GEOGRAPHICAL NOTES.

AT the Royal Geographical Society on Monday night, a paper was read by Mr. F. S. Arnot on his journey from Natal to Bihé and Benguella, and thence across the central plateau of Africa to the sources of the Zambesi and the Congo. Mr. Arnot reached Natal in September 1881, and has only just returned from his seven years' wanderings, during which he crossed the continent to some extent in the route of Livingstone. His paper forms an important supplement to the work of Livingstone, Cameron, Ivens and Capello, and the German traveller Reichart. Crossing from Natal obliquely, he struck the Zambesi near Sesheke, and ascended the river to Lealui, the town of Liwanika, to endeavour to persuade the chief to let him proceed northwards among the Batonge and Mashashe. Unsuccessful in this, Mr. Arnot left Lealui in May 1884, and proceeded to Bihé and the coast. Returning to Bihé, Mr. Arnot proceeded eastwards, crossing the interesting country from which so many rivers take their rise, flowing north, south, and west, to the Congo, the Zambesi, and the Atlantic. He touched Lake Dilolo, which he has reduced to very small dimensions, and has done something to rectify our knowledge of the sources of the Zambesi. The main stream, according to Mr. Arnot, comes from the east, and of this the Leeba is only a tributary. He stayed for two years at the capital of the kingdom of the chief Msidi, of whom and his government he gives an interesting account. Here he was in the region of the sources of the Lualaba. Msidi, who is really a native of Unyanyembe, seems a man of some ability, and is rapidly extending his power. He and Kangombe between them have almost swallowed up the once powerful kingdom of Muata Yanvo. Mr. Arnot returns to the Bangweolo region in March next.

DR. MEYER, and his companion Dr. O. Baumann, who were recently compelled by the hostility of the natives in East Africa to take flight to the coast, actually succeeded in crossing the country of Usambara by a new route. After marching through Bondei to the mission station of Magila, they travelled for several days through a fertile, and in places thickly-wooded depression, which forms part of the Sigi basin, reaching Hanon on September 8. Crossing the Mielo Ridge they descended into the valley of the Kumba River, and on September 18 reached the valley of Mlalo, where the Umba River runs. This region is well cultivated, and covered with numerous and large villages. Proceeding to Masende, Dr. Baumann with some natives explored the mountains, arriving eventually at a fertile region inhabited by the Wambunga. These people differ completely from the Washamba of Usambara, and are a remnant of the aborigines of the mountains, speaking a dialect similar to the Kipare.

FROM the new volume of the *Geographische Jahrbuch* we learn that there are now 101 Geographical Societies in the world. Of these, France and her colonies have more than any other country,—29, with 19,800 members; next comes Germany, with 22 Societies, and 9200 members; followed by Great Britain and her colonies with 9 Societies, and 5600 members. There are altogether 130 geographical serials published in the various countries of the world.

M. JEAN CHAFFANJON, the explorer of the Orinoco, we learn from the *Scottish Geographical Magazine*, is about to undertake a new task. He is going to explore the peninsula and lake of Maracaibo. A tribe of Indians live in the peninsula, concerning whom no scientific data have been obtained, for they allow no one to go among them. M. Chaffanjon will try to penetrate this mystery. He will also examine the lacustrine dwellings of an extinct race in the Maracaibo Lake, and then, following the chain of the Andes, will ascend to the source of the Magdalena, cross the group of mountains which separates this river from the Rio Canca, and explore the latter down to Antioquia.

SOME ANNELIDAN AFFINITIES IN THE ONTOGENY OF THE VERTEBRATE NERVOUS SYSTEM.

IN the controversy respecting the ancestry of the Vertebrata the nervous system has always played an important part: that system is—I think Prof. Wiedersheim was the first to say it—the most aristocratic and conservative of all the organ systems of the animal body, and it clings to ancestral traditions more than any other. Anyone who has read Kleinenberg's marvellous account of the complicated manner in which the permanent nervous apparatus of the Annelid worm is built up from that of the larva (in which process of building up it passes through stages which can only be looked upon as ancestral), will readily agree that if we are ever to trace the ancestry of Vertebrates at all, the nervous system will probably form a significant factor in the solution.

The attempts made hitherto to homologize the nervous system of Vertebrates, either in the embryo or in the adult, with that of some Invertebrate or other, do not appear to have met with much success. To take one of the most recent of these. Prof. Hubrecht has, at the close of his *Challenger* Report on the Nemertines, indicated what he would regard as points of homology between the nervous system of this group and that of Vertebrates. The comparison is, in my opinion, exceedingly strained, and indeed it would not be difficult to show that it is absolutely erroneous.

The theory of the descent of Vertebrates from animals allied to the Tunicata was, as is well known, partially based on certain characters of the nervous system in the Tunicate larva; but that theory can now hardly be defended, since Dohrn has adduced powerful arguments for putting the descent the other way about—*i.e.* from Vertebrates to Tunicata—by insisting that the structure and development of Tunicata prove them to be degenerate Vertebrates.

As a third alternative we have a descent offered us by Bateson from Balanoglossus-like animals, with gill-clefts and a nervous system and notochord resembling that of Vertebrates. Many zoologists see the main and only resemblance between Balanoglossus and Vertebrates in the possession of gill-clefts. It is many years now since these structures in the two groups were first compared, and the supposed relationships between them more recently insisted upon do not seem to me to be of a very stable order. The nervous system and notochord of Balanoglossus are to be excluded from the comparison simply because they are on the hæmal side of the body, and therefore cannot be compared to structures which, like the nervous system and notochord of Vertebrates, are *not* on the hæmal side. As I am here only considering the claims of the nervous system to an homology, I cannot fully discuss the gill-clefts of Balanoglossus, and need only remark that a respiratory function of some part of the alimentary canal—generally the anterior part—is very commonly met with in many classes of the animal kingdom. Now, gill-clefts alone, without sense-organs, skeleton, nerves, or muscles (and these have not been described yet for Balanoglossus), are merely the results of a gut respiration, the alimentary tract having acquired openings on the lateral surface of the body, and it is by no means improbable that such openings could be acquired independently in two groups of animals otherwise widely separated. Two such groups are Balanoglossus and the Vertebrata.

The only remaining theory[1] of Vertebrate ancestry demanding consideration is that of Semper and Dohrn, which would derive those animals from Annelid worms. The first comparison concerned the nephridia; and it is to be remarked that the nervous system, the question of the homology of which has not been left in the background, has always been the great obstacle in the way of its acceptation, for no one has, as yet, succeeded in finding, in the Vertebrate, any homologue of the Annelidan supra-œsophageal ganglion. There have been plenty of wild and improbable speculations as to its whereabouts. A new era, however, opens with Kleinenberg's hint that possibly the supra-œsophageal ganglion of Annelids is suppressed even in the ontogeny of Vertebrates; and, if we concede this, we must look to the ventral chain of the Annelids as typifying the initial structure from which the central nervous system of Vertebrates arose. And now what points of agreement have been discovered between these two structures and their related nerves and sense-organs?

Eisig has compared the lateral sense-organs of Capitellidæ, which are segmentally arranged along the whole body of the animal, with the lateral sense-organs of Vertebrates. The latter arise in the head, and are at first confined to the head metameres: later they grow on to the trunk; they there become also segmental, but they are innervated by a true cranial nerve. Now, although Dr. Eisig's comparison is a very enticing one, it can be neither accepted nor rejected without further inquiry. There are many facts for it and some very important ones which, though not directly opposed to it, are not in its favour. We must attach a good deal of importance to it, for the

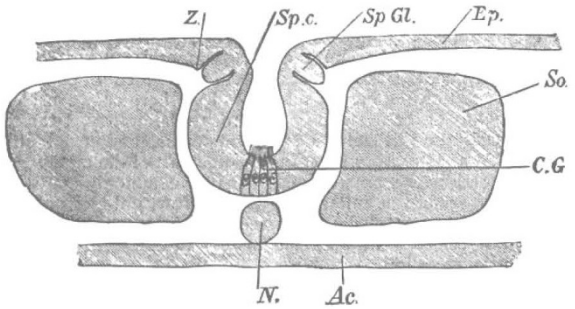
[1] Balfour ("Elasmobranch Fishes," p. 171) enunciated a different theory which can hardly now be maintained.

sense-organs of these Annelids are the only ones of which we know they in any way fulfil the conditions required of the ancestry of the lateral sense-organs of Vertebrates. It appears also that, if we admit the proposed homology as based upon the Capitellidæ, we can carry the origin of the lateral sense-organs of both groups back to still simpler structures, for it seems clear that the lateral sense-organs of Annelids have been derived from cirri and portions of the parapodial ganglia (Kleinenberg, Eisig). The rest of the Vertebrate sense-organs are easily accounted for. It is becoming more and more probable that the nose and ear are modified portions of the system of lateral sense-organs, and I am not without hopes of showing that the taste-buds of the higher Vertebrates may be derived from lateral sense-organs which wandered through certain of the gill-clefts during the development.

The eyes are not difficult to account for, as plenty of Annelids have eyes at the extreme anterior end of the ventral cord, in connection with the first ganglion.

To refer, in passing, to another structure. The Vertebrate notochord has been shown by Ehlers and Eisig to correspond with the "*Nebendarm*" of Annelida. At the risk of being pronounced a heretic, I venture the opinion that the swimming-bladder of fishes is also a derivative of the "*Nebendarm*," and that the notochord and swimming-bladder are parts of the same structure which have acquired different functions, and so developed divergently. It is certainly not difficult to raise arguments against the so universally accepted homology of swimming-bladder and lungs.

And now let me refer to some recent results of my own on the Vertebrate nervous system. I have depicted them, very diagrammatically, in the accompanying figure. It represents a



Diagrammatic transverse section through the trunk region of a Vertebrate embryo. *Ep*, epiblast; *Z*, *Zwischenstrang* of Prof. His; *Sp.Gl.* spinal ganglion; *Sp.c*, spinal cord; *So*, somite; *N*, notochord; *C.G.*, ciliated groove of ventral surface of spinal cord; *Ac*, gut.

transverse section through the trunk of a very young Vertebrate embryo, say a lizard; and it is designed more especially to show the nervous system. The neural tube (*Sp. C.*) is an open plate, the two sides of which are folding together; above it are seen laterally two small outgrowths (*Sp. Gl.*) not connected with the neural tube, and which have been split off from the neighbouring skin or epiblast (*Ep.*); they are growing out from the skin, and will soon be segmented off from it to form the spinal ganglia. It has usually been supposed that the cranial and spinal ganglia of Vertebrates arise as outgrowths of the central nervous system. Such is not the case; the diagrammatic figure given above partially disproves that, and it would be easy to give a series of figures which would demonstrate beyond doubt that the spinal ganglia and certain portions of the more complicated cranial ganglia arise from the epiblast outside and beyond the limit of the central nervous system, and that not a single cell of either cranial or spinal ganglia is derived from the latter. Now, the mode of development of the ganglia in Vertebrates tallies exactly with that described by Kleinenberg in Annelida for the parapodial ganglia. These latter also arise as epiblastic differentiations just above the lateral limit of the ventral cord, and, like the ganglia of Vertebrates, they appear segmentally.

Here, then, is one point of close resemblance, and not an unimportant one, between the Annelid and the Vertebrate.

Having got thus far, one is tempted to study the development of the central nervous system of Vertebrates more closely, in order to see whether other Annelid peculiarities recently discovered are represented. Of such, two have presented themselves, and while probably but the forerunners of a series yet to be unravelled, they are in themselves of the highest significance. I have represented these in the diagram in such a form that they may be easily understood; but be it remarked that they do not appear so obviously till at a later stage than that depicted.

Evidence has long been wanting of a bilateral origin of the central nervous system of Vertebrates (no doubt it is a bilateral structure—everyone, except perhaps Prof. Hubrecht, believes that), and if it is comparable to the ventral chain of Annelids, it ought to show traces of such origin in its early development. It is precisely this which I believe to have discovered.

Even before the actual closure of the two limbs of the neural plate occurs (a phenomenon which takes place much later than is generally supposed) the neuro-epithelium of the one limb does not pass directly into that of the other limb, for the two are separated below by a tract of non-nervous epiblast having the characters of a ciliated epithelium (*C. G.*). Thus, with greater truth than one can speak of the absence of primary connection between ganglia and central organ, it must be admitted that the two lateral halves of the central nervous system itself are at first destitute of nervous connection with each other. This ciliated groove (*C. G.*) is a very obvious structure in transverse sections of great numbers of Vertebrate embryos. Curiously enough, I cannot find it figured by any embryologist except His, and he does not say anything about it.

The peculiarities just described (a developing nervous apparatus composed of two bands of neuro-epithelium separated from each other by a ciliated groove) are eminently characteristic of Annelids. Nay, more; Kleinenberg states that the ciliated groove takes its origin from a double row of cells in the mid-ventral or neural line, and I am of opinion that such is the origin of the ciliated neural groove of Vertebrates. If this discovery of the double nature of the neural plate has the significance which I claim for it, the generally accepted opinion as to its primary structure must fall to the ground. The neural plate is usually supposed to be composed of two layers—an inner nervous one, and an outer ordinary non-nervous one; the inner layer is supposed to give rise to the nerve-cells, &c., while the outer epiblastic one, having unfortunately got shut in with the tube formation, has nothing left to it but to form the ciliated canal.

Both these conclusions are wrong. Years ago, Altmann showed—and it has been confirmed scores of times—that it is just those cells next the primary central canal which increase most, and so form the antecedents of the ganglion-cells. The real truth is, that the greater part of the epithelium lining the primary (as opposed to the permanent) central canal is a neuro-epithelium, for only such a one has the faculty of producing ganglion-cells on its inner side.[1]

The epithelium of this ciliated groove having developed cilia, undergoes no further differentiation for some time; *it is the only part of the primary central cylinder which is ciliated, and which does not form ganglion elements, and hence it is the only part which is not neuro-epithelium.* It forms later, by the growth and increase of its elements, *most if not the whole of the ciliated epithelium of the permanent central canal.*

In one respect the ciliated groove of the Vertebrate differs from that of Annelids—it gets invaginated along with the central nervous system; and I am not aware that any Annelid is known in which the ciliated groove is removed from the outer surface of the body, along with the ventral cords.

Now these facts are very remarkable, and, taken in connection with other points previously mentioned—such as the formation of the notochord and swimming-bladder, the lateral sense-organs, the origin of the ganglia—they furnish us with a combination of Vertebrate characters for which a parallel is to be found in the Annelida, and in no other group.

Further, we have in the nephridia of Vertebrates a series of structures which, as Semper first showed, find their parallel in Annelids. When one considers recent advances in our knowledge of the nephridia of Annelida (more especially those we owe to Drs. Eisig and Ed. Meyer) in connection with the, as yet, partially unpublished researches of Dr. Van Wijhe on Vertebrates, the justice of Semper's and Balfour's renowned comparison becomes more and more obvious.

I have shown, in a former number of NATURE (vol. xxxvii.

[1] As I write this, there occurs to me a beautiful idea of Kleinenberg's, that the ganglion-cells in the central organ which are perceptive of light have that power in virtue of the fact that they were themselves once retinal elements or parts of such elements.

p. 224), in what a marvellous manner the development of the hypophysis cerebri of Vertebrates, with its oral and neural portions, accords with the development of the permanent œsophagus and its special nervous system in Annelids. I now submit some no less striking resemblances between the two groups; and I am of opinion that we may hope, with work and increasing knowledge, to encounter many more such, as yet undreamt of.

J. BEARD.

Anatomisches Institut, Freiburg i/B., September 21.

THE JOURNAL OF THE ROYAL AGRICULTURAL SOCIETY.[1]

IT is seldom that the Journal of an important Society so abounds with obituary notices of prominent contributors as the one now before us. The sad refrain of "*In Memoriam*" runs through but too many of the closing pages of the number, in affectionate remembrance of names which have been associated with the advancement of agricultural knowledge throughout a considerable part of this century. The late Charles Randell, of Chadbury, was essentially a farmer of the widest views and experience, and full of sympathy for scientific work. The late John Chalmers Morton, the late John Algernon Clarke, and the late John Coleman ranked among the most distinguished ornaments of the literary aspect of agriculture. The editor, remarking upon these losses, says: "It is a noteworthy but melancholy circumstance that, in the short space of six months, the three leading professional writers on agricultural subjects should have been gathered in by the Great Harvester." We should be wanting in respect to pass over unnoticed these bereavements, and when we call to mind the very recent deaths of Dr. Voelcker and Mr. H. M. Jenkins, the late secretary and editor, we must admit that this Society has sustained exceptionally heavy losses.

The present number, however, bears witness to the fact that able successors are to be found to carry on the good work of the Society, and that, as the veterans pass away, young and enthusiastic labourers step into their places.

As usual, the material of the half-yearly issue may be divided into official Reports and articles by unattached contributors. The first section includes the Reports on the farm prize competition in Northumberland; on the implements, live stock, and poultry at the Nottingham meeting of last summer; on horse-shoeing, followed by an able paper on the structure of the horse's foot by Prof. G. T. Brown, C.B.; and on the Newcastle (1887) engine trials, by the Consulting Engineer to the Society. These Reports we cannot do more than notice as well worth the attention both of mature agriculturists and students of the art. The remaining portion of the volume contains articles upon the principles of forestry, farming in the Channel Islands, the propagation and prevention of smut in oats and barley, and various papers on stock-feeding and crop-growing.

None of these papers will create more interest than that upon the herbage of old grass-land, by Dr. W. Fream, and this paper stands prominently forward as the only one which may be described as an original investigation. The question is not only important, but controversial. The best way of producing that inimitable natural product, a rich pasture, has long been a subject of vital interest to landowners. In the long period of agricultural depression, grass-lands have scarcely shared in the general depreciation of values. Good grass-land will always let, and it is likely to maintain its value. The difficulty of converting tillage land into grass has always, however, been a problem hard of solution, and anyone who throws light upon this question is deserving of gratitude.

One of the chief difficulties has consisted in ascertaining the proper descriptions of seeds for producing a permanent pasture, and a great deal of discussion has taken place upon the relative merits and demerits of the members of the large family of the *Gramineæ*, as well as of the *Leguminosæ*, composing the complex herbage of a good meadow or pasture. Certain grasses have been named as especially suitable, while others, although occurring in all pastures, have been condemned as worse than useless. On the other hand, it has been freely asserted that many of our best grazing-lands are largely composed of grasses which have been stigmatized as worthless by certain authorities, and the inspection of high-class pastures has often staggered the botanist by the perverseness with which which they carried the "wrong" descriptions of grasses, and nevertheless held their own as producers of valued hay, or, if grazed, of beef, mutton, and milk.

[1] Second Series, vol. xxiv. Part 1. (London: John Murray, 1888.)

One of the most maligned of the grasses of late years has been common rye-grass. This grass, although popular with farmers, was stigmatized by Mr. Faunce de Laune, in an able paper published a few years ago, as a short-lived and inferior grass, foisted upon the farmers by seedsmen because of its cheapness and the ease with which it germinated and covered the ground. Mr. Faunce de Laune *ruined* rye-grass, his views being somewhat too precipitately indorsed by the officers of the Royal Agricultural Society, and the seed trade was ruled into unwilling obedience. Rye-grass was banished from all mixtures sown by truly enterprising and advanced agriculturists, but its use still lingered among the less scientific but more practical members of the confraternity of farmers.

In spite of this crusade against rye-grass, many observing and scientific agriculturists were in doubt, especially as rye-grass was seen to occupy a leading position in all natural pastures, and hence its evanescent or short-lived character was doubted.

Prof. Fream, partly from a desire to test the true value of rye-grass, but also with a view to investigating the botanical composition of good grass-land, put himself in communication with a number of experienced agriculturists in England and Ireland, and with their co-operation transplanted twenty-five representative sods, 2 feet long, 1 foot broad, and 9 inches deep, from as many pastures, and planted them side by side in a bed 72 feet long and 6 feet wide in the Botanical Garden of the College of Agriculture, Downton. This transplantation was accomplished in the winter and spring of 1887–88.

In the month of July the herbage of each turf was cut, and submitted to a quantitative botanical examination, with very interesting and surprising results. In the first place, these samples of pastures, brought from twelve English and eight Irish counties, gave evidence that the preponderance of their herbage was composed of two plants, one being the maligned and tabooed perennial rye-grass (*Lolium perenne*), and the other chief constituent being common white clover (*Trifolium repens*). As each of the twenty-five sods was selected from the best grass-land of its district by resident agriculturists of well-known judgment, the case appears to be conclusive in favour of the recently, but only recently, discarded grass. The actual fact is that rye-grass constituted in the various plots high percentages of the total gramineous herbage, as the following figures show:—No. 1 turf (Wainfleet), 75 per cent.; No. 2 turf (Tenterden), 90 per cent.; No. 3 turf (Sherborne), 76 per cent.; No. 4 turf (Sherborne), 77 per cent.; No. 5 turf (Somerset), 82 per cent.; No. 6 turf (Derbyshire), 18 per cent.; No. 7 turf (Somerset), 90 per cent.; No. 8 turf (Tipperary), 66 per cent.; No. 10 turf, 78 per cent.; No. 11 turf, 83 per cent.; No. 12 turf, 90 per cent. It is needless to continue this list, and it is sufficient to say that, with very trifling exceptions, these important turfs unanimously showed themselves in favour of rye-grass; in fact, this species heads the list in 21 out of the 25 cases.

Similarly, the leguminous herbage was found to contain one constituent in paramount abundance—namely, white clover; so that it may be approximately stated that, while the grassy herbage was chiefly composed of rye-grass, the leguminous herbage was chiefly composed of white Dutch clover. In one case—that of a turf sent by Sir Louis T. Delcomyn, of the Old Court, Bradwardine, Herefordshire—rye-grass and white clover composed the entire herbage, without the intervention of another plant of any kind whatsoever.

A more crushing piece of evidence against the enemies of perennial rye-grass could not well have been produced, and the farmer will once more be justified for his slowness in accepting the *dicta* of some of his would-be teachers. The case is of such practical importance that we have dealt with it at some length; and it should be added that the percentage botanical composition of the gramineous herbage of each turf is given in detail, so that the labour involved must have been very great.

Prof. Curtis, in a useful paper upon Forestry, deprecates the founding of a School of Forestry, but recommends the formation of a representative Board of Examiners in Forestry on the lines proposed by Mr. Rogers, of the Surveyors' Institution, and Colonel Pearson, to the Select Committee on Forestry. The Report on the Farm Prize Competition is of value for comparative purposes, chiefly as showing the amounts expended by good farmers upon fertilizers and feeding-stuffs, and the different practices obtaining in the locality where the competition took place. The remaining papers we cannot at present notice particularly, but have indicated their presence.