by Van der Loeff and L. Pfeiffer as to the motile flagellate bodies in the blood of persons suffering from these diseases. I will close these brief remarks by stating that in my opinion the processes which take place in the vaccinated cornea and in other lesions of vaccinia and variola are comparable in a remarkable degree to those which I have observed in cancer. The parasites in the latter condition present a more extended series of forms than those of variola; yet in both cases the fundamental characters of the parasites are the same—namely: "At certain stages they resemble recognised sporozoa, the intra-cellular phases being of especial importance. They tend to assume a round or oval form. Their protoplasm is dense and highly refracting and stains deeply with carmine, acid fuchsin, &c. Their nucleus often does not give the reaction of chromatin to acid hæmatoxylin. All stages of swarm-sporing can be observed."¹² Moreover, the same hypertrophy of cell protoplasm and cell nuclei is seen in the vaccinated cornea and in various cancers and sarcomata.

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NOTE ON THE LOCALISATION OF TACTILE IMPRESSIONS IN THE BRAIN.

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THE careful deductions of Exner have, in great measure, bridged over the chasm existing between the radical "localisationists" and the so-called "anti-localisationists." On the one hand, the general principle of localisation has been shown to be correct by the Vienna observer; on the other hand, that narrow limitation of numerous centres to areas not exceeding a few millimetres in diameter, which has constituted such a vulnerable position for the onslaughts of Goltz and Brown-Séquard, must now be considered untenable. Just as the fibre masses of the corona radiata are seen to spread out fan-shaped, and while terminating chiefly in some special cortical districts, yet detach scattered fibres to neighbouring areas, so the fields of cortical function delineated by Exner in his great work¹ are shown to consist of "absolute" and "relative" fields. The former have a constant relation to a given function; the destruction of the "absolute" field for the muscles of the arm is always followed by paralysis of those muscles. The latter have an inconstant relation; the destruction of the "relative" field of the arm muscles which surrounds the absolute field in zones of gradually diminishing intensity sometimes leads to such paralysis and sometimes does not. The various fields of motor and sensory function are also noticed to overlap considerably; the field for the arm dies out within the visual area, and encroaches considerably on the speech field. But a most interesting result of Exner's laborious compilation and comparison of the numerous cases of limited cortical lesion scattered through modern neurological literature is his conclusion that, as a rule, the sensory fields are nearly identical with the motor fields for the same periphery, and he cites this as a remarkable confirmation of the experimental results of Munk, who found his tactile areas in the dog's brain to correspond with the motor areas of Hitzig and Fritsch. Not only do the tactile fields correspond very closely to the motor fields of the same body regions, thus sustaining the anticipation of Meynert that the rôle of the cortex is not so much the liberation of an explosive motor force as the mediation of sensations of innervation (*Innervationsgefühle*), but all determinable function areas which on physiological grounds must be considered to require a bond of association in the cerebral mechanism are found to have a regional contact. Thus the symbolic field, that devoted to the registration and liberation of spoken and written symbols, is found to approach the fields of the upper extremity and of the lingual and auditory peripheries.

While our knowledge of the sensory cortical area is daily becoming more satisfactory, that of the course of the sensory tracts connected with the cortical areas in question is very

imperfect. We know partly from Veyssière's experiments, and partly from confirmatory pathological observation, that the fibres conveying tactile impressions are chiefly concentrated in the posterior division of the internal capsule. Meynert,² whose anatomically based presumptions have in many respects anticipated the results of actual observation, entertained the belief that this portion of the internal capsule was continued in the outer third of the pes pedunculi, the descending pyramidal tract, and reached the posterior columns of the cord through his so-called "upper fine-bundled decussation of the pyramids." On Meynert's hypothesis, then, the connexion between the posterior and "sensory" columns of the cord and the posterior part of the internal capsule was clear. Flechsig,³ however, showed that the true pyramidal tract has no connexion with the so-called upper decussation, and the conclusion was somewhat hastily drawn that Meynert's theory of a connexion between the posterior columns and the cerebral hemispheres was to be abandoned. In reality, Meynert's hypothetical tract requires but two topographical modifications to accommodate it to what is to-day demonstrable in any series of transverse and longitudinal sections of the brain isthmus.⁴ In a transverse section of the medulla oblongata, immediately above the level of the decussation of the crossed pyramidal tract, the raphe of the oblongata is seen to be very much thickened and to consist of fasciculi crossing at a rather acute angle. From the resemblance of the swollen part of the raphe to a fir-cone, whose knobs are represented by the entering fasciculi, I have proposed to designate this—which is identical with Meynert's so-called upper or sensory decussation—the piniform decussation.⁵ (Fig. 1)

FIG. 1.

Diagram of section transversely to axis of human oblongata at the level of the inferior end of the olive. O, Olive. Oi, Inner accessory olive. Pyr, True pyramidal tract. I, Stratum intermedium. L, Lemniscus layer receiving crossed fibres from posterior column through P, the piniform decussation. C, Central tubular grey around central canal. G, Nucleus of column of Goll. B, Same of column of Burdach. S, Gelatinous nucleus of ascending trigeminal root. F, Fibres from posterior column and its nuclei to piniform decussation.

Its fibres can be distinctly traced from the posterior columns, fielding off the grey masses of the nuclei of Goll's and Burdach's columns; they cross in the decussation and enter the internal division of the reticular field, dorsad⁶ of the pyramids, laterad of the raphe and mesad of the olive. Other of these fibres run into the hilus of the olive and in between the latter and the inner accessory olive constituting the lemniscus tract. I am not able to differentiate between the fibres which have these different destinations, though it

² Vom Gehirn der Säugethiere (Stricker's Handbook, II.).

³ Leitungsbahnen &c.

⁴ Under this term I include the axial parts of the brain; in other words, everything not comprised in the cerebral hemispheres and the cerebellum.

⁵ Architecture and Mechanism of the Brain, Journal of Mental and Nervous Diseases, 1881.

⁶ Professor Burt G. Wilder's toponomical terms are used in this paper.

¹² Jackson Clarke: Morbid Growths and Sporozoa, p. 28.

¹ Untersuchungen über die Localisation der Functionen in der Grosshirnrinde des Menschen. Braumüller, Wien, 1881.

seems that the fibres from the column of Goll mainly go to the field situated between the raphe and olive and dorsad of the pyramid, which is continuous with the stratum intermedium of the pons levels. The stratum intermedium, thus named by Meynert because it lies between the derivative tracts of the pes pedunculi and tegmentum and described by Henle as the "Bündel vom Fuss zur Haube," has been much neglected by anatomists. A careful embryological and comparative anatomical study of this tract cannot fail to throw much light on the cerebral architecture and we would refer provisionally to its enormous preponderance in the elephant, in which animal it appears to have different

FIG. 2.

Transverse section of pons of elephant two years old, natural size. Str, Stratum intermedium. P, Pons exclusively composed of ganglionic matter and transverse fibres. f, Curved part of facial root.

attributes than in man, evidently taking the place of the pyramidal tract, which in this animal is not present, at least in its typical relations, though the pes pedunculi is well developed. The fibres of the stratum intermedium enter the pes pedunculi in its inner third, and constitute one of the deeper fields of the pes described by Flechsig subjacent to the ganglion of Soemmering (substantia nigra). In the course of the imperfect spiral twist of all the pes fibres this field gradually moves to the outer part of the pes, and consequently becomes the most posterior portion of the internal capsule. Meynert's hypothetical tract may be thus re-established by

FIG. 3.

Transverse section through human pons. Pyr, Pyramidal fibres. P, Transverse fibres of pons. Str, Stratum intermedium, not distinguishable from L, The Lemniscus. Tg, Tegmentum. lf, posterior longitudinal fasciculus (oculomotor tract).

changing the nomenclature of the sensory decussation and substituting "stratum intermedium" for "outer part of the pyramidal and peduncular tracts." No uncomplicated lesion of this tract is recorded in the literature of focal brain lesions. I have been fortunate to observe one case since I first proposed the rehabilitation of Meynert's theory with the modifications here laid down,⁷ and as far as it goes the deductions to be drawn from it coincide remarkably with the anatomical theory. As I propose to publish the case in full when the microscopical analysis shall have been completed, I will here mention only the salient points. A man with moderate indications of atheromatous degeneration of the vascular system had had a sudden "seizure" while straining at stool, accompanied by complete right hemianæsthesia. I examined him two years after the attack, and found that the tactile sense had improved, but not to such an extent as to permit the man to resume his vocation; he had lost the faculty of

mechanical coördination without losing the sense of equilibrium or resistance. As there was contra-lateral facial palsy and marked difficulty of speech, approaching anarthria in its character, I diagnosed a hæmorrhage of the pons. Two years before his death he had another seizure of a transient nature, and several lesser ones followed at irregular intervals, the patient dying with terminal symptoms of paraplegia and amblyopia. A number of recent necrotic and cicatrised foci, with several very small hæmorrhages, were found in various portions of the brain; an old pigmented cicatrix was found replacing the right stratum intermedium, and involving the facial nucleus, ending at the raphe.

When it is borne in mind that those centripetal fibres which partly derived from Flechsig's direct myelo-cerebellar tract, and partly from the posterior columns through the olivary decussation, run into the cerebellar hemispheres, and that from the latter the transverse pons fibres originate, to apply themselves to the pyramidal tract and ascend to the brain through the pes pedunculi, it must be apparent that the great sensory tract united or nearly so in the cord, and widely separated in the oblongata and pons, becomes reunited in the pes pedunculi. This relation is best expressed in the diagram Fig. 4. Inasmuch as the sensory tract separates into two

FIG. 4.

Diagram of the tactile and equilibrium tracts. a, Tract from posterior column through piniform decussation to posterior part of internal capsule. b, Tract from posterior columns through decussation of olivary fibres to cerebellum, thence through pons to frontal lobes and great ganglia. c, Direct myelo-cerebellar tract. d, Auditory fibres to dentate nucleus and connexions. t, Its continuation to tegmentum.

divisions—one running directly through the brain axis to the posterior capsule, the other deviating from the direct course to enter the cerebellum, which ganglion mediates as a connexion of auditory and posterior column fibre—it seems legitimate to assume that the former division is the tactile and the latter the equilibrium sensation tract. Many doubtful points in the study of ataxic phenomena become clear in the light of this conclusion, particularly the common observation that there is no essential relation between tactile insensibility and ataxia. Another interesting point to

⁷ Chicago Medical Review and New York Medical Record, 1881.

determine is the anatomical connexion between the posterior columns and the trineural fasciculus.⁸ The trineural fasciculus originates in the piniform decussation; whether its fibres are ultimately derived from the opposite posterior column, and hence connect the posterior columns and the great visceral cranial nerves, or whether they run up into the opposite stratum intermedium, it is difficult to determine. While I am inclined to believe that the latter is the case, the possibility of the former disposition must not be lost sight of. If it becomes established it will explain the remarkable effect which progressing disease of the posterior columns has on the production of gastric, bronchial, and cardiac crises.

TEN CASES OF DIPHTHERIA TREATED WITH ANTITOXIN.

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THE following cases of diphtheria have been under our care at the Evelina Hospital for Sick Children, where we were able to set apart a small isolation ward for their reception, and were fortunate in having a supply of Behring's antitoxin for their treatment. After our third case the supply failed us for a time, and it will be seen that the fourth case was treated with Aronson's antitoxin. A fresh supply of Behring's antitoxin was then received, and the remaining six cases were treated with it. In all the patients the treatment was commenced directly after admission and after a diagnosis had been made, partly on the appearance of the membrane and partly on the amount of depression, and in six of the ten on the small amount of albumen found in the urine. In some of them bacteriological investigations were also made. Two of our cases necessitated tracheotomy. In the first case tracheotomy was performed immediately after admission owing to the urgency of the symptoms; in the other case respiration stopped suddenly while some membrane was being obtained for examination and prolonged artificial respiration was necessary after the trachea had been opened. In the single fatal case death ensued after vomiting a quantity of blood, and the post-mortem examination revealed erosion of a branch of the tonsillar artery. With regard to the symptoms following the employment of antitoxin we noted rapid detachment of membrane and great improvement in the pulse and also in the general condition of the patients. In the fatal case the pulse was weak throughout, and in another case convalescence was marked by an abnormally slow pulse, which, however, improved after the administration of stimulants. This child also exhibited a rash somewhat resembling urticaria, but it was only present for a few hours. The last case treated developed urticaria, which gradually faded after three days. The albumen in the urine was not due to the antitoxin; it was detected in five cases before the treatment was commenced, and in a sixth (Case 1) it was found as soon as a specimen could be procured after tracheotomy. The amount of albumen was small in most of the cases, and it disappeared entirely before the patients left the hospital. It is too soon yet to say much about other sequelæ. So far as our present information goes, in none of our cases have any forms of post-diphtheritic paralysis appeared. Our cases have received the utmost care from our resident medical officers, Mr. W. L. Wainwright and Mr. T. Waddelow Smith, to whom we are indebted for the following abstracts of the notes:—

CASE 1. *Tracheotomy; recovery*.—A badly nourished boy five years of age was admitted to hospital on Nov. 3rd, 1894, in an apparently moribund condition, with extreme dyspnoea

and only occasional attempts at respiration. Tracheotomy was performed at once, followed by artificial respiration. The respiration became in a short time fairly good, but large quantities of foul-smelling mucus poured from the trachea. Both tonsils were covered with whitish membrane, and there was much offensive nasal discharge. The glands were much enlarged and there was one-tenth albumen in the urine. The disease was of ten days' duration according to the mother's account. The pulse after operation was 144, the respiration 48, and the temperature 102° F. Behring's No. 2 solution (10 c.c.) was injected at once. The pulse remained about 140 for two days and the respiration from about 36 to 40, but there was rapid and marked improvement in the heart sounds. On the afternoon of Nov. 4th the child was well enough to look at a picture book of his own accord. Large quantities of mucus and several pieces of membrane continued to be coughed up, and the temperature remained between 99° and 100°. On Nov. 6th the throat was quite clean, though still cedematous, the pulse was 120 and full, the respiration 28, and the temperature normal. The tracheotomy tube was removed on the same day, and recovery was quite uneventful, except that a fine trace of albumen remained until the 13th. On the 27th the patient was discharged in excellent condition.

CASE 2. *Death*.—A girl aged eight years was admitted on Nov. 7th, 1894, with diphtheria of two days' history. The tonsils were much enlarged and covered with membrane, as also were the soft palate and uvula. There were great pain on swallowing, profuse sanious nasal discharge, and much swelling on both sides of the neck. The pulse was 140 and very feeble, the temperature 101° F., and the respiration 36. Ten cubic centimetres of Behring's No. 2 antitoxin were injected. The urine contained one-twelfth of albumen. The pulse improved a little and fell to 120. The respiration was 23, and the temperature 98°, but the throat did not improve and the glands increased in size. On Nov. 9th, 10 c.c. of Behring's No. 1 serum were injected. The pulse remained about 120 to 130, but became more feeble, and the first sound could scarcely be heard at the apex. The nasal discharge increased, and though the temperature remained normal, the patient became very cold and the skin clammy. On the 10th she three times vomited a quantity of laminated clot, which appeared to have been lying in the œsophagus for some time and was of a greyish colour. On the afternoon of that day the patient gave a sudden convulsive start and died suddenly, a quantity of black coffee-ground material pouring from the mouth.

Necropsy.—There was very deep ulceration of the tonsils, and the right tonsillar artery was found to be laid open at the base of an ulcer for a distance of one-twelfth of an inch. There was a good deal of blood in the stomach, and the tissues in the submaxillary region were full of extravasated blood.

CASE 3. *Large patch on tonsil; recovery*.—A boy aged five years was admitted on Nov. 10th, 1894, with diphtheria of five days' duration. He was a well-nourished boy with a good family history. There was slight congestion of the tonsils and soft palate, and on the right tonsil there was a large grey patch of membrane. The uvula was clean, but slightly cedematous, and there were enlarged glands in the submaxillary region. The pulse was good, full, and strong, and 96 per minute; the respiration was 32 and not impeded; and the temperature was 104° F. There was no albumen in the urine. Two hours after admission 10 c.c. of Behring's antitoxin were injected into the muscles of the thigh. Three hours later the pulse was 108, the respiration 26, and the temperature 102°, the patient feeling very well. Six hours later the membrane had become almost detached, the patient still feeling very well. Next morning the pulse was 100, the respiration 24, and the temperature 98°. The patient took a hearty meal and did not complain of any pain in the throat. There was no albumen in the urine and the throat had completely cleared. The patient was discharged on the sixth day, being practically well.

CASE 4. *Naso-pharynx; recovery*.—This patient aged ten years was admitted on Nov. 16th, 1894, suffering from a moderately severe attack of diphtheria. The history was of seven days' illness, with sore-throat and general malaise. On admission the pulse was 120, the respiration 28, and the temperature 101° F. There was no albumen in the urine, and the general condition of the child was good. The throat was congested, both tonsils were enlarged and there was on each a small whitish patch of diphtheritic membrane, but none on the uvula or soft palate. There was considerable

⁸ "Solitary bundle" of Lenhossek and Stilling, *fasciculus leres* of Lockhart Clark, "Respirationsbündel" of Krause; I term it "trineural fasciculus" on account of its established connexions with the eleventh, tenth, and ninth (and that aberrant branch of the ninth pair, the *nervus intermedius*) cranial pairs.