more limited infection. Table II. shows the results both of the subcutaneous injection and of the feeding experiments as obtained by us. We insert for purposes of comparison an excerpt from Professor Koch's table (see Table III.) in relation to his experiments on the feeding and subcutaneous injection of pigs.

TABLE II.—*Showing the Results of Subcutaneous Injection and Feeding of Pigs with Material obtained from Cases of Human Tuberculosis.*

Subcutaneously from Sputum.

Number of animal.	Weight.	Sputum.	Died.	Killed.	Number of days.	Weight.	Lesions.
1	29⅓	S——	—	+	227	56	Tuberculosis local, bronchial and mediastinal glands, lungs, and liver.
2	30	R——	+	—	137	24	Tuberculosis local, abscess, inguinal and lumbar glands, lung, liver, and spleen.
3	19	,,	+	—	47	16½	Tuberculosis local, lumbar and bronchial glands, lungs, liver, spleen and kidneys.
*4	58	H——	+	—	102	70	Tuberculosis local, lumbar glands, and lungs.
6	20	,,	+	—	146	24	Tuberculosis local, inguinal and lumbar glands, lung, liver, and spleen.
7	35	,,	+	—	31	24	Tuberculosis local, inguinal and lumbar glands, and lung.

Subcutaneously with Emulsion of Nodules from the Liver of Pig No. 3.

5	36	—	—	+	189	—	No lesions.

Feeding with Sputum.

8	35	H——	+	—	82	26	Tuberculous tonsillar and cervical glands.
9	30	,,	+	—	72	23	Tuberculous tonsillar glands.
10	36	H——, J——, S——	+	—	78	26	Tuberculous tonsillar and cervical glands.

* Injection also intra-thoracic.

TABLE III.—*Extract from Professor Koch's Table showing Results of Subcutaneous Injection and Feeding of Pigs with Material obtained from Cases of Human Tuberculosis.*

Species of animal.	Nature of infection.	Nature of infective material.	Time after inoculation.		Result.		
			Dead.	Killed.	Positive.	Doubtful.	Negative.
6 pigs.	Feeding.	104 days daily 15 cubic centimetres of sputum containing tubercle bacilli.	—	3 after 104 days; 3 after 136 days.	—	1	5
2 ,,	Subcutaneous injection.	2 cubic centimetres pure culture, 1 in 100.	—	1 after 100 days; 1 after 135 days.	—	—	2

As regards the main object of this research the experiments cited (*vide* Table I.) appear to demonstrate that the human tubercle bacillus is not markedly exalted in its virulence for the calf by a single passage through the pig, the cat, the rabbit, or the rat. At the same time the experiments show that the human tubercle bacillus is by no means innocuous to the calf, as the control animal injected directly with sputum contracted an extensive glandular tuberculosis. At first sight these results might suggest that the passage through the intermediate animals had caused a diminution in the virulence of the bacillus for the calf, but it must be remembered that in the one case the associated organisms had been eliminated by passage, whereas in the other case they may have played an important rôle in aiding the attack of the tubercle bacillus. The important rôle that these associated organisms are capable of playing in certain diseases is a matter of general knowledge; one need only refer to the case of tetanus where large quantities of living tetanus spores can be injected without effect, but where the addition of other organisms to the spores enables these to develop and to give rise to the disease. *Apropos* of this it is interesting to note that the only pig in the series which failed to show tuberculous infection of any sort was the animal inoculated with tuberculous material obtained from another pig and in this material the tubercle bacillus was unaccompanied by other organisms. The problem is also complicated by the possibility of the juices of the emulsified organs having played some part in the process. As mentioned above, with reference to the infection of the pig an important result was obtained, as the experiments conclusively prove that this animal is capable of contracting a rapidly fatal general tuberculosis as the result of inoculation with the tubercle bacillus of human origin.

OZONE IN CHRONIC MIDDLE-EAR DEAFNESS.

BY GEORGE STOKER, C.M.G., M.R.C.P. IREL.,
PHYSICIAN TO THE LONDON THROAT HOSPITAL.

THE form of deafness to which this article refers is that popularly known as "throat deafness" and to the medical profession as "chronic dry catarrh of the middle ear." It is generally believed to be due to stenosis of the Eustachian tube. This latter condition may arise from interference with nasal respiration due to congenital malformation or to hypertrophy of the mucous membrane of the nose or naso-pharynx. The symptoms are progressive deafness, with tinnitus of various kinds and varying intensity. The tympanic membrane is retracted and usually opaque. There are no signs or symptoms of the auditory nerve being involved. Of all forms of deafness this is the most common and the most intractable, and it is no exaggeration to describe it as the opprobrium of otology. The stenosis of the Eustachian tube affects the mucous membrane lining the middle ear (1) by preventing the free ingress and egress of air; and (2) by confining the secretions that exude from the lining of the cavity and thus setting up unhealthy conditions. These conditions lead to thickening of the mucous membrane and consequent deafness. The nasal stenosis may be relieved and the Eustachian tube become more open but the deafness still increases; this points to a remaining unhealthy condition of the middle ear. The effect of oxygen and more particularly of its allotropic form, ozone, in restoring a healthy condition to diseased nasal mucous membrane led to a trial of the latter in chronic progressive deafness. The ozone was generated by means of an electric current acting on a Ruhmkorff's coil to which the ozonising tube was attached. The ozone so generated was pumped into the middle ear through an Eustachian catheter for about three minutes, from twice to four times a week, according to opportunity. The following are notes of cases treated, the conditions first described being those existing before the ozone was applied.

CASE 1.—The patient, a woman, was first seen on Feb. 4th, 1902. She had been growing deaf for six years. She had marked and very distressing tinnitus. Both tympanic membranes were depressed and opaque. Mastoid bone conduction was good. Aerial conduction was minus on both sides. A watch could be heard one inch from the right ear and two inches from the left ear. On March 24th, after the twelfth application of the ozone, the tinnitus had disappeared. A watch could be heard three inches from the right ear and four inches from the left ear.

CASE 2.—The patient, a man, was first seen on Feb. 4th, 1902. He had been deaf for seven years. He had had constant tinnitus. Both tympanic membranes were depressed and opaque. Mastoid bone conduction was good. Aerial conduction was minus in both ears. A watch, on contact with either the right or the left ear, could not be heard. On

March 4th, after the tenth application of the ozone, the tinnitus had disappeared. On April 18th there had been no recurrence of tinnitus. A watch could be heard on contact with the right and left ear.

CASE 3.—The patient, a man, was first seen on Feb. 4th, 1902. He had been deaf over one year. He had mild intermittent tinnitus. Both tympanic membranes were depressed and opaque. Mastoid bone conduction was normal. Aerial conduction was minus on both sides. A watch could be heard on contact with the right ear and half an inch from the left ear. On March 12th, after applications of the ozone, the tinnitus had disappeared. On April 18th there had been no recurrence of the tinnitus. A watch could be heard eight inches from the right ear and nine inches from the left ear.

CASE 4.—The patient, a woman, was first seen on Feb. 4th, 1902. She had been deaf for seven years. There was constant tinnitus. Mastoid bone conduction was good. Aerial conduction was minus on both sides. A watch could be heard two inches from both ears. On March 4th, after the sixth application, the tinnitus had ceased. On April 18th there had been no recurrence of the tinnitus. A watch could be heard two and a half inches from the right ear and three inches from the left ear.

In all the above cases it will be seen that the hearing has considerably improved; in some the progress made has been remarkable. This improvement as shown by the watch represents a much greater improvement when the voice is in question. The disappearance of the tinnitus after a few applications is very important. It is reasonable to suppose that if the ozone could have been used every day the results would have been better still. In carrying out the above treatment I have been fortunate in having had the assistance of my colleague, Mr. A. de Prenderville, house surgeon to the London Throat Hospital.

Hertford-street, Mayfair, W.

THE EPIDEMIC OF CEREBRO-SPINAL MENINGITIS AT LISBON.

BY H. W. SEAGER, M.B.

THIS disease, which appears to be epidemic in Germany, France, and Italy, was unknown in Lisbon two years ago except for a few sporadic cases. In 1900 only one death was ascribed to cerebro-spinal meningitis; but it is noteworthy that there were 319 deaths imputed to simple meningitis and 64 to tuberculous meningitis in that year, whereas for 1899 the figures were respectively—four for simple meningitis and one for tuberculous meningitis. There was no case of cerebro-spinal meningitis recorded in 1899, but no doubt the enormous increase of deaths from meningeal disease in 1900 called the attention of Dr. Ricardo Jorge, the very able and energetic officer of the State Department of Public Health in Lisbon, to the disease and caused more strict inquiry into its nature.

Since 1900 part of a hospital has been reserved for cerebro-spinal meningitis and about 150 cases have been treated there. I was allowed to see the wards and patients there when visiting the hospital on July 23rd, 1902. The building is large, with lofty, well-ventilated, and well-lighted rooms. It was formerly a convent. One side is used as a ward for cases of tuberculosis and the other for the meningeal disease in question; the latter is carefully kept entirely distinct from the other. A noticeable feature in this hospital, as in other Lisbon hospitals, is that in the quadrangles round which the wards are built there is a well-kept garden which is bright with cannas, calceolarias, veronicas, and many other brilliant flowers besides many varieties of palms and flowering aloes and yuccas. The male attendants all wear long white linen coats reaching to the ankles and the female nurses wear white or grey dresses of coarse linen. On entering the hospital we had to don long white linen coats buttoned from the throat to the ankles which were unpacked for us from a bale of medicated cotton-wool—a precaution which did not altogether add to the respectability of our appearance when we left, as cotton-wool sticks to cloth lovingly.

There were some 20 patients under treatment in the hospital, of whom one had been admitted on the previous day and two in the previous week. The rest were chronic cases—i.e., cases which had been in the hospital for some time—but all, except one boy with paralysis of the glottis, appeared to be doing well, and several were convalescent and only kept in the hospital for fear of a relapse, which very frequently occurs in this disease. When this disease first appeared at Lisbon previously to the adopting of the treatment which I will describe later 60 per cent. of the patients died.

Cerebro-spinal meningitis is a disease almost entirely confined to the lower classes, so that probably dirt, overcrowding, and malnutrition are largely conducive to its prevalence in Lisbon. It appears to be infectious and to a slight extent contagious. A plan of Lisbon in which the infected localities are marked shows large areas of houses and offices occupied by the wealthier classes quite free from this disease, while numerous cases occur in the poorer districts surrounding these areas. There are a few cases among well-to-do people, but hitherto no other exciting causes than poverty and squalor, and perhaps contagion, have been noted. The disease appears to have no connexion with the water-supply or the sewage. The water in Lisbon is derived from very many sources, some of which are in the town itself, whilst the rest of the water is brought by aqueducts from a distance. There are no filter-beds for the water derived from any source, and, as far as I can learn, the waters are mixed in the reservoirs, of which there are several in the town, before they reach the supply-pipes. Information, however, on this head is rather hazy and doubtful. The bacteriological analysis of the different sources is hardly satisfactory, ranging from 60 to 300 bacteria per cubic centimetre. Sewage is discharged into the Tagus at a distance of two and a half miles from Lisbon without any treatment at all.

Cases of cerebro-spinal meningitis are usually taken to the hospital in quite early stages and as it is a disease of the poor almost all the cases go to the hospital. I saw one on the third day. The patient appeared to be fairly cheerful and collected; he had a normal pulse but a very dirty and furred tongue, as indeed had all the cases which I examined, even the so-called convalescent ones. The period of incubation of this complaint has not yet been discovered. There are absolutely no data on this head to be procured in Lisbon. The earliest symptoms of the disease are rigors, headache, pains in the joints, and painful opisthotonos. The fluid drawn off by puncture and aspiration in the lumbar region of the spinal cord with a hypodermic syringe is clear and limpid in the early stages, during which time the temperature falls as low as 95° F. After an indefinite period varying from hours to days the fluid drawn off becomes flocculent and contains pus, and the temperature rises and may reach 104°, but generally does not exceed that limit. When the temperature has risen—generally when it is at its height—a puncture is made between the eleventh and twelfth lumbar vertebræ, or between the twelfth and the sacrum, with a hypodermic needle which is disinfected with lysol, the skin having been previously washed with lysol. The operator does not cleanse his fingers immediately before the operation, though he washes his hands immediately before entering the ward. A quantity of fluid is withdrawn by aspiration with the hypodermic syringe from the spinal canal, the quantity of which varies but frequently amounts to over 50 cubic centimetres. Artificial serum is then injected with the same hypodermic syringe into the needle which is left *in situ* and the surrounding parts are washed with the serum. Lastly, a quantity (from nine to 12 cubic centimetres) of solution of lysol of the strength of 1 in 100 is injected with the same instruments and the needle is withdrawn. The prick of the needle naturally causes pain which the patient seems to dread very much and there seems also to be pain when the needle enters the spinal canal and when the fluids are injected. That the patients should dread the operation is not perhaps surprising. I saw five punctures made in one patient who was certainly only of ordinary fatness for a young woman, but the needle (over two inches in length) did not reach the canal except after considerable pressure. The liquid withdrawn is measured and a part reserved for bacteriological examination. The temperature falls immediately but rises again after from one to three days when the puncture and injection are repeated and so on until only quite clear and limpid fluid is withdrawn after the puncture, and then the injection of lysol is stopped. Afterwards some few punctures are made to see if the fluid continues clear. There was one case of phlyctenular hæmorrhage about the ankle in the ward which at first was supposed to be small-pox—the phlyctenulæ appeared on the third or fourth day of the disease and have been observed previously