to ask me to perform the operation.

The second patient, the young and only son of a doctor in the North of London.—Two years ago the left ear of this little fellow began to discharge. His father, an old friend of mine, on some of whose patients I had performed mastoid operations, wished me to see his son, but heard that I was abroad. He consulted another aural surgeon who advised drops, and drops were used for two years. Becoming tired of this treatment, he recently brought his boy to me, and after examination I stated that though I might by operation arrest the discharge and restore *some* hearing he had brought him too late to save it all. I also informed him that, and

paracutics, who have hitherto been considered quite beyond all possibility of cure, may at

NOTE 73—*continued*

explained why, *no ear should be allowed to discharge for more than three months, and very few as long as that, if the safety of the hearing was to be assured*, also that when Nature cures this disease *perfectly*, she cures it *quickly*. Perfect restoration was now out of the question, for three-fourths of the drum-head had already been destroyed by disease. He asked, however, to have an operation performed in order to get rid of danger to life. I therefore operated by my conservative method, with the result that all discharge has ceased and the patient can hear the watch at five inches (*instead of the fifty of perfect hearing*). Before the operation he could only hear this watch when it touched his ear.

Both of these patients should have undergone operation *in time to save their hearing*. If they had undergone conservative mastoid operations at the right time each might now have perfect ears and hearing. Neither of them escaped operation by delay, and one of them (the lady) had to undergo a more severe operation than would have sufficed to *save* her hearing when first seen. Each of them experienced years of danger and discomfort, and finally *both suffer from deafness*. Those are examples of the sad results of the old teaching. Those are the calamities such teaching leads to, and which I have therefore for years condemned. I shall continue to denounce the perpetuation of this ineffective treatment; it does not arrest the disease, and consequently the patients become deaf. Any treatment which terminates thus in deafness is a failure—is condemned by its results. That treatment is the most conservative which ensures the safety of the hearing. These two patients could have been no worse off if they had not undergone any of the futile treatment by drops and powders, for such treatment is in reality *no treatment at all of the chief seat of disease*. In

length be relieved of their deafness, may have their hearing restored by the treatment which I

NOTE 73 – *continued*

these two instances neither the patients themselves, nor the general practitioners in charge, can justly be blamed for the loss of hearing. *At the time they first sought specialist advice this loss could have been prevented by conservative mastoid operation; at the time they underwent operation the disease had been allowed to go too far, and fifty operations would not have availed to restore them.*

The loss of those ears was due to the misleading teaching of text-books, and on their writers the responsibility lies: on the men who *should* know enough of this disease to be able wisely and correctly to *lead* medical opinion, instead of which they *follow* old custom and treat the *wrong end of the disease.*

Perennial flow the drops into the ear
In futile wash of *outfall* not of *source.*

They recommend treatment of the *effect*, and not the *cause* of disease. The enormous, yet preventable loss of hearing which now takes place through unchecked aural suppuration while patients are under treatment by orthodox methods, can only be due to a *want of knowledge or a want of courage; a want of knowledge* that the disease may progress (as in the two cases just mentioned) and destroy the hearing in spite of the assiduous use of drops and powders, or, knowing this, *a want of courage* in not insisting on the performance of an operation which is known to be necessary, in order to prevent the disease from destroying the hearing.*]

[* A recent invitation to lecture abroad on this subject, which I received from a foreign teacher and writer on Otology, was accompanied by the following remarks: "We are all coming to your way of thinking, that suppurating

have just described.[74] Therefore I have confidence that our labours will, in the future, have more encouraging results than they have had in the past.

NOTE 73—*continued*

ears must be treated on more conservative lines." I replied that "a change in this respect was inevitable, and that it was only a question of time, and the education of a younger generation." Unless these important matters are pointed out in the clearest possible manner, there will be no radical change, the community will continue to suffer. Among civilised nations every year, probably a million persons lose the hearing of one of their ears or of both, from this disease alone; yet by early and appropriate treatment I have found that about 90 per cent. of *this enormous loss is preventable*. No one can restore an ear which has been destroyed by unchecked suppuration: if the patient comes early, however, the alert and watchful surgeon can usually prevent such a disaster.]

[NOTE 74.—A communication which I lately received from a stranger in the Provinces, of whom I have no more acquaintance than the letter affords, will show that paracutic deafness is *not necessarily any longer a hopeless condition*. Names are omitted. The letter begins thus: "I feel that I should like to write and tell you the result of your treatment of paracusis which I have just undergone. For the last ten years I have been gradually getting deaf. Five years ago, and again two years ago, I consulted Mr. A. of B., who told me that I did not stand much chance of improvement, but with care need not get much worse. However, I found that I was getting worse until last Autumn, when I was recommended to see

Study of the auditory apparatus must perforce lead the observer to the conclusion that hearing is the function, not of the tympanum, but of

NOTE 74—*continued*

Mr. C. D. of E.,* who was anxious for me to go in for your special treatment. The result is that I now have perfect hearing. I think the treatment is wonderful, more especially as every other Aural Specialist pronounces deafness with Paracusis as incurable. Your treatment should prove of inestimable benefit to thousands like myself, who otherwise had only the prospect of getting much deafer. Mr. C. D. was more than kind to me, and I feel that I can never repay all he has done. At the same time I thought I must write and thank you for the treatment also." It is not often (as in this case) that the gratitude of a patient extends beyond the surgeon who affords the relief.]

[* One of those Provincial Aural Surgeons whom it has been my privilege to instruct.

In compliance with numerous applications for instruction in the pathology and conservative surgery of the ear which have reached me since my resignation from the staff of the Throat Hospital, I have decided to resume the teaching of these subjects, and have, therefore, provided accommodation for, and am now organising, an Otological Clinic, in order to facilitate the giving of lectures and operative demonstrations. Both are necessary if the younger surgeons are accurately to realise when and how it is their duty to intervene (especially in cases of aural suppuration) if they are regularly to prevent disease from destroying the hearing; if the safety of the hearing is assured, the question of danger to life will hardly ever arise. Although private Clinics are

the labyrinth, and that the tympanic mechanism is subservient to labyrinthine needs, just as the ocular structures subserving accommodation are naturally regulated in harmony with retinal requirements. Unless there is unhampered adjustment between the structures dominated by the muscle of the tympanic membrane, and those controlled by the muscle of the oval window, there must be some deafness. It is so rare, however, for the labyrinth to be at fault except in regard to the tension of its window,[75] that it may be laid down as a precept, that *a very large preponderance of chronic deafness is due to derangement of aural accommodation.* This is clearly the cause in patients with paracutic deafness (and they comprise the majority), for they hear well in a noise - that is, when the muscles of accommodation, responding reflexly to the *extra stimulation* of a noise, overcome some obstacle to their proper working, and then are free to raise the tension of the labyrinthine window and of any

NOTE 74—*continued*

common abroad, they have not hitherto been established in this country. I have already referred to the inadequate accommodation afforded by the volun ary Ear and Throat Hospitals of London. They may well be supplemented, indeed they must be.]

[NOTE 75.—This (oval) window being under the control of a tympanic muscle, should be regarded as part of the mechanism of accommodation.]

other relaxed tympanic structures to the proper pitch for transmitting sound, *i.e.*, for hearing. Anything, therefore, may cause deafness, which interferes with the *freedom* of the mechanism of aural accommodation, and consequently with the requisite regulation of the labyrinthine window, *the tension of which, like that of the drum-head, is under reflex muscular regulation*, and *appears normally to be regulated in accordance with the variation in the character of different sounds.*

When there is an obstacle to this regulation, *then there must be some deafness;* when this obstacle can be overcome by the extra exertion of tympanic muscles in a noise, *then there may be paracusis too.*

Briefly to sum up. *Paracutic* or catarrhal deafness appears to be due to *loss of power* (*i.e., of sound vibrations*) *in transmission through the tympanum.*

First, through diminution in the resilient continuity of the chain of bones and membranes extending from the drum-head to the labyrinth, in consequence of relaxation of some of these structures. (This relaxation being partly due to atrophic weakening, and consequent stretching of the fibrous ligaments and membranes.)

Secondly, through change in the character of the surface lubricant in consequence of catarrh of mucous

membrane. (For viscid lubricant, *i.e.*, viscid mucus, is an obstacle to the mobility of such light mechanical structures as those in the tympanum.)

Thirdly, through that loss of muscular tone which results from enforced idleness of the tympanic muscles. (Loss of tone causes loss of the essential resilient and balanced tension of those important vibrating tympanic structures which adequate tone would ensure.)

These three factors appear to participate in the production of this form of tympanic or *obstructive* deafness; it is also known as "hereditary," "family," or "throat," deafness, and, when sufficiently advanced, is *usually* associated with the phenomenon paracusis, and *occasionally* is preceded or accompanied by tinnitus.

In the short discussion which followed the delivery of this address, the examination of patients, and a few opening remarks by the President (Dr. Kitchin), Mr. Francis Muecke, F.R.C.S., said: "Mr. Heath's description of this disease and his treatment are entirely opposed to what we have been taught in books about it, though after what I have just seen of his cases I shall certainly try it, for no other treatment does any good. However, I have no doubt it will be strongly opposed, for I remember when he brought in his conservative mastoid operation for saving the

hearing of discharging ears, how everybody ran it down because it was not in accordance with books, and now every surgeon at the hospital I am attached to practises it." Dr. Westerman said: "Mr. Heath's address, and his cases, have so upset my ideas of the pathology of this disease that I do not feel competent to criticise his statements."

Mr. Heath, in reply, said: "He regretted that the discussion had been so brief. He had expected, and hoped, to be called upon to answer some helpful and desirable criticisms; the subject, however, was a complex one to discuss without time for consideration and reference."

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