destitute of chlorophyll. This at least is the most prevalent view. Exceptionally, submerged Phanerogams are found with an epidermis destitute of chlorophyll, and there are also some exceptions to the general rule quoted about the leaves of terrestrial Phanerogams. Now it happens that the at present prevailing view is only right in one respect, for up to the present, observations prove the regular appearance of chlorophyll in the outer layer of submerged Phanerogams. The second half of the prevalent view should be completely reversed, for the appearance of chlorophyll in the epidermis of the green organs of Phanerogams is the rule, and with few exceptions. The results of Stohr's researches lead to the following:—1. The epidermis of the green organs of the broad-leaved Gymnosperms, and of by far the most of the terrestrial Phanerogams, contains chlorophyll. 2. Chlorophyll appears regularly to be absent from the green organs of the needle-leaved Gymnosperms and the terrestrial Monocotyledons. 3. Chlorophyll is in most cases only to be found in the under surface of the leaves, but is also to be met with in the leaf-petioles and stipules. It remains in such position during the whole life of the organ. 4. Chlorophyll is seldom to be found in the upper and lower surfaces of the leaves at the same time. In most cases one can see that the chlorophyll of the cells of the epidermis of the upper surface of the leaf is quickly destroyed upon its formation, by the effect of a too intense light. 5. So far as the process of the evolution of the chlorophyll bodies was observed, the latter showed themselves as starch-chlorophyll bodies. M. Stohr gratefully acknowledges that these investigations were undertaken at the suggestion of Prof. Wiesner, the author of a memoir, "Ueber die natürlichen Einrichtungen zum Schutze des Chlorophylls der lebenden Pflanze." The leaves of nearly one hundred species of plants were carefully examined, and full details of these examinations are given in the tables that accompany M. Stohr's memoir. The investigations were carried out in the botanical-physiological laboratory of the University of Vienna. (*Sitzungsberichte d. k. Akad. Wissenschaften—mathem.-naturw. Cl.*, 79 Bd., S. 87.)

BLOOD VESSELS OF VALVES OF THE HEART.—Recent researches by Dr. Langer (Vienna Acad. *Anz.*) prove that several mammalian genera (pig, dog, bullock) have a fully-formed blood-vascular system both in the semilunar and the atrioventricular valves. On the other hand an examination of about 100 human hearts (of children and adults) discovered blood-vessels in the heart-valves only in one case, that of a woman of sixty, in whom they were evidently the result of a pathological process. Dr. Langer explains the difference by a difference in the mode of formation of the valves.

LIGHT AND THE TRANSPIRATION OF PLANTS.—Dr. Comes (Naples Academy) finds, *inter alia*, that light favours transpiration; that a little after midday transpiration is at its maximum; that, other things equal, that organ transpires most which is most intensely coloured, and it emits most water when exposed to that part of the solar spectrum where it absorbs most light; and that only those luminous rays which are absorbed favour transpiration of an organ (not the inactive rays); so the transpiration is minimum under the rays coinciding in colour with that of the organ, and maximum under the complementary rays.

PINGUICULA ALPINA.—Prof. Klein of Buda-Pesth publishes in the la t part of Cohn's *Beiträge zur Biologie der Pflanzen* an interesting memoir on this plant. 1. It appears in two forms: one has bright green leaves; the other has more or less reddish-brown coloured ones. These forms however appear only to possess the value of local varieties. 2. *Pinguicula alpina* is, like the other species of Pinguicula, an insectivorous, *i.e.* flesh-eating plant, but is partly also a plant-eating one. 3. Its roots are simple, *i.e.* they do not branch, and they possess notwithstanding a pericambium. The cells of the bast layer have handsome, for the most part doubly-ridged longitudinal walls, and are the first formations that differ from the primary meristem of the end of the root. The greatest part of the root remains in respect to the tissue formation in an undeveloped and almost embryonic condition. 4. The caulome contains between the pith and bark a vascular ring which is characterised by very short-jointed vessels: these joints are bound together at the points of contact, and their cross walls are broken through by one single circular opening. The bundles of vessels belonging to the roots spring partly out of the caulomic vascular ring, partly out of the leaf spur. 5. The original bending in of the edges of the leaves can be regarded as an advantageous arrangement in respect to the catching of insects, as insects cannot easily get over the edge of the leaf, and can therefore also be generally caught under it. 6. The cells of the epidermis of the leaf contain no chlorophyll, but the green-leaved specimens contain a colourless sap and the red-leaved ones a reddish sap. Besides they always possess a cell nucleus in which crystalloids are to be found. 7. The edge of the leaf is transparent, and consists of a single row of epidermis cells. 8. The epidermis of the leaves contains as well on the upper as on the lower side tolerably numerous stomates, which are only wanting on the outermost edge. Their manner of formation corresponds mostly to that observed in Thymus; it shows however some deviations. The stomate is surrounded by a narrow edging which is more strongly cuticularised than the outer walls of the epidermis cells. The cells of the stomates contain no crystalloids, but only a few very small chlorophyll bodies. 9. The epidermis of the upper surface develops two kinds of glands with and without stalks. The glands with stalks consist of a basal cell projecting above the epidermis; out of this proceeds a one to four-celled half spherical columella, on the top of which a glandular body, consisting of a layer of radially-placed cells, is placed cap-like; the stalkless glands are similarly built, only the stalk is wanting, the columella is conical, and the glandular body does not as a rule project more than half over the epidermis. The process of development is similar in both glands. 10. Stalkless glands appear also on the lower side of the leaf. They are only feebly developed, and their cap portion hardly projects over the epidermis. From their presence it can be deduced that the various kinds of Pinguicula once only possessed stalkless glands; from which in process of time both the stronger developed stalkless glands and those also with stalks became developed on the upper side of the leaf, by which the capacity of the leaves for catching and digesting insects was at the same time perfected. In connection with this, one can infer a somewhat similar theory about Utricularia and Aldrovanda, and even about Dionæa and Drosera. 11. The bundles of vessels belonging to the leaves are branched out in netlike veins, and anastomose chiefly with one another. The veins at the ends unite near the edge of the leaf into a sympodial layer, from which numerous veins go out directed to the edge of the leaf and end in enlarged spirally thickened cells, which cells sometimes border directly on the epidermis cells belonging to the edge of the leaf or are separated from them by one or more cells. 12. The tracheal vessels of the leaves, as well as of the other parts of *Pinguicula alpina* never contain air, but either a watery fluid or a yellowish-brown resinous-looking substance. This circumstance, together with the strange branching of the tracheal vessels in the edge of the leaf particularly adapted to catching insects seem to prove (or show) that the tracheal vessels serve for the transport of a substance that stands perhaps in direct connection with the function of the leaves. 13. The mesophyll cells form among one another tolerably large interstices filled with air, and contain generally chlorophyll bodies in abundance. 14. Starch is to be found in the chlorophyll bodies of *P. alpina*, and also in the small stems and roots of the hybernating plants, when it appears in small compressed nuclei. 15. Glands with and without stalks appear in the flower stalks as well as in the flowering parts.

## GEOGRAPHICAL NOTES

AT a meeting of the Geographical Society on Monday evening Capt. T. H. Holdich, R.E., of the Survey of India, read a very interesting paper on the geographical results of the Afghan campaign, in which, after giving a sketch of the features of the country, he summed up the additions lately made to our knowledge. These are very considerable, for in the last two or three years he and Major Woodthorpe with their staff have surveyed and mapped from 25,000 to 30,000 square miles of country. Some of the more important facts ascertained are the facility with which practicable roads can be made through the passes of Afghanistan, and the comparatively low elevation of those of the Hindu Kush, which, according to Capt. Holdich's view, would offer no real barrier to the advance of a properly-equipped army. Capt. Holdich hinted that the further mapping and survey of the country were being continued by native explorers attached to the Survey of India, and he thought that in a few years' time it would be known from end to end, and that our surveys would then join on to those of the Russians north of the Hindu Kush. Capt. Holdich remarked also on the curious intermingling of races in some parts of Afghanistan, and in the ensuing discussion Mr. Blanford, late Director of the Geological

Survey of India, made some valuable observations on certain points connected with soil-formation, &c., in Central Asia.

UNDER the title of "Die geographische Erforschung des afrikanischen Continents von den ältesten Zeiten bis auf unsere Tage," by Dr. Philipp Paulktschke, Messrs. Brockhausen and Bräuer of Vienna have published a volume of 320 pages, containing a brief but full sketch of the progress of African exploration from the earliest times down to the present day. Its special value consists in the detailed bibliography of the subject contained in the footnotes on every page, which must be of the greatest service to the student of African exploration and geography. There are occasional slips, as when Mr. Monteiro's book on "Angola and the River Congo" is entered under "Monteiro," as published in New York in 1875, and again under "J. John," as published in London in 1876. But such blunders are wonderfully few. About 1500 names are referred to altogether.

DR. LENZ, on November 22, was at St. Louis, whence he was going to Tangier.

As a memorial of the work performed in the *Vega*, a "*Vega* Fund" has been raised by subscription in Sweden to encourage further geographical research. The sum raised is 35,000 crowns, which will be intrusted to the Swedish Academy of Sciences, and the interest either employed at once or be allowed to accumulate for a term of years. Only natives of Sweden, Norway, Denmark, and Finland will be entitled to receive the benefit of the fund.

Two important expeditions are soon to be sent into Central Africa, under the auspices of the Algerian Missionary Society, which already has stations at the northern ends of Lake Tanganyika and the Victoria Nyanza. One will go from Zanzibar, and the other will ascend the Congo.

## *THE INFLUENCE OF PRESSURE AND TEMPERATURE ON THE SPECTRA OF VAPOURS AND GASES*[1]

IN the course of my inquiry last year into the homology of the spectral lines of chemically-related elements I occasionally made the observation that the two strongly-marked red lines which bromine in the fluid state gives when the spark is taken from it in De la Chanal's fulgurator grow very feeble or entirely disappear in the spectrum of the rarefied vapour in the Geissler-tubes, while other lines not previously seen become visible. It appeared to me of interest to inquire more particularly into the changes of the spectrum of one and the same element, as these changes are naturally of the greatest importance in the comparison of chemically-related elements; and with this view I addressed myself to the problem of the changes of spectra at higher pressures.

According to Wullner's well-known experiments, which only deal with the three permanent gases, hydrogen, oxygen, and nitrogen, the spectral lines of the second order grow broader with higher pressure, and at the same time a continuously illuminated background is to be observed. This phenomenon, however, presents even in the three permanent elements the greatest difference. Thus, while the lines in the hydrogen spectrum become easily broader even under moderate pressure, those in the spectrum of nitrogen do not expand. Therefore it occurred to me that a comparative investigation, which would extend to as many elements as possible, would be desirable, inasmuch as it encouraged the hope that by this means one could arrive at a law, perhaps even at an explanation, of these phenomena.

I now venture to present to the Academy a report of my experiments as far as they have gone, reserving a full account till their completion.

In my experiments I have treated the most volatile of the metalloids, and among the metals have included quicksilver and sodium. I will in due time give a full account of the apparatus and methods which I employed in my experiments, but at present I must confine myself to a statement of the results already ascertained.

The spectrum of the three halogens, at higher pressures, exhibits in each case the same peculiarities. The lines have the appearance of merging into each other, and without showing an expansion into bands, they become occasionally somewhat broader. There is a steadily luminous background which becomes brighter when the pressure is increased, and which is often more intense than the lines themselves. This latter circumstance is frequently seen in the case of iodine, where the continuous spectrum finally covers all the rest. In the case of chlorine and bromine single lines are always distinguishable from the continuous surrounding light. The appearance of certain lines in the red field in chlorine and bromine which always preserve their precision and delicacy is worth mentioning.

The changes in the intensity of the spectral lines as exhibited under different pressures are very interesting. If you compare the spectral lines of the halogens with each other, in order to ascertain their homology, and in doing so only employ the spectra of rarefied vapours in Geissler tubes, you meet considerable difficulties, for you can only compare the lines in groups, and these lines present frequently in each of the three elements such differences of intensity that you may be left in doubt as to the existence of a homology of their lines. But the apparent differences arise in reality out of the variation of intensity and the number of the lines with the pressure. By appropriate change in the density of the gas or vapour you can always produce spectra which exhibit the perfect homology of the lines. Thus, in the case of iodine you must employ that tension which iodine-vapour has at 50° or 80° C., while in the case of chlorine and bromine atmospheric pressure is required.

The spectrum of sulphur does not change at all at higher pressure, the lines maintaining their perfect sharpness, while in the red field a continuously illuminated background appears.

Phosphor and arsenic do not give any reaction, and even the continuous spectrum does not appear. With arsenic I observed what I think has hitherto been overlooked, namely, that it gives at a moderate pressure, and without the interposition of a Leyden jar, *a spectrum of the first order*. It is almost continuous, and with increase of pressure of interposition of the jar it gives to the spectrum of lines the spectrum of the second order.

Great is the difference between the metalloids of which we have hitherto been speaking and the metals; they show an expansion of their lines into bands, while the continuous light takes a less prominent place. In quicksilver the breadth especially of the green and violet lines is conspicuous.

With sodium I have only noticed the great width of the D-lines when they appeared reversed, for I could only examine the light after its passage through a layer of cooler vapour. Sodium gives at high pressures a continuously illuminated spectrum near the D-lines, which then appear reversed; at first one or two lines, but soon they widen and merge into each other, and the dark band of absorption gradually covers the whole illuminated part of the field.

[1] By G. Ciamician, in *Sitz. Ber. der k. Akad. der Wiss.*, Vienna, lxxvii. Band, v. Heft.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE*

CAMBRIDGE.—Prof. Stuart finds the progress of his School of Mechanism and Engineering again compels enlargement. Some pupils are now making small engines, and require more space for erecting them. A room for mechanical drawing is needed, and also an enlarged stove. The Museums and Lecture-rooms Syndicate think it best in the present condition of University funds to erect a new temporary building 46 feet long by 21 feet wide, adjacent to the present workshop, and this, with other rooms which can be added, will supply present necessities for about 360*l.*

The balance of 821*l.*, being the debt on the last two years of the Museums Maintenance Fund, has been granted as an extra payment from the University Chest, and in future years 3000*l.* will be granted annually for the Museums and Lecture-rooms Maintenance Fund.

Prof. Stuart is to have the services of a Demonstrator of Mechanism and Applied Mechanics.

Clare College announces a scholarship of 60*l.* a year in chemistry and chemical physics, botany and geology, to be competed for on March 29 next, without limit of age. Jesus and Magdalene Colleges continue to offer no inducements to natural science.

BY a Royal decree, published last month, a museum will shortly be opened at Palermo on the plan of the one founded in Rome in 1874, with the object of making known the best scho-