Silver Vanadates.

1. *The Ortho-Silver Vanadate*, Ag_3VO_4, is obtained as an orange-coloured precipitate by mixing a freshly prepared solution of the trisodium salt with a solution of silver nitrate, in which every trace of free acid has been neutralized; unless these precautions are attended to, the precipitate consists of a mixture of the ortho- and pyro-salt. The trisilver vanadate is insoluble in water, but readily dissolves in ammonia and nitric acid. Analysis gave the following results:—

		Calculated.	Found (mean).
Ag_3	= 324·0	73·75	73·83
V	= 51·3	11·67	11·76
O_4	= 64·0	14·58	——
	439·3	100·00	

2. *The Tetrabasic Silver Vanadate*, $Ag_4P_2O_7$, is prepared by mixing a solution of the corresponding sodium salt with a neutral solution of nitrate of silver. It falls as a yellow dense crystalline precipitate, resembling in colour the ordinary phosphate of silver. On dissolving the salt in nitric acid, the silver is precipitated as chloride, and the vanadium determined as V_2O_5.

Analysis gave:—

		Calculated.	Found.
Ag_4	= 432	66·81	66·45
V_2	= 102·6	15·87	15·97
O_7	= 112·0	17·32	——
	646·6	100·00	

The reactions of the tri- and tetrabasic vanadates of the other metals are then described.

The author has to thank Messrs. Oelhofer and Finkelstein for the valuable assistance which they have given him in the above investigation.

The Society adjourned over the Easter Recess to Thursday, April 28.

April 28, 1870.

Dr. WILLIAM ALLEN MILLER, Treasurer and Vice-President, in the Chair.

Principal Dawson, LL.D., of M'Gill College, Montreal, was admitted into the Society.

The following communications were read:—

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I. "On the Organs of Vision in the Common Mole." By Robert James Lee. Communicated by Samuel Solly, F.R.S. Received March 30, 1870.

The eye of the Common Mole and the structures connected with it undergo some remarkable changes during the growth of the animal. The gentleman who does me the honour to present the results of an investigation into that subject to the Royal Society was desirous that it should be undertaken in order to ascertain the cause of the anomalous condition in which the organ of vision is found in the adult Mole.

It was the suggestion of Mr. Solly that an examination of the eye of the young or fœtal Mole might assist in the explanation; for Mr. Solly had reflected much on the subject, and entertained reasons for believing that such an inquiry would be attended with a satisfactory result.

It is known that there is distinct evidence of the existence of an eye and other parts concerned in the endowment of sight in many of the various species of the Mole genus. To what extent, however, the defective state of the organs permit of sight, or whether the animal is totally blind, are questions still undecided.

That the organs of vision in the young Mole would be found in a more perfect state than in mature age was what Mr. Solly anticipated, while he conjectured, for physiological reasons, that the cause of the difference between them would be found to be a process of atrophy or degeneration in the various structures essential for the enjoyment of sight.

The specimens sent me for the purpose of examination consisted of a female Mole, which appeared from its dimensions to have attained the full period of development, if it had not somewhat exceeded it, and of six unborn young about an inch and a quarter long, and, as far as I could judge, beyond the middle of the period of gestation.

Before entering into anatomical details, I venture to review briefly the researches which have been made by anatomists into this subject. A summary of the views entertained by those who preceded him is given by Gottfried Treviranus, in his work published in 1820, 'Vermischte Schriften Anatomischen und Physiologischen Inhalts,' in the chapter on the Nerves of Sense in Mammalian Animals. From this account it appears that it was Zinn who first described an optic nerve in the Mole, and declared it to be a branch of that division of the fifth pair of nerves which is distributed to the nose.

The description by Zinn was published in the fourth volume of the Commentaries of the Royal Society of Gottingen. "The optic nerve," he says, "is long and of considerable tenuity. Its origin is the same as that of the very large nerve which passes to the proboscis. It takes a long oblique course, lying above the muscles of the nose, and passing in an outward and backward direction, surrounded by dense structures, is finally

inserted into the posterior part of the globe of the eye in the line of the axis of vision."

In 1813 Tiedemann published a description of the optic nerve and the fifth pair, which differed in a very important respect from the account given by Zinn; for he says that although the optic nerves are small and difficult to distinguish, yet they exist as separate nerves, and present the same general character as in most of the mammalia. Tiedemann carried his investigations still further, and declared the absence of the third, fourth, and sixth pairs of nerves. He described certain filaments, which he stated to be unconnected with the optic nerve, and to be similar to those branches which are found in the tissues around the eye in other animals. The absence of the third, fourth, and sixth pairs of nerves was subsequently asserted also by Carus; but his account of the origin and termination of the optic nerves is not quite intelligible to me. It appears, however, that the conclusions of Treviranus and Carus agreed that there was some connexion between the optic nerve and the fifth, which sufficed to supply the Mole to a certain degree with the sense of sight. Indeed the chief physiological fact which Treviranus endeavoured to establish in the chapter of the work alluded to, was that the nerves of one particular and special sense were capable, under certain circumstances, of becoming endowed with the properties of nerves of another and different sense. "The fifth pair of nerves in some mammalia supply the place of the most important nerve of sense" is the introductory sense in the chapter; or, in other words, that a nerve of touch and feeling may become a nerve of sight, that is, sensitive to the rays of light; and he concludes the chapter thus:—"I cannot but agree with Carus that the optic nerve and the fifth branch enter into connexion in the eye to produce the retina." This opinion met with opposition from Prof. Müller, who controverted it by the statement that true optic nerves had been exhibited to him by Dr. Henle (Baly's translation, p. 842).

From a remark of M. P. G. Pelletan, in his 'Mémoire sur la Spécialité des Nerves des Sens,' quoted by Mr. Solly in his work on the Brain, it would appear that that anatomist had made a very careful examination of the organs of vision, both in the adult and fœtal Mole, for he "recommends the dissection of either fœtal Moles, or very young ones, in whom the optic foramen is still distinct." The importance of this remark consists in the proof that Pelletan had observed that the optic foramina undergo some change subsequent to the birth of the animal.

Von Siebold has published the results of investigations into the difference between the eyes of certain species of *Talpa*. "The eyes are rudimentary," he says, "in the Mole and *Spalax typhlus*, which live underground; and above all in *Talpa cæca* and the Chrysochlores are the eyes rudimentary. They are a little more developed in the Musaraignes and the Common Mole. According to Ollivier (Bulletin de la Société Philomathique, vol. ii.

No. 38, p. 105) all the ordinary elements of the eye are found in *Spalax typhlus*."

Leydig, in his 'Handbuch der Histologie,' has some important remarks on the eyes of blind animals, and has described, in Muller's 'Archives,' 1854, p. 346, the cellular structure of the lens of the Mole's eye, as presenting the character of embryonic structure, from which he concludes that the lens remains in its primitive embryonic condition.

Mr. Solly's investigations were directed to the state of the optic commissures at the base of the brain. "In the Mole," he says, "in which the optic nerves are so extremely minute that they have often escaped detection, and are by many authors described as entirely wanting, these commissural fibres are found distinctly crossing the base of the skull opposite the usual situation of the optic commissure; while the small black speck, evidently the rudiment of the eye, is supplied by a minute branch from the fifth pair" (p. 289, *op. cit.*).

In Prof. Owen's work on the 'Comparative Anatomy and Physiology of Vertebrates' (vol. iv. p. 246), the organ of sight, like that of smell, is stated to be "wanting in a few mammals, the eyeball being reduced to the size and condition of the ocellus in *Amblyopsis*, and to its simple primitive office of taking cognizance of light, a filament of the fifth aiding a remnant of the proper optic nerve. The Moles, especially the Italian kind, *Talpa cæca*, and Mole-rats, exemplify this condition, in which, as in *Spalax typhlus*, the skin passes over the ocellus without any palpebral opening or loss of hair."

Mr. Herbert Mayo has given a similar description in his 'Physiology,' and has supplemented it by a drawing, in which the fifth nerve is represented as sending a filament directly to the globe of the eye.

From the above enumeration of the views entertained by anatomists regarding the eye and optic nerve of the Mole, it is apparent that attention has been directed by some to the eye in particular, and to the structures intimately connected with it, while others have arrived at their conclusions from examination of the interior of the skull and the optic region of the brain.

It remained therefore to ascertain the condition of the optic nerve in the posterior part of the orbit, especially that portion of the nerve which lies in the optic foramen, and thus endeavour to connect the appearances described in the eye with those observed at the base of the brain.

It is proposed to give an account of the dissection of the full-grown Mole, in order to contrast the state of the eye, the optic nerve, and the cranium with that which those parts present in the fœtal Mole, following such an arrangement of the facts that the important points of difference shall be apparent without separate comparison.

The eye of the Common Mole presents the appearance of a minute black and shining bead, closely attached to the skin of the head, and concealed

by the hair so completely that it is difficult sometimes to discover it. In removing the skin the small globe is easily detached at the same time, and no indication remains of the exact position in which it was situated. This shows that in the Mole the cavity of the orbit is wanting, and that the structures usually found in the vicinity of the eye are in a different condition from that which they present in other mammalia. It is necessary, therefore, to divide the skin around the base of the eye in order to preserve the connexion between the globe and the subjacent tissues.

Beneath the eye, and forming a basis on which it rests, is "a firm mass of cellular fibrous tissue which assumes on dissection a fusiform shape, with an attenuated portion passing towards the base of the skull." The filament becomes so exceedingly delicate in the deeper part of the orbit that the difficulty of ascertaining its precise condition is probably the reason of the difference of opinion on the subject.

In Mr. Solly's specimen there was found to be no attachment whatever of the filament to the base of the skull; but in a former dissection of a smaller, and probably younger specimen, the continuity between the bone and the tissue was evident.

The filament of tissue above described, and the connexion which it formed between the eye and the skull, induced me to examine it microscopically, in order to ascertain whether it contained nervous fibres, or possessed any of the characters of the optic nerve.

It exhibited a tendency to divide in a longitudinal direction when needles were applied to it, and presented the appearance of cellular tissue, without, however, any trace of nerve-fibre. It will be seen nevertheless, from the description of the optic nerve in the fœtal Mole, that this delicate thread is the only vestige which remains of that important part of the organs of vision in the full-grown Mole.

With regard to some minute branches of nerves and blood-vessels which pass into the tissue forming the base of the eye, both on its outer and inner side, it is not in my power to say definitely from whence they come, as their minute size prevented me from tracing them in the deeper part of the orbit to their points of exit from the skull.

The eye of the full-grown Mole presents a surface uniformly black and glistening, in which there is no indication of a cornea and sclerotic distinct from one another, nor any evidence of an iris or pupillary aperture. Within the globe, when ruptured with the points of needles, a layer of black pigmentary particles was found to line the internal surface of the dense structure which corresponds to the sclerotic.

In addition there was a confused mixture of grey and white granular substance, in which there was no distinct evidence of remains of the usual contents of the globe of the eye, though, as will be seen, those structures exist in fœtal life.

The specimens were sent to me preserved in alcohol, consequently the brain was firm, and easy to be removed entire from the cranium.

On raising the anterior lobes gently from the base of the skull, it was ascertained that no nerves connected the brain with the bone anterior to the fifth pair. The base of the brain also exhibited an entire absence of the optic nerves beyond a vestige in a very minute chiasma, as described by Mr. Solly.

On examining the internal surface of the base of the skull, the usual foramina for the optic nerves are found to be wanting, a condition which is observed with facility in the dried specimens in the Museum of the Royal College of Surgeons. Among these there is one in which there is a vestige of an optic foramen on the left side of the head, while on the opposite side the surface is smooth and perfect.

In the arrangement of the details which have been given above of the appearances observed in the course of the examination, attention has been directed to three points in particular, namely to the condition of that part of the optic nerve which is situated externally to the skull, and which exists as a mere thread of connective tissue; secondly, to the eye itself, and the structures within, so far as it was necessary to consider them in their efficiency for optical purposes; thirdly, to the internal surface of the skull in its relation to the part of the brain from which the optic nerves take their origin.

The following description of the various structures in the fœtal Mole will be more general than the above account of them in the full-grown Mole, as five specimens instead of one were examined.

On the removal of the skin and a layer of muscular tissue subjacent, a part of the globe of the eye is exposed. When the whole side of the face and the temporal region are dissected, the eye is found to be in close proximity to the large branch of the facial nerve, as is represented in the drawing accompanying this account.

The eye has the usual appearance presented by the organ in most fœtal mammalia; in form globular, and in size proportionate to the head of the animal; the cornea translucent; the sclerotic perfectly distinct, and of dense white tissue; the iris apparent through the cornea, with a clear pupillary aperture.

Between the eye and the facial nerve a small portion of the optic nerve is seen in the superficial dissection, and appears to form an upright peduncle for the globe.

It is necessary to divide the seventh pair in order to examine the deeper parts of the orbit. When the dissection is completed, and the optic nerve exposed in its whole extent, from the eye to the base of the cranium, the branches of the fifth pair of nerves are brought into view. The main branch of the second division of the fifth nerve lies a little below the optic nerve, parallel with it, and supplies large and numerous branches to the anterior part of the face. There is no necessity to describe minutely the appearance presented in the deep dissection of the orbit, as I observed nothing unusual to require particular notice. There are some minute

muscles attached to the globe which do not admit of separation into distinct parts, but completely surround the posterior half of the globe.

To trace the optic nerve through its foramen to the brain was successfully accomplished in only one dissection. After exposing the optic nerve and the eye completely, all the surrounding parts were removed, and a section made through the skull so as to exhibit a lateral view of the interior of the cranium.

The brain itself was disorganized in all the young specimens; but in the dissection just alluded to the optic nerve was seen to pass through the base of the skull, and to enter the membranes to a short distance, so that it would have been possible, if the brain had remained perfect, to trace it to its origin.

With regard to the eye itself, no difficulty was experienced in separating the iris, choroid, and lens. The other structures usually existing in the eye had been so long subjected to the influence of the alcohol that I could not determine their condition.

It must necessarily happen that many interesting observations are made in the course of an investigation like that which has been briefly described, and many minute details might have been added to this account; but it appeared to me to be desirable to limit the details, as far as possible, to those which were sufficient to establish the remarkable physiological fact that the Mole, at the time of birth, is endowed with organs of vision of considerable perfection, while in mature age it is deprived of the means of sight in consequence of certain changes which take place in the base of the skull, terminating in the destruction of the most important structures on which the enjoyment of the sense of sight depends.

II. "On an Aplanatic Searcher, and its Effects in improving High-Power Definition in the Microscope." By G. W. Royston-Pigott, M.A., M.D. Cantab., M.R.C.P., F.R.A.S., F.C.P.S., formerly Fellow of St. Peter's College, Cambridge. Communicated by Prof. Stokes, Sec. R. S. Received March 31, 1870.

(Abstract.)

The Aplanatic Searcher is intended to improve the penetration, amplify magnifying-power, intensify definition, and raise the objective somewhat further from its dangerous proximity to the delicate covering-glass indispensable to the observation of objects under very high powers.

The inquiry into the practicability of improving the performance of microscopic object-glasses of the very finest known quality was suggested by an accidental resolution in 1862 of the Podura markings into black beads. This led to a search for the cause of defective definition, if any existed. A variety of first-class objectives, from the $\frac{1}{16}$ to the $\frac{1}{4}$, failed to show the beading, although most carefully constructed by Messrs. Powell and Lealand.