# SOCIETIES' PROCEEDINGS

## ROYAL SOCIETY OF MEDICINE—SECTION OF OTOLOGY AND SECTION OF LARYNGOLOGY

**December 5th, 1941**

*Chairman*—F. W. WATKYN-THOMAS, F.R.C.S.

(President of the Section of Otology)

### The Effects of Flying on the Nose and Ear

The opening papers by Wing Commander J. F. Simpson, Group Captain E. D. D. Dickson, Squadron Leader D. B. Fry, Squadron Leader J. E. G. McGibbon and Squadron Leader R. H. Winfield appear in this issue of the *Journal of Laryngology and Otology*, pp. 1-25.

DISCUSSION

The CHAIRMAN (Mr. WATKYN-THOMAS) congratulated the openers not only on the matter but also on the manner of their papers. They had spoken clearly and audibly, and he hoped that would be a lesson to the Section. These papers were all of extreme importance, and he hoped that a good deal would be said about them.

The interpretation factor in hearing, with which both Wing Commander Simpson and Squadron Leader Fry had dealt, was of the utmost importance for practical purposes, and it was, of course, an exposure of the weakness of all their hearing tests.

Squadron Leader Winfield's remarks on air-sickness would appeal to many of them personally as well as professionally. His own experience was that such sickness was liable to come on when the machine got into a pocket. As for ocular sickness, he had found that an infallible way of producing it was to look at the tip of the wing when the 'plane was banking. He himself had to look away very quickly indeed.

On Group Captain Dickson's point about deafness at 4,096 level, this was of the greatest interest, and they must accept his view that it was because the part of the organ of Corti responsible for the reception of these sounds lay at the anatomically most vulnerable point that this gap occurred. He saw a gap beautifully shown at the same point the other day in a man who had been fooling about



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with a service revolver, fortunately only loaded with blank cartridge.

He was with Squadron Leader McGibbon in his use of the term " aviation pressure deafness " rather than the word " otitis " ; the latter was a description which he thought was begging the question.

Major D. J. GUTHRIE supported the Chairman in his congratulations to the authors. Seldom, if ever, had the Section listened to so excellent a series of papers—papers so informative and so clearly and concisely delivered, and with no overlapping, showing that there must have been previous arrangement as to what each had to say.

The rise of aviation medicine had been of very great interest, and personally he thought he could claim a certain amount of experience in this matter because as long ago as 1910, as a newly qualified man, he happened to act as honorary surgeon to the first Scottish Aviation Meeting. It was interesting to note that at that time, on the first day, owing to a slight breeze, there was no flying, on the second day one or two 'planes taxied around, and on the third day some exaggerated hops by Cody, who was known as " Buffalo Bill ", created wild enthusiasm.

Those days were long past, and the next experience he had was in the last war when he happened to be in the Air Force for two years, and carried out a little minor investigation on nasal obstruction in aviators, which he had the temerity to publish in the *Lancet*. He re-read it the other day, and it was quite amusing that one of the men to whom he wrote later asking how he was getting on said that now he could fly very much better—he could even fly at the great height of 12,000 ft.

There were one or two points in the present discussion which everyone must have noted. In the paper by Wing Commander Simpson the question of sinus pain was rather interesting. Ear pain had been heard of, but sinus pain was relatively new to him, although he had heard several aviators mention it. A point he wanted to ask was whether the normal nose had been examined immediately after flying and what change occurred normally in the nose at heights. Was there nasal congestion ?

Group Captain Dickson's paper was very interesting in that it showed that the deafness was not necessarily at the same point as the most intense noise. One point with regard to prevention had struck him. Would it be possible to employ, instead of the usual phones, bone conduction as a means of communication ? A few years ago he saw an apparatus called the " Audione " or some such name which was used to test bone deafness, and this instrument could be applied to any part of the skull. Would it be possible to communicate by that means ?



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With regard to Squadron Leader Fry's paper, it was interesting to hear him touch, very lightly, upon the psychological aspect of hearing and upon the importance of intelligence in interpreting signals. That suggested certain lines of research. Had he made any investigations on the influence of fatigue upon hearing? There was also one other point. It might be that minor degrees of speech defect had something to do with the want of interpretation of signals. Such minor degrees were very common. Not everyone in the Air Force had the excellent elocution which Squadron Leader Fry so well exemplified, and there might be some scope for training with regard to that subject. It might be useful to institute dramatic work for aviators in their leisure hours with the object of inducing clear speaking. Dramatic work did train in that respect.

Squadron Leader McGibbon's interesting paper raised the age-long controversy regarding the Eustachian tube. Was it open or closed, and how did it open? One observation studied lately showed it to open in the upper part after which the lower part was opened and closed. Had Squadron Leader McGibbon made any investigations with the otolaryngoscope, which did help a great deal in noting the condition of the Eustachian tube?

With regard to indrawing or invagination of the tympanic membrane, it would appear from his experiments that the tympanic membrane had the most surprising mobility. One would imagine, again from those experiments, that it would even touch the promontory. Had any observation been made on the extent of the mobility of the tympanic membrane? It was more elastic than was imagined. He had seen the attic congestion to which the Squadron Leader had referred and it was most important to note this and to distinguish it from otitis. He had seen it recently.

Lastly, with regard to Squadron Leader Winfield on the question of air-sickness, he presumed that air-sickness was virtually the same thing as sea-sickness, that it was influenced in the same way by the movement of the head, by cold and other factors, and that it included a very definite psychological element. Had he tried the effect of glucose in these cases, and what was the nature of the effect? Glucose was handed out sometimes on former Channel crossings.

Mr. F. C. ORMEROD added his congratulations to the "team". The Section of Laryngology was very much impressed a month ago by Group Captain Dickson's description of the organization for otology in the Royal Air Force, and to-day they had been shown the results of that organization and would wish to congratulate him on what he had achieved.

One point which Group Captain Dickson had raised was with regard to the "island" of deafness in the region of 4,096. Mr. Ritchie Rodger in 1915 published a paper on deafness in



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boiler-makers due to noise, and other reports on the subject had been made at various times. In Mr. Ritchie Rodger's paper he thought he described the lowering of the tone limit, he did not mention the "island" period. That was more easily shown by the major audiometric means of testing.

A few years ago a monograph was published by Larsen who had carried out research in Copenhagen among the riveters in the shipyards and he found a persistent island of deafness in the neighbourhood of 4,096, where he estimated the noise of riveting was much lower than in the region of from 512 up to 1,000 or 2,000. As in aeroplane noise, there were found to be persistent islands in the intensity of 120 ?, and above that pitch the hearing was quite normal. People who had been working in these yards for thirty years heard ordinary conversation perfectly well, but they could not hear whispering. He also found that if a man had a week's holiday his hearing, particularly in this region, improved, but on getting to work again it deteriorated. Even on a Monday, after a day's rest, there was an improvement, but this did not persist on resuming his employment. These men were able to carry on with their work quite well and many of them had perfectly normal hearing. It was interesting to find that the aeroplane engine and the noise it produced had the same effect. He attempted to explain why the region 4,096 was the site of deafness by a statement—he did not know how he proved it—that this pitch was about 9 mm. from the basal end of the cochlea. The central ossification of the petrous bone occurred at this point. The cochlear branch of the internal artery bifurcated at that point, so that there might be a slight lack of blood supply. Again, at the same point there was a slight constriction of the osseous labyrinth. The further suggestion was made in another paper about ten years ago that the point in question was very close to the round window, not the oval window, and that that might have something to do with determining the reception of these high-pitched sounds.

Mr. MUSGRAVE WOODMAN, after adding his thanks, said that as a yachtsman he knew a great deal about sea-sickness, where the psychological factor was very important. In his early days he went as a medical officer in the Royal Mail to the West Indies, when the vessel was rolling like a tub and there was a great amount of sea-sickness amongst the passengers ; but after about three weeks they became perfectly immune, were quite happy, and even engaged in dancing. Then the vessel turned round when it got to the West Indies and faced the other way, it began to pitch, and the whole lot of the passengers went down again. Presumably when the type of motion altered, the disposition to sea-sickness or air-sickness was affected.



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Nothing had been said touching on the point of the patency of the Eustachian tube. He had used with great benefit the Eustachian bougie to which Sir James Dundas-Grant called attention some years ago. He had been able to overcome many cases of giddiness by the use of that instrument, and, apart from treatment, it gave an idea of the extent and permeability and exact position of strictures of the Eustachian tube. Was this of any use at all in the Air Force ?

Could any members of the Air Force throw any more light on that very interesting nerve deafness which occurred and which might be total or permanent ? Such cases were seen in civil practice. One tragic case within his knowledge occurred at a public school where a boy who apparently had everything in front of him went stone deaf and remained so, to the great detriment of his career. That was a matter which called for definite research. There was nothing wrong with the drum ; no inflammatory element was visible. He desired advice on the subject.

Mr. R. J. CANN said that no doubt as a result of wide dispersion of the Air Force, in spite of the most excellent organization of the R.A.F. ear specialists, it did befall some civilian otologists in E.M.S. base hospitals to have presented to them on occasion members of the Air Force with ear lesions resulting from flying. He had looked forward to that meeting in the hope of getting an answer to some of the problems with which one was presented. He thought that in the series of opening papers he had had practically every question answered, and he was very grateful personally to members of the Air Force for coming to help that day.

With regard to aviation noise deafness and the dip in the 4,000 region, he wondered whether the effect might be the result not of the noise but of the vibration. Experiments had been made in exposing animals to the same noise under different conditions, in the one case suspending them from the ceiling in a cage so that they were not subject to vibration, and in the other case putting them on the floor, and the damage to the auditory apparatus was considerably greater in those who had exposure to vibration as well.

On the question of flying officers flying with colds, one knew that it was forbidden, but the rule was very often observed in the breach, not, of course, in extreme but in mild cases. When he had seen these officers with air pressure damage to their ears they almost all of them have been flying with mild catarrhal colds. On asking them " Why did you do it ? " the answer was, " We cannot let the squadron down." That, of course, was a view which must command sympathy, but it had to be pointed out to them that in consequence of what they had done they were out of operational duty for a much longer time than they need have been if the rule had been observed. It would be a good thing, it seemed to him,



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to tell the squadron as a whole that flying with a cold was a serious matter, and then if a flying officer said he had a cold and could not fly the others would appreciate the situation, and the man himself would not have the fear of letting the others down. Of course, such a rule might be imposed upon and used for the purpose of escaping duty, but he doubted very much whether such a thing existed in the Air Force.

Just to illustrate the keenness of flying men, a night-flying pilot came to him in the summer time, a victim to hay fever in a severe form, which made flying impossible as he thought, because he could not breathe through his nose. His reaction to asking for treatment was that he might be enabled to breathe—he did not realize the importance of his nasal obstruction to his ear—and he asked whether, on somewhat the same plan as was done in race horses, a fresh orifice could not be made, just for the duration of the war!

Mr. T. RITCHIE RODGER said that he had been particularly interested in Group Captain Dickson's paper about the drop at the 4,096 level. It took his mind back almost for a generation in otology, because when he made that little investigation which had been referred to by Mr. Ormerod he found that the opinion held by their predecessors in 1915-16 was that it was the higher limits of hearing that suffered in noise deafness, and the work that had been done during the previous decade disproved that or seemed to disprove it. His own clinical investigation was on boiler makers in Leith and seemed to disprove it, and now Group Captain Dickson took them back to the old idea with probably a more reasonable explanation of it. The older men said that for some reason or other the part of the organ of Corti concerned with the reception of the higher sounds was more vulnerable. That was the nearest guess they could make at that time to the explanation—that there was greater vulnerability than at the lower ranges. From experimental work done by several men it appeared that the disorganized part of the organ of Corti corresponded with the pitch used. In his own clinical observations he had used a series of tuning forks—they did not have an audiometer in 1915—and what he did was to go down to the shipyards with his pockets bulging with tuning forks and strike them all over the place until he found what were the predominant noises to which the ears of the men were exposed. He came to the conclusion that 400 and 500 double vibrations per second were the predominant noises, and he used a series of four tuning forks—one 128 double vibrations, another 419, a third 520, and a fourth 2,048, but he did not go as high as 4,096, so that he did not find the results of that block which he might have found if he had used a 4,096 tuning fork. He found that the two middle forks corresponded to the predominant noises. Even boys who had



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been employed only for six weeks or three months showed a certain amount of depreciation at that level, but not above it and not below it, and it was only in the men who had been for fifteen or twenty years or more employed in the work that any alteration in appreciation of the 2,048 fork was found.

They thought it justifiable to come to the conclusion that the upper limit was not involved particularly until the whole gamut was affected by long exposure to the injurious sounds. But as he had stated, it seemed from later investigations and from what Group Captain Dickson had said that day, they were back to the old idea that the upper reaches, at any rate in the region of 4,096, did suffer more than the other parts of the scale.

Mr. E. D. D. DAVIS said that he was very much interested in all the papers and had learned a great deal from them. There were one or two points which he desired to raise. The function of the Eustachian tube in opening and shutting was very complicated. Here Squadron Leader McGibbon's paper in the *Journal of Laryngology* was a very good one. If a patient were found with a large cleft in the palate it was possible to watch the Eustachian tube, and a very definite movement of the orifice was seen during swallowing. Hajek in Vienna had a patient who had lost a part of his cheek from rodent ulcer, and there again it was possible to watch the movements of the Eustachian tube.

He had seen a few cases of the effect on the drum of a very rapid dive, and also in caisson workers, in which there appeared to be a certain amount of hæmorrhage into the middle ear. In most of the cases the hæmorrhage had been more or less into the drum or approaching the drum rather than into the middle ear. He would warn everyone to let the cases alone, not to puncture the drum.

One other point was with regard to the efficacy of glucose in sea-sickness or air-sickness. Oriel, employed by the Cunard Line Company, found it of value only in those cases in which there had been upset by vomiting for many days. He did not think it had any value as a preventive. It was only to cut short the malaise.

Mr. STIRK ADAMS said that Group Captain Dickson had mentioned that there was no loss in the upper tones in the man who developed the 4,096 dip after exposure to loud sounds. Was that absence of loss in the upper tones tested in the monochord? Unless such a test was carried out an audiometric test alone was insufficient to justify such a sweeping statement. The 4,096 dip was found very commonly. One of his friends pointed out when he was working on the 2B audiometer (before the 6A audiometer was available) that the commonest lesion he found in men with failing hearing was a dip at 4,096. That would have to be regarded as a widespread lesion in civil life, apart from damage from service noise.



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Another question was that of treatment of the closed Eustachian tube. He had been extremely interested to know that two hours after the injury had occurred was the limit at which a spontaneous relief could be expected under ordinary circumstances. He wanted to ask whether instructions had been issued to the personnel that that was the case, and whether they had used a negative pressure chamber in the treatment of these invaginations of the middle ear from closure of the Eustachian tube.

On the question of sea-sickness, there was, apparently, a type of sea-sickness quite different from that commonly associated with paralytic vomiting. Had that type been noted in the Air Force—a paralytic type in which the individual became collapsed and extremely ill until the ship was in harbour ?

Wing Commander J. F. SIMPSON, in reply, said that Major Guthrie had asked about changes in the mucosa. As he had mentioned in his opening remarks, they had to look at these people in the pressure chamber going up and down, and he emphasized that they could not see any change, but he imagined there must be one. That suggested to him to emphasize once more that not only was there a one-way mechanism in the Eustachian tube, but there must be a similar mechanism in the opening around the ostia of the sinuses. He did not know what that was, he would have liked some suggestion.

With regard to the mobility of the tympanic membrane, he had done some experiments with Siegel's speculum and a bicycle pump and football bladder, blowing up the ear and putting up pressures even to 300 mm. of mercury, and in not every case had even pain been complained of, but the drum was pressed right in, and, when finished, a hyperæmic reaction followed almost immediately. He had always applied suction up to not quite such a high pressure (that seemed rather more painful), and putting suction on the nose caused more pain than putting suction on the ear, but that was by the way.

Mr. Watkyn-Thomas had called attention to the nerve deafness of injury that resulted from a dive. That was one of the most interesting things he had seen in the Service. He could not give any explanation. It might be that there was some difference in the partial pressures in the case of the tissues of the middle ear. It was out of his sphere, but there were a lot of things they did not understand, and if anybody could give any clue he would be grateful. But no mistake must be made, this was a separate thing from the air pressure deafness. Under his care now there was a case in which both occurred simultaneously. The ear was full of fluid. It had been treated with extravasation for a month without relief. He had sucked up fluid from the drum, but the deafness remained, and the whole of the mastoid cells took part in the effusion. It was part



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of the middle-ear cleft. It was shown on the X-rays. The fluid was sterile, and so remained, and the patient still was deaf.

As for flying with a cold, they told their medical officers that flying was forbidden, but they could not always be on the spot to see that it was carried out. Mr. Davis had spoken about the blood in the drum. He could assure them that it filled the middle ear in some cases, and a case had been found of the antrum being filled with blood.

Group Captain E. D. D. DICKSON, also in reply, said that Major Guthrie had asked about bone conduction being used as a means of intercommunication. That had been tried and given up.

Mr. Cann had asked about the effect of transmitted vibration. What part vibration played in producing high-toned deafness he could not say.

Mr. Stirk Adams had asked whether he used a monochord. Yes, that had been used. They did not as a routine go further than 9,000 cycles.

Mr. STIRK ADAMS : Have you tried 25,000 ?

Group Captain DICKSON said that they had not tried it. Larsen, he thought, had tried it, and had said, he thought, that there was no loss. They themselves did not use it because it did not come within the requirements. But in many of these cases, especially the early cases, there was a definite block at 4,000, and it picked up again at 8,000. He had tried the monochord up to 16,000 vibrations—he had not gone further than that.

With regard to civil cases, that same dip might be found at 4,000. All their own cases were young people whose history had been gone into very carefully and they did show that definite dip. Their hearing, from the Air Force point of view, was normal to begin with. That 4,096 dip, he was convinced, was definite evidence of acoustic trauma.

Squadron Leader FRY said that he had been asked about the evidence of fatigue. He did not think there was direct evidence of that. It was known that at the end of a long flight the members of the crew were less ready to receive signals and understand them. One point he would make clear was that the faithfulness of the reproduction of a signal or speech was affected by the electrical channel. If there was a very good electrical channel the effort entailed in listening was much less than if there were a bad. If one took two channels, one good and one bad, at the beginning people would understand about equally on both, but after a little time on the bad channel they would show fatigue.

About speech deafness, in the Air Force there had been for the last two years a unit whose job it was to try to instruct people on the best way to talk into the microphone. He had had the privilege of being at the head of that unit for nearly two years.



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Every effort was made to ensure that the speech signal which went into the microphone was of the best possible kind.

With regard to island deafness, no one could deny that that was very common. There was first of all the question as to where the actual minimum of hearing loss occurred. One could really only discover that by the use of a continuation frequency audiometer. In order to get really reliable evidence, the subject must be tested over the whole of the frequency range, and he knew that Dickson agreed with him that where the dip was shown at 4,096 on the audiometer it was due to the fact that one was using an audiometer that worked in opposites. If a continuous frequency audiometer was used the minimum—that is, the greatest hearing loss, would not always be at the same place and might not always be at 4,096.

As to the effect of noise, here again it was a question of the careful insulation of noise. Analysis had been made of engine noise and workshop noise, and with the octave filter one did not get a very close analysis of the actual noise. As it was almost certainly the amplitude of certain components which was causing the damage, it was essential to know if there was a certain amplitude at a given frequency. Therefore it was essential to have the noises analysed with a 5-scale wave analyser, and in that way one got a great deal more light on the subject. That work had been begun in America and possibly over here.

Squadron Leader WINFIELD said that Major Guthrie had raised the question of the analogy with sea-sickness. There was variation owing to the different type of motion. One observer spent seven years at sea and never was sick, but he had suffered from air-sickness. Glucose was of value only in the more nervous type of condition. At the beginning of flying training a man might suffer from this nervousness, go without food, and possibly suffer from hypoglycæmia. When in the air cases of that kind did receive benefit from glucose.

With regard to the paralytic type, this was never seen fully developed in the Air Force, because, he imagined, a certain length of time must elapse before the full picture appeared, and a person who fell into that category would be weeded out very early in his flying training because he felt extremely unwell in the air and might or might not vomit. Two distinct types of vomiting were encountered, one in which vomiting came on suddenly and was more or less of a projectile nature and was followed by complete relief and the man could go off to his navigating or his ship and carry on satisfactorily. In a more common condition the main feature was nausea rather than vomiting—a cumulative picture which might or might not end with vomiting.

Squadron Leader MCGIBBON replied on the question of bougies. He had mentioned in his opening remarks trying to pass the tympanic



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sound in fifty-seven cases, but in all of these he came up against quite a firm obstruction.

Mr. Stirk Adams had asked about treatment. If immediate treatment was going to do any good it must be applied in a short time—he thought within two hours. Group Captain Dickson had allowed him to ask medical officers at his station to do this when the airmen came down, and at one or two stations there had been a lessening of the number of patients referred to hospital, and from one station no patients at all had been received for three or four weeks.

The CHAIRMAN expressed the thanks of both Sections to the five openers and the meeting concluded.

# ABSTRACTS

## EAR

*Investigation of Professional Deafness in Shipyard and Machine Factory Labourers.* BØRGE LARSEN. (*Acta Otolaryngologica* 1939, Supplementum xxxvi.)

The author has investigated the hearing in a large number of employees in the shipbuilding yards at Odense near Copenhagen. They were employed in the boiler-making and riveting departments, and had in many cases been employed for upwards of thirty years.

In workers accustomed for many years to work in an extremely noisy environment it was found that the upper auditory limit was lowered to a point below the pitch considered normal for the particular age, according to Struycken. It was found that the lowering of the upper limit by air conduction was associated with a similar lowering by bone conduction. In these individuals there was very little raising of the lower tone limit. Out of 246 ears only twenty-two were raised, five to 20 cycles, fifteen to 24 cycles, and one to 36 cycles. Hearing by air conduction for $a^1$ (435 cycles) was normal in 137 ears, but of these hearing of a whisper was reduced to below one metre in twenty-eight ears. In sixty-one it was between one and eight metres and in forty-eight it was over eight metres. Where either air or bone conduction is reduced by 50 per cent. or more, hearing for whisper is reduced to one metre. On the other hand in seventy-nine cases where the hearing for whisper was reduced to less than one metre, the upper limit was not lowered below normal, and in a few cases was particularly high. In men of 51 years, after thirty-one years' work in the boiler shops, hearing for whisper was reduced in all cases to less than one metre, but in many the hearing for the spoken voice was well preserved.

Audiographic investigation of these cases showed that there was a sharp dip in the acuity of hearing beginning as a rule between



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