will be contracted and extended in opposite quadrants until at 45° they are divided by two diagonals, on each side of which the colours are complementary. Beyond 45° the rings begin to coalesce, until at 90° the four quadrants coincide again. During this movement the centre has changed from bright to dark. If the motion of the analyser be reversed, the quadrants which before contracted now expand, and *vice versâ*. Again, if the crystal (say positive) be replaced by another (say negative), the effect on the quadrants of the rings will be reversed. This method of examination therefore affords a test of the character, positive or negative, of a crystal.

A similar process applies to biaxal crystals; but in this case the diagonals interrupting the rings are replaced by a pair of rectangular hyperbolas, on either side of which the rings expand or contract, and the effect is reversed either by reversing the motion of the analyser, or by replacing a positive by a negative crystal, or *vice versâ*. The experiment may then be made in biaxal crystals, by turning the analyser slightly to the right or to the left, and observing whether the rings advance towards or recede from one another in the centre of the field. In particular, if, polariser and analyser being parallel, the plate A have its axis in a N.E. direction to a person looking through the analyser, the plate B its axis in a N.W. direction, and the crystal be so placed that the line joining the optic axes be N.S., then on turning the analyser to the right the rings will advance to one another if the crystal be negative, and recede if it be positive. The mathematical expression for the intensity of the light at any point P is in this case

$$\tfrac{1}{2}(1 + \sin. 2j \cos. \theta + \sin. 2b \cos. 2j \sin. \theta),$$

where b is the angle between the principal section of C through P and the principal section of B, and j the angle between the principal sections of B and the analyser. This shows that when the polariser and analyser are parallel or crossed at 0° or 90°, and consequently $j = 45°$ or 135°, the expression is independent of b, *i.e.*, the intensity is the same throughout circles about the centre, but that when the polariser and analyser are crossed we have an expression of the form

$$\tfrac{1}{2}(1 \pm \sin 2b \sin. \theta),$$

the sign of the second term depending upon the direction in which the analyser has been turned, and also upon the sign of θ, that is, upon the character (positive or negative) of the crystal.

The dispersion of the planes of polarisation effected by the passage of plane polarised light through a plate of quartz cut perpendicular to the axis may be rendered visible by interposing such a plate of quartz between the polariser and a uniaxal or biaxal crystal, when the analyser is at 90°, *i.e.*, when dark brushes are formed. In this case the brushes cease to be black, and are tinged throughout with colour. The analyser must, however, be turned back or forward, according as the quartz be right-handed or left-handed, in order that it may cross in succession the planes of polarisation of the different coloured rays, and so produce the most vivid effects. The dispersion of the brushes by a plate of quartz may, however, be studied by employing an additional polariser and quartz plate between the source of light and the whole system previously used. By turning this polariser round we extinguish each ray of the spectrum in turn, and tint the whole field with the complementary colour. The brushes will then appear to revolve about their centres as the tints vary continuously from one end of the spectrum to the other. If the polariser be turned still farther round, the tints which had changed continuously from red to violet, or *vice versâ*, change suddenly from violet to red, or *vice versâ*, and the brushes jump suddenly back to their original position.

This last optical arrangement may be employed to examine the more important phenomena of the dispersion of the optic axes produced, not by a quartz plate between the usual polariser and crystal, but by certain biaxal crystals themselves.

BOTANY

The Leaves of Drosera

In a recent note to the Paris Academy of Sciences, M. Ziegler writes as follows:—

The hairs on the leaves of Droseras exude at their extremity a small drop of glue, by which insects are caught. Whenever an insect becomes attached, the exterior threads bend over it, covering it like the fingers of a hand, and do not straighten again till some days after, when a fresh drop exudes for a fresh prey.

In studying these remarkable plants, I noticed that all the albuminoid animal substances, if held for a moment between the fingers, acquired the property of making the hairs of the Drosera contract. I also observed that such substances, when they had not been in contact with a living animal, had no visible action on the hairs. This shows that the simple contact of the fingers communicates to inert animal substances a property which they did not possess before.

These same animal substances thus prepared lost this singular property when they were moistened several times with distilled water, and dried each time in a water-bath. This is a convenient mode of preparing the substances for experiment.

The contraction of the hairs is not caused by animal heat, which the fingers may have communicated to the animal substances, for the hairs contracted equally when the substance had been cooled before placing it on the leaf.

The perspiration of the fingers cannot affect the phenomenon, for the property can be communicated to animal substances across fine waxed paper. And the result is not affected if the substances are first covered with a coating of wax, thus preventing any chemical action of soluble matters which the animal substances may contain.

A living animal thus communicating by simple contact new physical properties to an inert body, it was important to know whether, by increasing the amount of transmission, we should observe any change in the vital state of the animal. Some rabbits were enclosed in light wooden cages. These were of such a size that their sides were always in contact with the hairs of the animal at one part or other. To the outside of the cage were atrached bags of cloth or paper, containing (for each cage) two kilogrammes of dried serum (albumen from blood). Other rabbits were placed in exactly similar cages, but without the albumen. Their food consisted of 25 grammes of hulled oats every twenty-four hours, with cabbage leaves at discretion.

At the end of some days, the rabbits that had been in contact with the albumen became diabetic in a high degree (though without saccharine matter); the urine was given in normal quantity, but the loss in ammoniaco-magnesian phosphate was very great, and these rabbits deteriorated and lost weight. The other rabbits, which had not been in contact with albumen, remained in their normal state, and even gained weight.

It was interesting to ascertain if the avidity of the Drosera for insects was insatiable, and to find what would be the effect on it of increasing the contact of a living animal. Some dozens were accordingly placed, with a small clod of earth and sufficient water, in light platinum capsules. These capsules were each placed in a sheath containing blood albumen, which had previously been held for half an hour in the hand. At the end of twenty-four hours all these Droseras had become quite insensible to insects and to organic animal bodies modified by living contact. The properties of these plants were reversed, and strange to say, their hairs were found to contract under the influence of organic matters which had previously been in contact with paper packets (of double or triple envelope) containing sulphate of quinine. Organic matters influenced in this purely physical manner by sulphate of quinine have no contractile action on the hairs of the Drosera in their normal state. The plants whose physical properties have been reversed by the influence of albumen in the above way, could be restored to their normal state by placing them for twenty-four hours with the platinum capsule on a packet of sulphate of quinine. This method may be adopted whenever, from any cause, the leaves have become insensible to insects. In every case the contraction of the hairs is always slow; it commences visibly in about a quarter of an hour, and is often not complete till after several hours.

Among vegetable matters seeds only are impressible in the way referred to, and the experiments mentioned (which were made with albuminoid animal substances) may be repeated with these.

Nature of Diatoms

In a recent essay by Prof. Adolf Weiss, of Lemburg ("Zum Baue und der Natur der Diatomaceen"), it appears to be demonstrated that the siliceous investment of these little plants has cellulose for its base. The silex is infiltrated to a variable extent in the different families, and the mode of its deposition can to a certain extent be ascertained by examination with polarised light. In opposition to the opinion hitherto generally admitted, Prof. Weiss shows that the siliceous coal is capable of

polarising light; and he has found also that it contains a certain amount of iron-oxide compounds, which are for the most part in an insoluble condition. He strongly objects to the view that the *Diatomaceæ* are one-celled organisms, but contends that each frustule is composed of numerous very minute but perfectly individualised cells. The different markings on the frustules—areolæ, ribs, crests, &c.—are in no way caused by the contour lines of the several cells of which they are composed. The size of the cells is very variable. In *Triceratium favus* they are as large as 0·008 of a millimetre, whilst in *Hyalosira delicatula* they do not exceed 0·00025 of a millimetre. Each cell is arched, and, as a rule, prolonged into a papilliform process at its centre. The papillæ are the cause of the moniliform or pearl necklace-like markings of diatoms when examined with high powers, and which appear as striæ with low powers. The large cavity between the two frustules is, he thinks, comparable to the embryo-sac of higher plants; and Weiss has succeeded in observing the development of new individuals in it. The product of this new individual indicates the alternation of generations in the *Diatomaceæ*.

SCIENTIFIC SERIALS

THE first number of *Zeitschrift für Ethnologie* for the current year (1872) opens with a paper by A. Bastian on "The Position of the Kaukasus in relation to the history of the migration of nations," in which the author points out the importance of studying the hydrography and orography of a country before we attempt to trace the origin of its inhabitants. Mountains and streams afford more stable evidence in regard to ethnological centres of origin than the ever-fluctuating combinations of language. Thus, for the history of our own Continent we can have no more important standpoint than the Kaukasian range, which forms the boundary line between Europe and Asia, from which rivers open the way into the Caspian and Black Seas. Herr Bastian next traces the various directions taken by successive waves of population after they reached the Steppes between the Don and the Dnieper, which long formed the meeting-place of the Scythio-Sarmatian races, and often witnessed the fierce encounter of rival hordes, whose defeat or success on that great battle-field of nations decided the fate of future races. The relation of the nomadic races of Asia to the Persian Empire is of special interest to us, since the latter by its control over the destinies of the western half of the Asiatic continent has exerted the most important influence on the ethnological history of Europe. In Asia the course of civilisation has followed the line of the Steppes; and the nomadic tribes who possessed horses have spread themselves through every pastoral district, amalgamating at times with the earlier settlers, but more generally organising themselves into hostile bands, whose leaders became the founders of equestrian dynasties, and raised thrones for themselves in Central and Western Asia. The author follows at length the progress of Parthian and Persian conquests and migrations, and, after considering the anatomical features and cranial dimensions and forms of the various races, which have given conquerors to the world, discusses the probable bastard or mixed origin of those inferior subjected races, who from time to time have risen against their masters, and asserted their right to freedom, as in the case of some of the Servian tribes against their Pannonian lords, and various Mestizoes or Creoles in Africa and America.—The remaining papers in this number are below the usual standard of the *Zeitschrift für Ethnologie*. We have a paper by Dr. E. v. Martens "On the Different Uses of the Conchilia," originally read to the Anthropological Society of Berlin, which is little more than a *résumé* of what G. E. Rumph, P. Bonanni, Johnston, and Mr. Woodward have given in their semi-popular works on subjects of conchological interest. Dr. Martens also contributes a translation of a paper on the geography, history, and statistics of the Island of Puerto Rico, by S. Bello, of Espinosa. We learn that while sugar and coffee constitute the riches of the island, all the tropical fruits abound, and the excessive annual rainfall maintains a vigorous and verdant vegetation. The hot moist climate is unhealthy, and dysentery, yellow fever (vomits), and remittent fevers of various kinds prevail. The population has, however, gone on steadily increasing during the last forty years, notwithstanding the diminution in the numbers of the slaves, amongst whom the deaths have of late years exceeded the births in the ratio of from 5 to 10 per cent. In 1839 the population was 319,000, in 1870 it had risen to 646,360; in the latter year the number of the slaves had fallen to 32,000, after being 42,227 in 1866, thus giving a diminution of 25 per cent. in four years.—M. de Quatrefages' history of Prussian aggrandisement, which first appeared in the *Revue des Deux Mondes* (1871), under the title "*La Race Prussienne*," has called forth an impassioned and indignant rejoinder in this number of the *Zeitschrift für Ethnologie*. We should be more disposed to concur in the line of argument adopted by the writer in refutation of M. de Quatrefages' too sweeping assertion that Prussians are Finno-Slaves with only a slight admixture of French and German blood in the higher classes, if he had not allowed personal rancour and national hate to over-weigh every consideration of courtesy, justice, and reason. We think an ethnological journal is not the place for international warfare.

Annalen der Chemie und Pharmacie, viii. Supplementband, 2 Heft.—The first 100 pages of this number are occupied by an important theoretical paper "on a periodical law of the chemical elements," by Dr. Mendelejeff; the author has arranged the elements into eight groups and into twelve series; there seems to be a most curious regular progression, both in the atomic weights, the atomicities, and in the chemical proportion of these groups. To take for example the third series of elements, starting from group 1 to 7, we find the following:—Sodium[i] 23, Magnesium[ii] 24, Aluminium[iii] 27·3, Silicon[iv] 28, Phosphorus[v] 31, Sulphur[vi] 32, Chlorine 35·5, it will be seen that the first named is a very positive element, and that the positive character gradually changes through the groups until in the seventh we have a powerfully negative body; the atomic weights and atomicities of the elements also increase in a regular manner. In the other series the same kind of relation seems to exist; the author has left spaces in his table for elements not yet discovered, but for which he gives hypothetical atomic weights. The next paper is by Gorup Besanez "on the dolomite springs of the Jura," and is followed by another "on a new class of platinum compounds," by Schutzenberger; by the action of carbonic oxide on platinous chloride at high temperatures three distinct compounds have been obtained, the first containing one equivalent of carbonic oxide to one equivalent of platinous chloride, the second two equivalents of carbonic oxide, and the third one and a half equivalents of carbonic oxide to one of platinous chloride. Linnemann and Zotta have found that by heating glycerine with calcic chloride, small quantities of phenol are formed, and at the same time there is produced glyceric ether. Phenol is also obtained from glycerine by the action of zincic chloride or potassic bisulphate.

IN the *Journal of the Franklin Institute* for April we have the continuation of several papers already commenced, viz.:—Mr. Joseph Harrison's article on the locomotive engine, and Philadelphia's share in its early improvement; of Mr. J. S. Smith's account of the Keokuk and Hamilton Bridge; of Mr. J. F. Henry's paper on the flow of water in rivers and canals; and of Mr. J. Richard's article on wood-working machinery. The only new article of any length is by Lieut. Dutton on the principles of gun construction, and there are the usual paragraphs of Items and Novelties.

THE *American Journal of Science and Arts* for April commences with Prof. Marsh's account of the discovery of additional remains of Pterosauria, with descriptions of several new species, *Pterodactylus occidentalis*, *P. velox*, and *P. ingens*, of which full measurements are given, the last probably measuring nearly 22 feet between the tips of the fully expanded wings.—Prof. A. E. Dolbear describes a new method of measuring the velocity of rotation; and Prof. Dana continues his history of Green Mountain geology, dealing this month with the quartzite.—From Mr. F. B. Meek we have descriptions of two new starfishes and a crinoid from the Cincinnati Group of Ohio and Indiana, which he proposes to name *Palæaster* (?) *Dyeri*, *Stenaster grandis*, and *Glyptocrinus Baeri*.—Prof. Abbe gives an account of his observations on the total eclipse of the sun in 1869; and Prof. Twining of various observations on the aurora of Feb. 4.—Mr. Verrill's series of papers include this month recent additions to the molluscan fauna of New England and adjacent waters, with plate.

In the May number is a valuable epitome of recent geographical work in the United States, deduced from the report of the Corps of Engineers, U.S. Army, the route of the Northern Pacific Railroad, and the map of transportation routes in Minnesota and Dakota.—Prof. W. A. Norton contributes a paper on molecular and cosmical physics, in which he propounds several new theorems: the subject is to be continued.—As the commence-