Another cell occasionally observed in the exudation impressed me strongly as a leucocyte in process of division. One or two such are represented in the illustration considerably above their relative size.

Outside the microscopical appearances there are one or two points of importance calling for comment in this case. The fresh and fatal outburst of the disease in the membranes of the brain four weeks after the temperature had fallen to the normal is noteworthy, and may be advantageously considered alongside the experimental research of the Messrs. Klemperer,⁹ in which it is alleged that the injection of any nutrient medium in which the pneumococcus has been cultivated renders animals immune against pneumonic septicæmia, and that the injection of the serum of pneumonic patients after the crisis cures pneumonia in rabbits. Regarding the local condition, it is to be concluded that the chronic bronchial catarrh had led to injury and choking of the lymphatics which travel along the septa, causing tardy absorption of the products of the pneumonia; also, it is not improbable that the alveolar walls themselves had in places sustained some damage. The existence, therefore, of a previous bronchial affection should be kept in view in estimating the prognosis of a pneumonia. When no bronchial affection has existed, impaired resolution must be attributed to a sluggish state of the lymphatics induced by cachexia. I think this case also teaches that there is a possibility of the condition terminating in abscess, the groups of lymph cells depicted acting as foci for such. However, a favourable prognosis is the rule, and, judging from the condition of the lung generally in the present instance, there is, I think, little doubt that recovery would ultimately be brought about had the pneumonic virus not attacked the meninges of the unfortunate subject.

REFERENCES.

- ¹ *The Pathology of Bronchial Affections and Pneumonia*, London, 1891.
² *Berl. klin. Woch.*, 1879, p. 304. ³ *Clin. Med.*, 1, p. 574. ⁴ *De la Pneumonie Chronique*, Thèse, 1860. ⁵ *Deut. Arch. f. klin. Med.*, vol. xxxiii. ⁶ *Gas. Beltrige*, II, p. 716. ⁷ *Manual path. Hist.*, Art. Pneumonie. ⁸ *Pneumonia*, p. 125. ⁹ *Berlin. klin. Woch.*, August 24th and 31st, 1891.

CLINICAL OBSERVATIONS ON TROPACOCAINE
IN OPHTHALMIC PRACTICE.

By GEORGE FERDINANDS, M.D., C.M.,

Assistant to the Ophthalmic Surgeon, Royal Infirmary, Aberdeen.

AFTER reading Dr. Chadbourne's valuable and concise paper¹ on the synthetical hydrochlorate of tropacocaine, I obtained, with some difficulty, a small sample. The following brief clinical observations were noted by me during a period of six months. Solutions of various strengths were used, thus—1, 2, 3, 5, and 10 per cent. The installation of one drop of a 2 or 3 per cent. solution (there being not much difference between the two) caused complete anæsthesia of the cornea in two minutes. But, for the removal of small foreign bodies, the cornea was always sufficiently insensible in about thirty seconds. Hardly any smarting or discomfort was felt, and that only momentarily. There was no hyperæmia. The conjunctiva, especially the palpebral portion, was slower in becoming anæsthetised, but it appeared to retain its insensibility for a longer period. Sensation gradually returned in from ten to fifteen minutes. This depended, no doubt, on the size of the drop instilled into the eye and the amount that escaped from it. A 1 per cent. solution within a few minutes gave sufficient anæsthesia to remove foreign bodies, but sensation returned early; and although repeated instillations completely anæsthetised the cornea and conjunctiva, the solution was discarded as unsuitable. A single instillation of the 5 per cent. solution rendered the cornea and conjunctiva completely insensible in a minute and a-half, but superficial anæsthesia of the cornea was produced so rapidly that in five seconds it was insensible to the touch of a camel's hair brush. The anæsthesia lasted from fifteen to twenty minutes. A drop of the 10 per cent. solution caused insensibility of the cornea within a few seconds, but it also gave rise to considerable injection, which remained for a few hours. At the end of the half-hour during which the patient was under observation, the anæsthesia still remained complete; unfortunately its full duration could not be recorded. Next day the patient stated

that an hour after he left a pain set up in the eye, which kept him awake the whole night. He described it as acute and extending to the back of the head, and frequently darting up to the brow. These statements made me chary of using the strong solution any further. Besides, there was no need for so concentrated a solution, as the 5 per cent. gave every satisfaction whenever rapid anæsthesia of the deep-seated parts was desired. The 3 per cent. solution was most frequently employed. Below are a few instances in which tropacocaine was used.

Eye-lids and Conjunctiva.—Meibomian cysts were painlessly incised and scraped. In cases of muco-purulent ophthalmia requiring the application of a strong solution of nitrate of silver a drop of tropacocaine prevented the after-smarting which usually follows that operation. Cocaine, as a rule, is less effective when the conjunctiva is inflamed. But tropacocaine does not appear to fail in this respect, neither did its continual use produce that sodden appearance of the conjunctiva which is frequently the case with cocaine. In entropion of the lower lid requiring the removal of a piece of skin, and in other operations about the lids, three drops of a 3 per cent. solution injected subcutaneously at the spot made the operations painless.

Cornea.—Ulcers were painlessly cauterised. Needlings were also satisfactorily accomplished without pain. In cataract operations, with and without iridectomy, no pain was felt, three instillations of a 3 per cent. solution being used. A single drop of a 5 per cent. solution rendered the excision of a portion of prolapsed iris painless. The same solution gave satisfaction in an iridectomy for glaucoma.

Nasal Duct.—Canaliculi were slit up without pain, and the injection of a few drops of a 3 per cent. solution down the duct rendered otherwise painful probing tolerable.

Strabismus.—A single drop of a 5 per cent. solution produced sufficient anæsthesia of the muscle. Some minutes were usually allowed to elapse between the instillation and the operation. The 3 per cent. solution required several instillations.

CONCLUSIONS.

1. Tropacocaine is more reliable and deeper in its action than cocaine, and the anæsthesia it produces lasts a little longer. Unlike cocaine, it anæsthetises inflamed tissue—at least, more deeply than does that salt. There is complete absence of the haze over the cornea which is so characteristic of cocaine anæsthesia. This was specially appreciated when needling. The strength of the solution depends on the requirement. For general use 2 or 3 per cent. is sufficient and a 5 per cent. solution may be used with safety when anæsthesia of the deep-seated parts is required.

2. Solutions of tropacocaine made with distilled water keep well and retain their strength for months. One solution (3 per cent.), prepared in January last, although now a little cloudy, has not lost its activity. So far no fungus has been noticed growing in the solutions.

3. With the exception of the one case mentioned in which the 10 per cent. solution was used, tropacocaine gave rise to no disagreeable symptoms. It practically has no mydriatic action; neither is it hæmostatic. But it certainly did not give rise to "intense hæmorrhage," as was the experience of Seifert.²

I am inclined to think that cocaine will eventually be replaced by tropacocaine when its advantages are fully understood. Even if it were only for its antiseptic properties, the new anæsthetic should be given the preference. The price is not prohibitive, and increased demand will place it within the reach of all.

THE PHYSIOLOGICAL EFFECTS OF ELECTRICAL
CURRENTS OF HIGH FREQUENCY.

By H. LEWIS JONES, M.D. CANTAB., M.R.C.P.,

Medical Officer in charge of the Electrical Department, St. Bartholomew's Hospital.

THE application to medicine of electrical currents of great rapidity of alternation, or high frequency currents, as they are commonly called, has occupied the minds of medical men to a great extent during the past twelve months. In France

¹ BRITISH MEDICAL JOURNAL, August 20th, 1892, p. 402.

² *Internat. klin. Rundschau*, No. 8, 1893.

especially is this the case, where d'Arsonval has given much study to this difficult subject. The demonstrations which were given at the Royal Institution by Tesla in the spring of last year left an impression upon the minds of many people that enormous voltages were harmless to the human body if only they could be made to alternate with sufficient rapidity, and people were astounded at the spectacle of a lecturer placing himself in a circuit carrying a current alternating some hundreds of thousands of times per second, at a pressure of many thousands of volts. These experiments, coming not long after the accounts of the execution of criminals by electricity in America with pressures of 1,200 or 1,500 volts, and compared with the occasional notices in the newspapers of fatal accidents to workmen engaged upon electric light cables at 1,000 volts, made it seem as though the rapidity of alternation was the factor which protected Tesla from injury by the enormously high voltages which he was handling. The same view is taken by d'Arsonval in his papers before the Société de Biologie. He there describes an apparatus consisting of an induction coil supplying current to Leyden jars, the jars being made to discharge through a circuit including a helix of ten turns of thick wire and an air gap. In this way there is set up in the circuit a succession of sudden rushes of current, which oscillate hundreds of thousands or even millions of times per second, the rate being determined by the Leyden jars; and the wire helix becomes the seat of electro-magnetic induction effects, comparable exactly to the induced primary currents of a medical induction coil, but very much more intense. These induced currents of the helix

are the subject of d'Arsonval's experiments. By attaching wires to the beginning and end of the helix the induced currents or extra currents can be led off; their energy was sufficient to bring to full incandescence a lamp requiring two ampères to light it, and it was therefore assumed that they had a magnitude of two ampères. The electromotive force of the currents was at least 8,000 or 10,000 volts, because they were able to leap across an air gap of several millimetres, and yet their effect upon the tissues of the body was very slight; in fact, they were hardly felt.

Now it is certain that a current of far less than 1 ampère, either steady or alternating 20, 50, or 100 times per second, would produce unbearable and dangerous shocks in its passage through the tissues; and the inference drawn is that the extreme frequency of alternation can render a current of dangerous magnitude innocuous. But I am not satisfied that such an inference is a proper one, for the following reasons:

1. A Leyden jar discharging through the body produces effects which are painful and severe, as all who have felt them will agree; but yet this is a discharge of high frequency of alternation; in fact, it is by the Leyden jars in the circuit that the oscillatory character and the rapid rate of alternation of the discharge is determined. Oliver Lodge gives the rate of oscillation for a pint-sized Leyden jar at ten million per second; for jars of greater capacity the rate is less rapid.

2. The high frequency and high potential discharges of Tesla's apparatus are not altogether harmless, but can produce severe shocks and can kill small animals, as Elihu Thomson has shown. The discharges from the terminals of such an apparatus can produce severe muscular contractions even with the resistance of a considerable air space interposed in the circuit; so much so that in some recent experiments which the writer was enabled to make through the kindness of Mr. Campbell Swinton, it was considered prudent to proceed no further with the experiment of actually touching both the terminals of the coil at once.

3. It is very doubtful whether d'Arsonval's estimation of the magnitude of the current of his apparatus is correct. The incandescence of a lamp filament with currents of high frequency has been recently under discussion in some of the electrical journals, and a very satisfactory explanation of the phenomenon has been forthcoming.¹ It is well known that for alternating currents the resistance of a conductor is greater than it is for steady currents, and the increase of resistance rises rapidly as the rate of alternation becomes greater; and with frequencies approaching one million per second the effective resistance of the lamp used by d'Arsonval would be raised enormously; this would require the energy needed to bring it to incandescence to be applied at a proportionately higher voltage, while the magnitude of the current would be lessened in an equal degree. For example, the energy of 2 ampères at 100 volts is the same in amount as that of 0.02 of an ampère (20 milliamperes) at 10,000 volts.

We are therefore able to say that the current which raised d'Arsonval's two-ampère lamp to bright incandescence was very much less than two ampères, and was probably only a few milliamperes, and herein lies the pith of the whole question. The experiments with high frequency currents of high tension are harmless if the magnitude of the current is small, and as the high potential is in fact obtained at the expense of the current, this latter diminishes in proportion as the potential is raised by each successive step up in the transforming apparatus. For the present it may be taken as not yet proved that high frequency of alternation can render electrical currents harmless; and it may still be accepted that the effect produced by the passage of a current through living tissues depends primarily upon the magnitude of the current, as measured in ampères, which is made to traverse them, and upon its density or concentration therein.

CASES OF LUPUS TREATED BY MEANS OF TUBERCULIN, COMBINED WITH OTHER MEASURES.

By JAMES DONELAN, M.B., M.Ch.,
Physician to the Italian Hospital, London.

THE publication in the BRITISH MEDICAL JOURNAL of June 3rd of Mr. Malcolm Morris's cases of lupus treated by means of Koch's lymph combined with surgical measures, and his appeal for the experiences of others with similar treatment, induces me to send the notes of the following cases, in which a sufficient time has elapsed to allow some idea to be formed of the value of this method as a means of cure:

CASE I.—A strumous-looking youth, aged 19, came under my observation in September, 1890, some months before the announcement of Koch's remedy. He had a small patch of lupus involving the right ala of the nose, and extending for about an inch outwards on the cheek and down to the angle of the mouth. There was no evidence of deeper disease in the nose, pharynx, or larynx, and a careful examination failed to detect any signs of pulmonary mischief. I scraped the patch, removing the greater part of the ala of the nose, and freely cauterised the bleeding surface with the electro-cautery. The wound healed without trouble, and for some months the patient remained free from any outward sign of the return of the disease. He went to the South of France in January, 1891, and returned to London in the middle of April, when I saw him again. The cicatrix appeared firm and sound, but at two or three points in the outer margin of the scar there were signs of renewed activity. The ala of the nose, pharynx, larynx, and lungs appeared to be as healthy as before. On April 18th he had an injection of 0.01 c.c. of Koch's lymph. No immediate effect was produced, but when 0.03 c.c. was injected on the 20th a marked local reaction took place. His temperature rose to 101° F. The patch became red, and was surrounded by a bright red areola, with several little red spots outside it like the eruption in scarlet fever. After two or three days some of these little spots became pustular. The areola extended down on the upper lip, and it became evident that the inferior turbinated body and part of the outer wall of the right nasal fossa were

Electrician, December, 1892.