Kuile, if applied to a series of impulses, really amount to sympathetic resonance. In the paper referred to¹ Mr. Wilkinson describes the construction and properties of a model made with careful adherence to the proportions and nature of the cochlear mechanism. It is by far the most important recent contribution to the knowledge of the problem. Very little attention had previously been given to the experimental investigation of the physics of resonant vibrators immersed in liquid. Professor McKendrick had shown that a series of metallic reeds immersed in water was capable of sympathetic resonance, but the system was apparently thought too far removed from the actual structure of the basilar membrane to throw very much light on the behaviour of the latter. Mr. Wilkinson's model is a great advance. It was shown to the Physiological Society in December, 1921, and to the British Association in September, 1922. Details of the mode of construction, in which various difficulties were successfully overcome, must be read in the paper. The mechanician of Professor Leathes's laboratory, Mr. C. E. Stewart, is to be congratulated on the result. It consists essentially of a series of strips of very fine phosphor-bronze stretched across a gap in a brass plate and soldered to this at both ends. The gap is wider at one end than at the other, in order to give a graduated series of different lengths. The strips were first soldered at one end, then stretched by a series of weights, and while under tension soldered at the other end. The whole was then coated with gelatin to form a continuous membrane, leaving a gap at one end (the "helicotrema"). This structure was made to form the division between two closed chambers of water (the "scalae") into which the two "windows," closed with india-rubber, opened. On one of these a little wooden rod ("stapes") was cemented. The top of the upper chamber was formed by a glass plate. Finely powdered blue enamel was distributed over the membrane to indicate the region of vibration when tuning-forks of various period were applied to the "stapes." The lengths and tensions of the strips, as also the dimensions of the chambers, were carefully calculated, but the vibration rates turned out to be higher than those expected. This is, of course, partly due to difficulties in construction and probably also to the omission of some unknown factors which complicate the formula.

It will be remembered that the rate of vibration of a string depends on three factors. It is directly proportional to the square root of the tension, inversely proportional to the length and to the square root of the mass. As regards the first of these factors, it was early recognized that the difference in length between the fibres at the two ends of the basilar membrane was insufficient to account for the range of pitch perceived, but it was sometimes overlooked that, as Dr. A. A. Gray has shown, there is also a difference in tension, such that the shorter fibres in the membrane are more tightly stretched and the range hereby increased. The mass of the vibrating element was mentioned incidentally by Helmholtz in referring to the membrane being weighted by the liquid in which it lies. But the real importance of this factor was first pointed out by Mr. Wilkinson. He shows that each element of the membrane is to be considered as consisting, not only of the fibre itself and the cells covering it, but also of two columns of water reaching from each element to each window, one on each side. This mass of water vibrates with the fibre, greatly increasing its mass and lowering its rate of vibration. Since the shorter columns are nearer the windows and the shorter fibres of the membrane are at this end of the cochlea, the range of response is further increased, and the reason why the basilar membrane is narrower at the base than at the apex of the cochlea is clear. It is further clear why the membrane must be a continuous one, because, if the fibres had gaps between them, no regular loading of the fibres would be possible.

Passing to the behaviour of this model, it was found that when the "stapes" was touched lightly with a vibrating tuning-fork of 32 D.V. the membrane responded only at one extreme end. Sixty-four D.V. gave a fairly local response about one-third of the way along. To 200 D.V. there was a response at about the middle, below the calculated position, with a partial response at the position for 100 D.V. To 400 D.V. the reaction was close to the calculated point, with a well-marked partial vibration at the 200 D.V. position and a less marked one at that for 100 D.V.

¹ Analysis of Sound by Resonance, *Journ. of Laryngol. and Otol.*, September, 1922. Also a brief account in *Proc. Physiol. Soc. in Journ. of Physiol.*, vol. lvi, p. ii (February, 1922).

The model is probably capable of further improvement, but it appears that many important investigations might be made in its present form. The degree of damping and the extent of spread of resonance may be mentioned. It may be pointed out that some degree of resonance of adjoining elements is not contradictory to the theory of Helmholtz. The amplitude of vibration of these is probably too small to stimulate the nerve endings. Gray has shown that a similar cutting out of the smaller stimuli occurs in the localization of a point of pressure in the skin.

One fact of interest may be referred to in conclusion. The model responds also to a tuning-fork held in contact with the brass case, just as does the cochlea to conduction through the bone. This indicates that the impulses given by the movements of the stapes are of the same nature as those of sound waves directly transmitted to the water, as would be expected from theoretical considerations.

LUMINAL IN MIGRAINE.

BY

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PAROXYSMAL recurrent headaches of hemicranial type are so common, and hitherto have been so difficult to diminish either in severity or frequency, that the apparent success of a new remedy which I have been using in this distressing complaint for the past year is, I think, sufficient justification for putting my results before the profession in order that others may test its value, I hope with similar good effect.

The close relationship of true migraine to epilepsy, as one of the paroxysmal neuroses, resembling epilepsy in being preceded often by an aura and succeeded by violent headache, suggested originally the treatment of migraine by prolonged administration of bromides in various forms and combinations. In my hands bromide has practically proved a failure in the treatment of migraine, though in a few cases aspirin, and in others cachets of pyramidon (gr. vii) with cannabin tannate (gr. ii), have notably cut short the duration of the headache if taken immediately after the attack is recognized. Migraine subjects almost invariably visit the oculist before the neurologist, and glasses are often ordered, though very rarely is true migraine improved thereby. Dieting of various kinds, reasonable and unreasonable, is also usually tried, the attacks being spoken of as liverishness, dyspepsia, or bilious headaches. A diet of milk and nuts alone has occasionally been said to cure a tendency to frequently recurring headaches.

Some headaches, doubtless, are of intestinal toxic origin, such as a chronic appendicitis; others, as we know, may be due to errors of refraction, nasal obstruction, pyorrhoea, etc., and may yield to the appropriate treatment. Such headaches must, however, be differentiated from migraine, which in its more characteristic type is notably hereditary, frequently unilateral (hemicrania), and often preceded for twenty to thirty minutes by a visual aura known as a scintillating scotoma, with temporary marked diminution of visual acuity. Nausea and vomiting usually follow the headache, sometimes occurring early, often delayed for hours, when the vomiting appears to relieve the headache.

Migraine may alternate with epilepsy in the same patient or in different members of a family, and I have known the same visual aura of scintillating scotoma herald both the epileptic and migraine attacks to which a boy of 13 was subject, whose mother was also a sufferer from migraine. The striking success of luminal in a considerable number of epileptics, who might justly be labelled "bromide failures," is now beginning to be common knowledge, through the writings of Golla and others, though at the same time a few cases, especially in children or young adults, seem to do definitely worse on luminal than on bromide, having more frequent attacks and greater mental torpor. In my experience I have found that it is the epilepsies in children, associated with some organic cerebral lesion, such as an infantile hemiplegia or congenital mental defect, without any family history of epilepsy, that are especially likely not to be benefited by luminal.

In analogy, therefore, with the successful treatment of some of the "bromide failure" epileptics with luminal, it occurred to me to try the effect of this drug in obstinate and frequently recurring migrainous attacks. I may say at

once that so far—and I have been using it thus for about a year—I may call its success most gratifying, both the frequency and the severity of the attacks being enormously reduced.

The action of luminal is sedative and hypnotic, and it is chemically a derivative of veronal or of its sodium salt medinal, which is much more soluble. Luminal differs structurally from veronal in that an ethyl group C_2H_5 is replaced by a phenyl group C_6H_5 . Its action is much stronger than that of veronal or medinal, $1\frac{1}{2}$ grains of luminal being perhaps equivalent to $7\frac{1}{2}$ grains of medinal in hypnotic effect.

Luminal is put up in $1\frac{1}{2}$ -grain tablets, or it may be used as a powder in cachet or given in solution. Two examples of its use in migraine may be given as illustrating its effects, though they could be multiplied.

CASE I.

Mrs. X., aged 56, since girlhood always subject to headaches, especially severe at the menstrual periods. Never neurasthenic, but rather placid. Headaches very severe during last twelve years, and especially frequent during the last three years, latterly every ten or fourteen days. The attacks are preceded by an aura of visual defect, and followed by nausea and vomiting and complete prostration. Each attack lasts two or three days. Any excitement, fatigue, journey, or theatre or other entertainment is apt to bring on an attack. The attacks on the right side are always more severe than those on the left. The menopause became completed about eighteen months ago, but this made no difference to the frequency or severity of the attacks. Intense mental anxiety in December, 1914, appeared to aggravate the headaches and produced sleeplessness, which persisted. All forms of medicinal treatment, massage, and electricity are said to have been tried, without much avail, massage to the back of the neck alone giving some temporary measure of relief. Luminal in $1\frac{1}{2}$ -grain doses, three times a day, was then started, but after a few days the dose was diminished to $3/4$ grain three times a day on account of extreme drowsiness and inco-ordination of movement. The half-dose suited well; she slept very well, and when she reported seven weeks later there had been no attack at all for the past five weeks, and she felt altogether greatly improved and able to take interest in affairs as she had not been able to do for years.

CASE II.

R. P., a man aged 39, has suffered from migraine for the past three years, gradually increasing in frequency, lately every week or ten days, while recently he had four attacks in three days. The attacks are preceded by partial blindness lasting about an hour, which is followed by violent headache for two or three hours. On May 23rd last I gave him 1 grain of luminal, with a little bromide, belladonna, and arsenic three times daily, and up to the present date of writing (August 15th) he has had only one attack, on June 17th, while away on holiday and while he had been without his medicine for ten days. This morning he writes that he has just had an attack of partial blindness, with a feeling of dazed "far-awayness," lasting for thirty-five minutes, but with no headache following, and he is exceedingly grateful for the improvement in his condition.

The dose of luminal should as a rule be not more than $3/4$ grain three times daily at first, and if the result is good the dose need not be increased, but after a fortnight may be reduced to twice daily, and later to once daily, at bedtime. Occasionally larger doses, as $1\frac{1}{2}$ grains three times a day, may be required to produce a good effect, but if this dose is made a routine at the commencement of treatment toxic symptoms will often be met with, such as excessive drowsiness, inco-ordination of the limbs, and a sensation of unreality in relation to surroundings.

After continual administration of the drug for a week or more, various cutaneous rashes may be seen, such as erythema, urticaria, and a macular pink blotchy eruption, perhaps followed by dry branny desquamation. These rashes are unlikely to occur if an initial dose of $1/2$ or $3/4$ grain three times a day is not exceeded.

If migraine or other headaches are associated with sleeplessness, luminal is especially indicated, and $3/4$ grain three times a day will usually give refreshing sleep every night, such as the patients have not known perhaps for many months. This coincident relief of the insomnia and of the distressing headaches is a most striking evidence of the value of this treatment. How long to continue it must be settled by further experience.

At present, after two weeks' administration of $3/4$ grain of luminal thrice a day I reduce the dose to twice daily (morning and evening) for another fortnight, and then to a nightly or even occasional dose of $1/2$ or $3/4$ grain for three months or even more. Many sufferers from migraine will, I expect, require to take it occasionally, once or twice a week, indefinitely.

NINETIETH ANNUAL MEETING OF THE

British Medical Association.

Held at Glasgow, July, 1922.

PROCEEDINGS OF SECTIONS.

SECTION OF ANATOMY.

Professor ALEXANDER MACPAIL, M.B., C.M., F.R.F.P.S.,
President.

PRESIDENT'S INTRODUCTORY REMARKS.

THE PRESIDENT, in his opening address, extended a hearty welcome in the name of Professor Bryce and the Officers of the Section to the members assembled from all parts of the country. He congratulated the Council of the Association on having included an Anatomy Section at this meeting: it was good for the scientific side of the work of the Association and it was good for the science of Anatomy. Anatomy must ever remain the very corner stone of medical education and research; yet in these days of a crowded curriculum and growing specialism in science there was danger of the clinician and the anatomist losing touch with one another. He had seen it stated that in our day any attempt at research in human anatomy was comparable to the process of "flogging a dead horse." This might be refuted in many ways, but by none more appropriately on this occasion than by reference to the remarkable presidential address delivered the other evening by Sir William Macewen; in each advance in the treatment of disease recorded in that address nothing was more striking than the extent to which exact and elaborate anatomical research—on the growth of bone, on the potentialities of the pleural cavity, on the intricacies of the membranes and circulation of the brain—gave the keynote of success to the brilliant series of remedial operations devised by their distinguished President.

He wished, before proceeding to the main subject of his address, to express grateful memories of his teachers of bygone days in the anatomy department of the university where now they met. His revered professor—and "Chief" for several years—John Cleland, was a giant in intellect as in stature; his lectures, though often far above the heads of all but his most brilliant students, were never "dry"; through all there gleamed golden veins of philosophy and poetry and high ideals of work and service; even the most junior student felt from the first that in his classes he had come under the influence of a great and a good man; his creed of industry and discipline was so exacting that incurring his correction was like breasting a mountain burn in flood; but his anger as quickly subsided, and the exceeding kindness which followed more than compensated for the spate of terror. The wonderful record of his research and exposition—accomplished at a period when mechanical aids were few and imperfect compared with modern resources—cannot be adequately dealt with here; but a saying of the late Professor D. J. Cunningham might be recalled, with which he ended a review of Cleland's Textbook, that the high quality and the great diversity of Cleland's work might well elicit, in the breast of any anatomist, feelings both of admiration and of despair.

He wished to congratulate Professor Bryce very heartily on the happy thought which led him to group together in his museum the anatomical preparations of William Hunter, Allen Thomson, and John Cleland. No Anatomy School in the world could claim a richer heritage. He suggested that it would be a graceful act to direct the Secretaries of the Section to send a cordial greeting of its esteem, with the affectionate remembrance of those members who had been his students, to Emeritus Professor Cleland, who had adorned for so many years the Chair of Anatomy in the University whose hospitality they were now enjoying.

He desired also to voice the gratitude and affection with which all their old students in this University regarded Yule Mackay and Bruce Young, the most distinguished among Cleland's assistants, and in conjunction with whom he issued the notable volume of *Memoirs and Memoranda in Anatomy*. The hope that a second volume would appear—rich in the same high level of observation and research—was, unfortunately, never fulfilled; the recognition of his great administrative ability by colleagues in University College,