the Linnean Society of London, who has carried it out with conspicuous success. Society and Journal have thus become more and more closely connected, and to what extent may be gathered from the fact that of the thirty-three papers which make up the body of the first two parts of the new series, fifteen were read at the Society's meetings. Of these, the papers by Prof. D. J. Cunningham and Dr. Elliot Smith on the anatomy of the cerebral cortex and fornix stand pre-eminent, as important communications by leading investigators, who with Symington and others have kept this rapidly developing department of laborious research fully abreast of the continental standard set by von Kölliker, Edinger, Ziehen, and those who have followed in the wake of Golgi and y Cajal. Dr. Elliot Smith's monographs are indispensable to the comparative neurologist, and they amply fulfil the expectation raised by his early investigations in Australia, and justify the graceful comment paid by Sir W. Turner at the summer meeting of the Anatomical Society, held in Dublin in June last, at which one was hurriedly read. Beyond this, the second issue in the new series of the Journal is especially noteworthy for a paper by Prof. Symington upon the thymus gland in Marsupials, about which little indeed is known, and for the first part of one by Dr. D. A. Welsh upon the parathyroid glands, both being exceedingly welcome now that current work upon the ductless- and blood-glands is revolutionising our knowledge and conceptions of these remarkable organs. Noteworthy also is the completion in the same part of a lengthy treatise by Dr. W. McDougall upon a theory of muscular contraction, since by comparison with a remarkable paper by Prof. Rutherford, side by side with which it has for the most part appeared, it opens up fresh themes for controversy upon this interminable topic, which show at least that the last word has not been written concerning it, and that there is sore need of its attack on other than morphological lines. Returning to the first part, we note a paper by Mr. F. J. Cole on the urinogenital system of the male guinea-pig, which for thoroughness of investigation and exhaustive literary research is worthy the standard he adopted in a recent paper on the nervous system of the chimæroids, and the very interesting announcement by Prof. Disse, of Marburg, that the olfactory nerve fibres in the chick arise from cells situated in the epithelium of the olfactory pit, and by Prof. Leboucq, of Ghent, that in the full-grown fœtus of a *Vespertilio* the fourth digit of the manus is tetraphalangeate.

Of the remaining papers one only calls for special comment, viz. that "On the anatomy of *Macropus rufus*," by Prof. Bertram Windle and Mr. F. G. Parsons, since it reveals some strange contradictions both within its own limits and by comparison with the afore-mentioned paper by Symington. It contains a great deal by way of careful and detailed anatomical description which, in correlation with similar papers which its authors have published elsewhere, ought to be of service for reference. Under the heading "Digestive System," however, they have described and figured the liver on one page as destitute of a left central lobe, the lobe present on that side being regarded as a left lateral, while on the very next page the latter is said to be absent. Their first conclusion is based on the relationships of the falciform ligament, unquestionably the only structure of real morphological value for the purpose, and they introduce some pertinent criticism of the methods of other anatomists. All the more remarkable, therefore, their account of certain glands, as said to exist in the "fœtus" (strictly a pouch specimen). On p 132 there is given a processed illustration, little resembling anything in nature, with an accompanying description of glandular structures regarded as "sublingual" and "extra-salivary." That the former are merely the ordinary sub-maxillary glands, there seems no manner of doubt. Concerning the latter, we are assured that "histological examination proved that they were salivary in nature." Great though the backward extension of the salivary glands in some mammals, nothing at all approximate to the remarkable condition here alleged has hitherto been observed, and sufficient is recorded by the authors of the detailed relationships of the so-called "extra salivary" glands to render it tolerably certain that they are but cervical thymus, a conclusion borne out by the authors' confession that they "did not succeed in tracing the termination of their ducts," and by comparison of the descriptions and figures of the neck glands in *M. giganteus* given by Symington, as he justly points out (p. 283). The brief statement which we cite concerning the histology of these glands is wholly insufficient. If they be really salivary, for so extraordinary a condition at least a figure and full details of microscopic sections should have been furnished in absolute proof. While we await with interest further investigation as to the real nature of these, we cannot allow the statements concerning the liver to pass without further comment. Leading anatomical journals other than that now under review might be cited in which inaccuracies unpardonable at times appear. Authors, when inexperienced, will write extraordinary things; experienced authors still more extraordinary. And surely the rendering of Nathusius's well-known name (p. xxix. Suppl.) as "Nathenius," is a matter which the editors, if not the author, should not have allowed to pass. The first two parts of the new issue of the Journal, as a whole admirable and encouraging, give excellent promise for the future, if only the conductors will declare themselves responsible editors and a proper coordination between authors and editors be assured.

GEOLOGY AND SANITARY SCIENCE.[1]

THIS memoir is a new departure on the part of the Geological Survey, being devoted only to applied geology, to questions which have for a long time caused the flow of a steady stream of inquirers to Jermyn Street. It shows how useful is some knowledge of geology to the proper understanding of many matters that are ever cropping up, privately in such things as the choice of a site for a dwelling, and publicly in such as water-supply for a district.

The extent of the district treated is shown by the excellent chromolithographed map, and may be understood from the following list of the border-towns, with London in the centre:—Chesham, Amersham, Beaconsfield, Windsor, Guildford, Dorking, Reigate, Sevenoaks, Gravesend, Billericay, Chipping Ongar, Epping and St. Albans. The colours differ largely from those used on the Survey maps, and the map differs from the lately issued Index Map (on the same scale, four miles to an inch) in showing the various divisions of the Drift; so that there are thirteen colours, besides a blank for Alluvium.

A short description is given of the general structure of the London Basin, with parts of its borders, and then (pp. 7–25) a more detailed account of the beds dealt with, from the Made Ground of London down to the Hastings Beds of the Weald; thus going a little beyond the area of the map, on the south, in which the last are not shown. These are grouped, not in the usual geologic way, but according to character; all gravels and sands being under one heading, all clays under another, with an intervening "mixed sub-soils" for those divisions that decline to be distinctly one thing or another. Under each of the many sub-headings

[1] "Memoirs of the Geological Survey. Soils and Sub-soils from a Sanitary Point of View; with especial reference to London and its Neighbourhood." By H. B. Woodward. Large 8vo. Pp. vi + 58; folding geologic map (13 colours).

© 1898 Nature Publishing Group

the sanitary aspects of the beds are noticed. In the map the index of colours is grouped in three series, clayey, gravelly and sandy, with Alluvium detached at the top, and Chalk at the bottom.

In the rest of the memoir a purely sanitary arrangement is adopted, under four heads, the first being that of the sub-soil with reference to sites for houses (pp. 27–32). The way in which not only the character of the beds, but also their thickness, position, and mutual relations affect the suitability of ground for building-purposes is enforced, and the causes of contamination of porous sub-soils are discussed: even gardens are not neglected.

Secondly, water-supply and drainage are treated (pp. 33–39). After noticing the supply of London, the question of rural water-supply is taken, the causes of contamination of shallow wells and the danger of "dead wells," used as receptacles for sewage, &c., being described. Then we have sanitary considerations in regard to the situation and surroundings of houses (pp. 40–45), under which head subjects other than geologic are referred to, such as surface-drainage, fog, sunshine, rain, wind, floods.

The troublesome question of cemeteries fittingly comes last (pp. 46–48), and the author concludes that "an isolated tract of elevated ground, where sands and sandy loams, or sandy and loamy gravel, of considerable thickness, rest on clay also of considerable thickness, offers the most desirable site," which, however, is qualified by the addition that "probably a sandy and calcareous loam is the best material for a graveyard." However, the difficulty is to get such desirable sites! The fitting conclusion is a list of the cemeteries in and near London, with the beds on which they are placed, by means of which people who are thoughtful of their latter end can select the geologic formation in which they would like to be buried.

The long index (ten pages), is really more than an index. It is not limited to giving the pages of reference; but also notes, by figures in another type, the height of the various places above Ordnance datum, and, by means of letters, the beds on which the places are—an ingenious and useful novelty.

Although this is the first Geological Survey memoir devoted to sanitary matters, it should be remembered that stores of information that is useful from a sanitary point of view are to be found in many of those memoirs, especially as regards wells and water-supply.

This work should have a ready sale, as it is written in such a way as to be useful to the ordinary inquirer, and of interest to any intelligent reader; but the price (*2s. 6d.*) is rather high, presumably on account of the map. It is to be hoped that the author may ere long have to prepare a new and enlarged edition, and that the success of the present venture may lead to other work of the same sort being undertaken. W. WHITAKER.

PROFS. C. RUNGE AND F. PASCHEN'S RESEARCHES ON THE SPECTRA OF OXYGEN, SULPHUR, AND SELENIUM.[1]

IN the above paper Profs. Runge and Paschen have extended their important investigations to the spectra of oxygen, sulphur and selenium, and have discovered in the low temperature spectra of these elements a number of series which are very similar to those previously found for other elements. The principal characteristics of these series are too well known to need any further explanation; they may be represented by Kayser and Runge's original formula,

$$N = A - \frac{B}{n^2} - \frac{C}{n^4},$$

where N is the wave frequency and n takes up the values 3, 4, 5 . . . for the different lines of the same series. In the present cases n^4 may be with advantage replaced by n^3. We may with equal accuracy take Rydberg's formula,

$$N = A - B(n + \mu)^{-2},$$

where A, B, μ are the three constants. In the spectrum of oxygen which goes by the name of "compound line spectrum," and which Piazzi Smyth has shown to be chiefly made up of close triplets, Runge and Paschen show that these triplets arrange themselves in two series, having approximately the same convergence frequency. The difference in the curve numbers of the components being the same for each triplet, they have all the characteristics of the "Nebenserien" or "associated series," as I propose to call them, because they always occur in groups of two. The formulæ for the strongest lines of the triplets in Rydberg's form is

1st assoc. series: $23207,96 - 110396\ (n - 0{\cdot}02148)^{-2}$
2nd ,, ,, $23200,63 - 109011\ (n - 0{\cdot}24127)^{-2}$

Rydberg has given a law according to which the principal series may be calculated from the associated series, with sufficient approximation to identify the lines belonging to it in the present instance. Only two triplets belonging to it have been found; the first in the extreme red has a wave-length of 7776 for its strongest lines, and the second, photographed by Runge and Paschen for the first time, has a wave-length 3948. In addition to the triplets, the authors have discovered a number of doublets which can also be grouped into two associated series, having the equations

$21205,56 - 109366,7\ (n - 0{\cdot}16191)^{-2}$
$21211,11 - 110346,7\ (n - 0{\cdot}01093)^{-2}$

and the principal series belonging to this group is probably represented by two lines at wave-lengths 4368, 5, and 3692, 6, the former being one of the strongest lines of the compound line spectrum.

The result of this investigation of the oxygen spectrum is, that it shows two sets of associated series similar to that found in the case of helium, and that therefore the spectroscopic evidence that helium is a mixture of two gases no longer holds. There is very little doubt that the oxygen spectrum is represented among the Fraunhofer lines; almost conclusive evidence in favour of this being given by the first triplet of the principal series, which falls at 7776 in a portion of the solar spectrum which is comparatively free from lines. The beautiful photographs of Higg show at this place a triplet the components of which have exactly the right difference in frequency.

Profs. Runge and Paschen also investigated the spectra of sulphur and selenium, and discovered spectra which correspond to the compound line spectrum of oxygen. The spectra consist chiefly of triplets which may be arranged in a group of associated series; and there are also indications of the existence of two principal series in each case. The authors apparently considered these spectra as due to the elements, but they have only been able to obtain them in the presence of oxygen. Further investigation is therefore required to show that they are not really oxide spectra. Should this prove to be the case it would be a matter of some importance and great interest, for it would show that we must consider the compound line spectrum of oxygen as due to a compound molecule, an "oxide of oxygen" similar in constitution to the oxides of sulphur and selenium which give the analogous spectra.

In conclusion, I may add a few remarks as to the relative merits of Rydberg's and Kayser and Runge's equations. The greater simplicity in form of

$$N = A - \frac{B}{n^2} - \frac{C}{n^4}$$

adopted by Kayser and Runge, and the ease with which the constants may be calculated would, independently of

[1] *Wiedemann's Annalen*, vol. lxi. p. 641.

© 1898 Nature Publishing Group