over those in the first, those in the eighth over those in the second, and so on (Figs. 5 and 5*a*).

When we inquire whether the symmetrical arrangements just traced are in harmony with the facts respecting compounds of two kinds of atoms in the proportions 1 : 2, we find some very important evidence.

Thus water, H_2O, crystallises in six-sided prisms or in rhombohedra; forms both of which are compatible with one or other of the above symmetrical arrangements.

And the following most interesting concurrence of facts indicates that the symmetrical arrangements in the fourth kind of symmetry above described (see Figs. 5 and 5*a*) are those of the atoms of quartz.

(*a*) Quartz consists of oxygen two atoms, silicon one atom; just the proportions in these arrangements.

(*b*) It has the property of circular polarisation, from which it has been proved that its molecules must have a *spiral* arrangement, and, since some crystals have the property of rotating in one direction, some in the opposite, that this spiral arrangement is right-handed in some crystals, left-handed in others.

(*c*) It crystallises in six-sided prisms terminated by six-sided pyramids, a form derivable, as we have seen, from the arrangements before us.

As to this last point, just a word of explanation why we must not look for the angles exhibited by our model arrangements to be identical with the angles made by the pyramid faces in quartz.

It is a matter of common observation that the process of crystallisation is generally associated with change of bulk, and if we suppose this change to arise from expansion, or contraction, generally expansion of the different kinds of atoms, and that these different kinds have *different degrees of expansion*, we see that a mass symmetrically arranged in the manner supposed will in crystallising expand or contract more in some directions than in others, and while we should look for a similar change in the direction of each of the three transverse subordinate axes of the crystal, we should look for a different change in the direction of the principal axis. And thus, supposing the mass when liquid immediately before it began to crystallise to have had the internal symmetry which has been depicted, it is evident that the unequal change of dimension in different directions might suffice to bring about such an inclination of the faces of the terminal pyramids to the sides of the prism as is actually found to exist.

In support of this explanation we have the fact that crystals not of the regular system have been found to expand unequally in different directions when subjected to heat.

Further evidence in support of the theories here submitted is found in the fact that, with scarcely any exception, the compounds we are now considering do not crystallise in the regular or cubic system.[1] WILLIAM BARLOW

(*To be continued.*)

THE HELVETIC SOCIETY OF NATURAL SCIENCES

THE sixty-sixth session of this Society was held early in the month of August of the present year in the city of Zurich. The proceedings of the various Mathematical, Physical, Chemical, Zoological, Botanical, and Medical Departments are somewhat fully reported in the *Archives des Sciences Physiques et Naturelles*, Geneva, October 15. On August 6 a preliminary meeting was held of the delegates of the Cantonal Sections and Special Committees, and next day the session was formally opened in the Town Hall under the presidency of Prof. Cramer. The two ensuing days were devoted to the work of the several Sections, all of which were well attended by numerous Swiss and foreign savants, brought together by the double attraction of the Helvetic Society and the National Exhibition, which was also held this year in Zurich.

In the Mathematical Section, over which Prof. W. Fiedler presided, the chief papers were those of Prof. Geiser (Zurich), on surfaces of the third degree; of Dr. Rudio (Zurich), on the geodetic lines traced on surfaces of the second degree; of Prof. Fiedler (Zurich), on the intersection of equilateral hyperboloids revolving on parallel axes.

In the Physical Section, presided over by Prof. R. Clausius, M. F. A. Forel (Morges) communicated the result of his researches made to determine the limits of variation of temperature in the waters of Lake Geneva. According to his thermometrical soundings, the diurnal variation is perceptible down to a depth of from 10 to 15 metres; the summer variation from 60 to 100 metres. Exceptional winters like that of 1879-80 are felt as low as 334 metres. Since that year the temperature of the water at these great depths has been raised on an average about half a degree Centigrade.

Some preliminary results of his researches on the refraction and dispersion of crystallised alums were communicated by M. Charles Soret of Geneva. By means of his completely reflecting refractometer, described in the *Archives* for January, 1883, the author has determined the indices of refraction for the principal lines of the solar spectrum from *a* to G inclusively for six sulphuric alums with alumina base.

Prof. Clausius read a paper of practical importance on the theory and proper method of construction of dynamo-electric machines. Some curious experiments were made by M. C. de Candolle of Geneva, showing how ripples are formed on sandy surfaces at the bottom of the sea. From these experiments it results that the phenomenon is produced by the friction of a liquid mass against any substance more viscous than itself. Hence the sand may be regarded as forming with the water a viscous mixture, on the surface of which the friction of the pure liquid develops ripples in the same way that the friction of the air develops ripples on the surface of the water itself.

Amongst the other memoirs in the Physical Section the most noteworthy were those of Prof. H. F. Weber (Zurich) on liquids and gases as heat conductors; an experimental demonstration of the second principle of the mechanical theory of heat, by M. Raoul Pictet; on the determination of the ohm, by Prof. H. F. Weber; on the results of the observations and researches made in the laboratory of the Lausanne Academy on atmospheric electricity, by M. Henri Dufour of Lausanne. The author described several successful attempts made by him to reproduce artificially the electric phenomena observed in the terrestrial atmosphere.

The Chemical Section was opened, under the presidency of Prof. Wislicenus, by Prof. V. Meyer's memoir on the nature of the chemical elements according to recent research. The author leans to the views of Mendeleeff and Lothar Meyer, who regard the properties of simple bodies as the periodical functions of their atomic weights. The fact that Mendeléeff was able to predict the existence of gallium and scandium, and correctly determine their atomic weights, was adduced in support of the theory that all the elements are merely different compound forms of one primitive substance. Hence, although hitherto baffled, the attempts now being made to decompose them may result in the experimental determination of one absolute primordial substance.

Prof. F. Krafft (Basle) presented some higher alcohols of the series $C_nH_{2n}+2O$, accompanying them with some remarks on the synthesis of alcohols in general. A *résumé* was given by Prof. Louis Soret (Geneva) of his researches on the absorption of the ultra-violet rays by various substances of animal origin. The author dwelt on the great importance of this branch of spectral analysis to chemistry, and concluded with a brief description of the method and appliances used by him in his original researches.

Other valuable chemical papers were those of Dr. M. Cérésole (Lausanne), on acetacetic acids; of Prof. V. Meyer on the apparatus used in determining the densities of gases at very high temperatures; of Prof. Schulze, describing the researches made by him jointly with M. J. Barbieri on phenylamidopropionic acid, which is obtained by heating albuminoid substances with chlorhydric acid and chloride of tin; of Prof. Wislicenus (Wurtzburg), on the relation of the optical rotatory power of carburets of hydrogen, on the existence of an atom of asymmetric carbon, and on the products of the reaction of dichloride of phtalyle on the sodic combination of malonic ether; Prof. G. Lunge (Zurich), on the formation of sulphuric acid in lead chambers; Dr. Urech (Stuttgart), on a lamp fed by ether of petroleum. This lamp, constructed by C. C. Lilienfein, of Stuttgart, consists of a metallic receiver containing the ether of petroleum, and connected with a Bunsen burner slightly modified in consequence of the liquid nature of the combustible.

In the Zoological Section Prof. C. Vogt, president, the proceedings were opened by a communication from Prof. H. Fol (Geneva), on the physiological origin of the individual in the

[1] With regard to calcic fluoride (fluor-spar), which appears as an exception, it may be remarked that a different atomic weight for calcium which would enable us to write the compound CaF would enable us to get over a difficulty with regard to another compound of calcium, as we shall see presently.

higher animals. M. H. Goll of Lausanne, presented a contribution to the natural history of the sedentary and migratory coregones of Lake Neuchâtel. Memoirs were received on the Arachnidæ of Switzerland by Prof. Pavesi of Pavia; on the fauna of Guatemala, by Dr. Otto Stoll of Zurich; on some new species of Medusæ from the Red Sea, by Dr. Keller of Zurich; on the Pelagic fauna of the Swiss lakes, by Dr. Othmar-Emile Imhof of Zurich; and on the influence of the physico-chemical environments on the development of the tadpole of the edible frog, by M. E. Yung of Geneva. From experiments made by mixing marine salt in various proportions with the natural freshwater element, M. Yung arrived at the conclusion that, the more saline the water, the slower is the development of the tadpole, all transformations ceasing in solutions of 9/1000, and death following in a few hours in solutions of 10/1000.

In the Botanical Section, Prof. Cremer, president, valuable memoirs were received from Prof. O. Heer of Zurich, on the Glacial flora of Switzerland, and on the fossil flora of Greenland. These were the last pages contributed to science by the distinguished savant, who had scarcely finished the revisal of the proofs when he died suddenly at Lausanne, on September 27. A series of hybrids between the *Primula auricula* and *Primula viscosa*, showing an uninterrupted series of forms intermediate between these two species, was exhibited by Prof. Favart of Lausanne. He also showed that the *Cardamine fossicola*, Godet, hitherto classed with the *C. pratensis*, Lin., should be grouped with the *C. matthioli*, Moretti. Some remarks were made by Prof. Schnetzler of Lausanne on a monstrosity of the Chinese primrose, and on the relation between an aërial alga (*Chroolepus umbrinus*) and a lichen (*Pyremula* sp.) M. C. de Candolle described the results of his attempts to determine how far any light may be thrown on the disputed origin of the *Cytisus adami* by the anatomical structure of its leaves. This plant, which suddenly made its appearance in the nursery of Adam at Vitry, near Paris, early in the present century, and which is remarkable for producing red and yellow blossoms mostly on separate branches, is usually regarded as a cross obtained by grafting the *Cytisus purpureus* on the *C. laburnum*. But M. de Candolle concludes that it is not a hybrid, but simply a degenerate variety of the *C. laburnum*.

In the Medical Section, Prof. von Kölliker, president, Prof. Klebs of Zurich read a remarkable paper on the transformations of the human species, which he regards as mainly the result of pathological influences.

Valuable communications were also made on the centres of origin of the optic nerves and on their relation to the cerebral cortex, by Dr. C. von Monakow of St. Petersburg; on the relations existing between the excitability and vulnerability of certain muscular groups, by Prof. Luchsinger of Berne; and on the mechanism of the ruminating process, by the same author.

The report on the Geological Section was unavoidably postponed to the November issue of the *Archives*.

NOTES FROM THE OTAGO UNIVERSITY MUSEUM

IV.—*On the Structure of the Head in "Palinurus," with special reference to the Classification of the Genus*[1]

THE genus *Palinurus* was divided by Milne-Edwards into two groups or sub-genera—one, the "Langoustes ordinaires," containing species in which the antennulary flagella are short, the bases of the antennæ approximated, and the rostrum present; while the other, or "Langoustes longicornes" (*Panulirus*, Gray; *Senex*, Pfeiffer), contains species in which the antennulary flagella are short, the antennæ widely separated at their proximal ends, and the rostrum absent.

In this classification, which is still in the main adopted by systematists, no notice is taken of the stridulating organ, first mentioned, I believe, by Leach, in *P. vulgaris*, and described at length by Möbius, and later by myself, in the same species.[2] This unique sound-producing apparatus is present in all the "Langoustes longicornes" which I have yet examined, as well as in *P. vulgaris* and *P. trigonus* among the "Langoustes ordinaires"; while in all the remaining members of the latter group which have come under my notice (*e.g.* the common New Zealand species, *P. lalandii* and *P. edwardsii*) there is no trace of it.

There is also great diversity among the "Langoustes ordinaires" in the development of the rostrum, the true size of which can only be seen in a longitudinal vertical section of the head (see Fig. 1). In *P. lalandii* and other non-stridulating species, the rostrum (A, *r*) is well developed, and bears comparison with that of *Homarus*, while in *P. vulgaris* (B, *r*) it is a mere spiniform tubercle meriting special description only from its position. *P. vulgaris*, moreover, has no trace of procephalic processes, which are present, though small, in *P. lalandii* (A, *pc.p*).

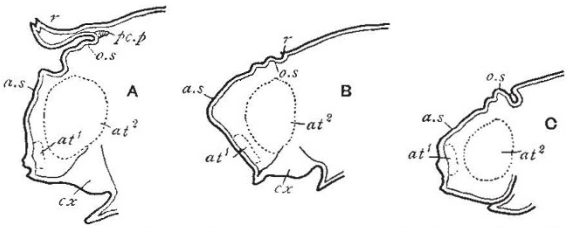


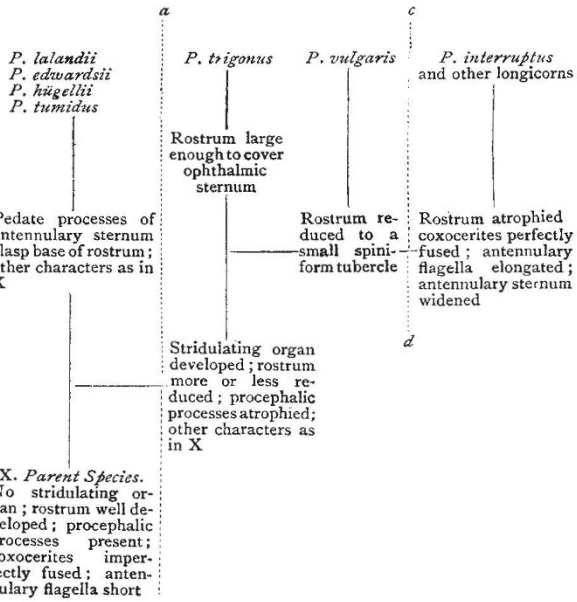
FIG. 1.—A, Longitudinal vertical section of the head of *Palinurus edwardsii*: B, of *P. vulgaris*: C, of *P. interruptus*. *as*, antennulary sternum; at^1, articular cavity for antennule; at^2, for antenna; *cx*, unanchylosed part of inner wall of coxocerite; *o.s*, ophthalmic sternum; *r*, rostrum; *pc.p*, procephalic process.

The woodcut shows that as regards both the rostrum and the antennulary sternum (the fixed part of the stridulating organ), *P. vulgaris* (B) approaches far more nearly to the "Langoustes longicornes," as represented by *P. interruptus* (C), than to the non-stridulating "Langoustes ordinaires," as represented by *P. edwardsii* (A).

On the other hand, all the brevicorn species examined agree in the imperfect fusion of the coxocerites or proximal segments of the antennæ. A transverse section taken immediately in front of the renal apertures shows that a small portion of the adjacent or inner walls of the coxocerites in *P. lalandii*, *P. vulgaris*, &c., are merely in apposition, whereas in the longicorn species concrescence is complete.

Assuming that the *Palinuridæ* are derived from an Astacoid or Homaroid ancestor through some such intermediate form as *Palinurellus*, one cannot but conclude that the species which have no stridulating organ, a well-developed rostrum, procephalic processes, and imperfectly fused coxocerites, come nearest to the parent stock, and that those in which the stridulating organ is developed, the rostrum and procephalic processes absent, and the coxocerites completely united with one another, have diverged most from that stock, and present us with the extreme of modification of the Palinuroid type.

This view is expressed in the following phylogenetic table:—



[1] Abstract of a paper taken as read at a meeting of the Otago Institute, September 12, 1883, and to be published in the next (16th) volume of the *Transactions of the New Zealand Institute*.

[2] Leach, "Malacostraca podophthalmata Britanniæ"; Möbius, *Archiv für Naturgeschichte*, 1867; T. J. Parker, *Proc. Zool. Soc.*, 1878, p. 442.