ring is very asymmetrical, being elongate in the major axis of the elliptical specimen. In *Heterocentrotus*, too (Figs. 2 and 5), the body is elliptical and the ring is asymmetrical, being longer in the direction of the major axis of the specimen. In this genus (one figured from the Bermudas [5] and one from the Philippine Islands [2]) there is only one ocular which borders the ring, a second barely reaching it in 5 or not really doing so in 2, this is not like the case presented in Fig. 8, the exceptional Strongylocentrotus, for there the lateral and not the median ocular is the one which surely borders the ring. A number of undetermined Echinoids at hand from the Pacific Ocean closely resemble Strongylocentrotus, and in them the aboral ring is like Fig. 7.

These comparisons have interesting morphological suggestions. *Dorocidaris* is a central form, as well as an early one palæozoölogically, in it the oculars are neither wholly on nor wholly excluded from the ring; from it *Diadema* is a departure toward and *Arbacia* from the ring, and all three of these are tolerably radial in symmetry. *Hipponoe* is a slight departure from the regular symmetry of the aboral ring, all the rest are not radial. The elongations of *Echinometra* and *Heterocentrotus* are in the same plane in each case, but the plane is not in the plane of the madreporic plate, as it is in the departures from radial and toward bilateral symmetry in clypeastrids and spatangids. The aboral pole of Strongylocentrotus is very much out of radial symmetry, though the shell in all other respects is very perfectly regularly radial. The meaning of the exceptional case presented in Fig. 8 might perhaps be understood as a reversion toward an ancestral form in which the oculars were all excluded from the aboral ring. I cannot think of any adequate physiological explanation of the relations of these bones in either Fig. 7 or Fig. 8.

Hamline Biological Laboratory, March 24, 1893.

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## THE CANALS OF MARS.

BY S. E. PEAL, SIBSAGAR, ASAM.

THE question as to the distribution of land and water on the planet Mars, and nature of the so-called "canals," is one on which there has of late been considerable speculation; and in the hope of throwing some little light on the subject, it may not be amiss to draw attention to a recent geological discovery relating to the distribution of land and water on our earth.

At no very distant period it was generally supposed that terrestrial continents and oceans had frequently — or at least occasionally — changed places, that oceanic islands, as a rule, were the summits of submerged or emerging ranges, the last relics, or forerunners, of extensive land masses. All this is now changed, and one of the most recent and important discoveries of modern geology is the fact that the great continental masses and deep ocean floors are permanent features of the earth's crust.

On p. 150, "Island Life," Mr. A. R. Wallace tells us that "there is the strongest cumulative evidence, almost amounting to demonstration, that for all known geological periods our continents and oceans have occupied the same general position they do now." And at p. 330, "during the whole period of geologic time, as indicated by the fossiliferous rocks, our continents and oceans have, speaking broadly, been permanent features of our earth's surface." Referring to ocean floors, Mr. J. Murray again says, "The results of many lines of investigation seem to show that in the abysmal regions we have the most permanent areas of the earth's surface." While M. Faye points out that "under the oceans the globe cools down more rapidly and to a greater depth than beneath the surface of the continents. At a depth of 4,000 metres the ocean will still have a temperature not remote from 0° C., while at a similar depth beneath the earth's crust the temperature would be not far from 150° C."

Last, Professor James Geikie, in his address to Section E, geography, of the British Association, says, "We must admit that the solid crust of the globe has always been subject to distortion, and this being so, we cannot doubt that the general trends of the world's coast-lines must have been modified from time to time by movements of the lithosphere. . . . It seems to be the general opinion that the configuration of the lithosphere is due to the sinking in and crumpling up of the crust on the cooling and contracting nucleus." "According to Professor Winchell the trends (of the great world ridges and troughs) may have been the result of primitive tidal action. He was of opinion that the transmeridianal progress of the tidal swell, in early incrustive times, on our planet, would give the forming crust structural characteristics and aptitudes trending north and south. The earliest wrinkles to come into existence, therefore, would be meridianal, or submeridianal, and such is certainly the prevalent direction of the most conspicuous earth features." "So far as geological research has gone, there is reason to believe that the elevated and depressed areas are of primeval antiquity — that they antedate the very oldest of the sedimentary formations. We may thus speak of the great world-ridges as regions of dominant elevation and of the profound oceanic troughs, as areas of more or less persistent depression."

The great areas of elevation and of persistent subsidence are very distinctly marked out on our earth by a meridianal-lobed arrangement, caused, as Professor G. H. Darwin thinks, by *tidal* rupture during early stages of crust formation. This great recent discovery is, therefore, one of the greatest importance to all seeking for the solution of the problem of the distribution of land and water on Mars.

Tested by our moon, and viewing the marea as "seas" now in some way solidified, the foregoing conclusions are borne out in the most remarkable manner on the hemisphere which is presented towards us.

From Walter to Cassini we have distinct evidence (of different kinds) of the existence along the prime meridian of a vast shoal or submerged continent lying north and south, bordered on the east by the series of marea, Nubium, O. Procellarum, and Imbrium, and on the west by Nectaris, Tranquilitatis, and Serenitatis, each series of three marea having a meridianal trend. Near the limb again, east and west, we see the well-known two series of vast walled plains, lying north and south, the great Sirsalis cleft, also north and south, 400 miles long, being a vast anticlinal surface-fracture.

That the persistent subsidence of ocean floors (an axiom in terrestrial geology) is also clearly seen in our moon, is well illustrated in the remarkable arrangement of the clefts in relation to the marea, viewed as areas of subsidence. In regard to this question, Mr. A. C. Ranyard in *Knowledge*, September, p. 173, says: "The evidence brought forward by Mr. Peal, with regard to the general subsidence of the great lunar marea seems to me conclusive." So that the two features of slow subsidence of ocean floors and meridianal arrangement of the land and sea areas due to primeval tidal rupture during crust formation, are seen on both globes of the earth-moon system.

But the arrangement of the land and sea areas on Mars is on a totally different plan, there is an entire absence of equatorial oceans, and of meridianally placed continents divided, as in our case and the moon, by wide troughs of subsidence. We see on that globe two vast polar oceans divided by a more or less continuous land girdle.

We may reasonably assume that on Mars the crust-formation began on the poles, and that, as time went on and further condensation took place, subsidence and formation of polar sea-basins would ensue, their floors, being the coldest and densest portion of the crust, persistently sinking in, would naturally cause the emergence of the equatorial land-girdle. The comparatively unbroken continuity of this latter would again be due to the absence of a large satellite causing tidal rupture: there would be no breaking-up of the emerging land girdle round the equator, during crust-formation, as in the earth-moon system.

Professor G. H. Darwin thinks that the effect of solar tides on Mars must be "inconsiderable," they might yet, however, be sufficient to cause and maintain a slight overspill from one polar ocean-basin into the other, as the northern or southern hemispheres were presented towards the sun.

During the equinoxes, also, for some months, twice a year, solar attraction would probably draw the water from each polar

basin during the daytime through the lowest levels on to the equatorial land-girdle, the ebb taking place at night.

Persistently in operation from the very earliest periods, these two causes might well establish and maintain well-marked tidal channels, the so-called "canals," in fact, and in this way solve these enigmatical features. Their being open to the seas at each extremity is a powerful argument in favor of the above view.

With such an effectual and continuous circulation of the water from the polar basins, over the tropical areas, we may perhaps see the solution for the remarkable mildness of the climate on Mars and smallness of the polar caps. The thermal effects of our Gulf Stream would be produced not only at one spot, or even one pole, but all round; each polar basin would have currents of warmer water poured in daily.

The occasional duplicity of the canals may perhaps be due to a series of large islands, as seen so frequently in terrestrial rivers flowing through alluvial tracts. Viewed from a great elevation, our Brahmaputra would undoubtedly appear double for hundreds of miles, especially in the dry season when the large sand "churs" or islands fill the bed of the river, though even in the rains there are many, more or less permanent, of large size, such as our "Majulé," or middle ground, 130 miles in length by 10 or 20 wide, giving the appearance of a series of vast loops. The rule indeed is that this large river is seldom seen confined to one channel.

The remarkable feature of the whole case seems to be that so far there has been little or no reference to terrestrial experience when discussing the problem of the distribution of land and water on Mars. The great recent geological discoveries bearing on the subject appear to have been overlooked, but if the law of the permanent subsidence of ocean floors, now an axiom among geologists, and so clearly seen on our moon, applies to Mars, we can see more or less clearly that the coldest and densest portions of the Martian crust will be the floors of the two polar ocean basins, the slow, steady subsidence of which causes the emergence of the equatorial land-girdle; the comparative completeness of this, again, being due to the absence of a large satellite, to cause tidal rupture during formation.

Last, we seem to see an intelligible solution for the so-called "canals," as modified tide-channels, and even for their occasionally appearing double; the exceptionally effectual circulation of the water on the planet being the solution for the mildness of the climate.

## NOTES AND NEWS.

THE expedition, equipped by the de Laincel fund for linguistic and paleographic research among the Maya remains of Mexico, under the charge of Dr. Hilborne T. Cresson of the Bureau of Ethnology, Washington, D. C., reached Mexico in January and proceeded to the Partedo de la Frontera near the Guatemalian border and from thence to the little-known region around the lake of Petin. While in this part of the country the guide died of malarial fever, and Dr. Cresson, accompanied by his Maya servant, continued the explorations until the season was too far advanced for further research. The expedition has been very successful in the collection of material which will aid in deciphering the Maya hieroglyphs and demonstrates a rich field for future study both paleographic and linguistic. It has been found that exact drawings made by the pencil the size of the original glyph or half-size, will be most serviceable for giving details which repeated trials of the camera failed to satisfactorily produce, as many of the minor components, which recent study has shown to be very important in the interpretation of the glyphs, are so delicate in execution and so worn by time that the impression is calculated to deceive the student. Moreover, the forests which surround the ruined Maya structures are very dense and a proper light for photography is impossible to be obtained, and even if enough space was cleared for light the cast shadows of the tablets themselves lead to erroneous lines, when the negative is printed. A comparison of photographs of paper squeezes, made by previous expeditions, shows that much of this work has been hurriedly done and the minor components more or less distorted by being carelessly removed, so making them almost useless for exact study.

— An important meeting of the Victoria Institute took place on April 17, at Adelphi Terrace, London, the president, Sir Gabriel Stokes, Bart., in the chair; after the election of several new members and associates, Major C. R. Conder, R.E., D.C.L., read a paper on "The Comparison of Asiatic Languages," in which he dealt with the ultimate relationship of the great divisions of Asiatic speech, forming the separate families called Aryan, Semitic, and Mongolic, and the affinities of the oldest monumental languages in the Akkadian and the Egyptian. After describing the accepted principles of internal comparison of languages in each group, Major Conder urged that the roots, to which philologists have referred all words in each family, run — in a large number of cases — through all these families, probably indicating a common source of language. He proceeded to draw results as to the primitive condition, and original home, of the Asiatics, and pointed out that Egyptian was grammatically to be classed with Semitic languages, and Akkadian with Mongolic speech. A comparative list of some 4,000 ancient words, from the languages in question, accompanied the paper, which was listened to throughout by a large and appreciative audience. The discussion was commenced by Professor Legge of Oxford University, who, referring to the work of his life as a student of Chinese for upwards of half a century, urged the value of such work as that done by Major Conder. In all his comparisons, he was possibly not prepared to agree, but that did not prevent him from recognizing the great value of what he had done, and the evidence afforded by such researches as to the primitive unity of the human race. Prof. Legge's remarks were followed by those of Mr. T. G. Pincher, the Akkadian scholar, Professor Koelle, Dr. Kenneth Macdonald, Professor Postgate, Principal R. Collins, and others. Captain F. Petrie, the honorary secretary, during the evening read an important communication from one of the members exploring in Egypt, in which some newly-discovered sculptures were described, these threw quite a new light on the mode of transporting immense masses of stone by water, which was in use among the Egyptians in the days of the Pharaohs.

— Professor S. S. Laurie's work on "John Amos Comenius" has been republished in this country by C. W. Bardeen of Syracuse, with a preface and a bibliographical appendix. Professor Laurie begins with a brief study of the Renascence and the Reformation in their relation to education, and then proceeds to an account of the checkered and roving life of the great Moravian bishop and educator. Then, taking up the leading works of Comenius, he endeavors to show what were the real contributions made by him to educational theory and practice. His principal merit, as Professor Laurie justly says, was in the method of teaching which he advocated, a method greatly in advance of that practised in his own time and similar in many respects to that followed by the best teachers of to-day. What the method was may be learned in detail from this book, where it is set forth at considerable length. He held that we ought to copy the methods of nature, and his works are filled with fanciful analogies between her operations and the labors and processes of the teacher. His own text-books, however, especially those for the study of languages, are often as unfit for their purpose as they could well be, and his whole method is of too formal a character, and is vitiated, as Professor Laurie remarks, by the belief that a man can be manufactured. Moreover, his idea of knowledge was too utilitarian, and he had no appreciation of philosophy or of art and the esthetic side of literature and life. Nevertheless, his method was a great improvement on that of his contemporaries, and his advocacy of milder discipline was equally commendable. He also advocated the Baconian study of nature; and in these days, when natural science and utilitarian studies have become prominent, and so much stress is laid upon right methods of teaching, it is not strange that his life and work have become objects of interest. Few persons, however, will care to study his own writings, and hence this book, which gives so full an account of them, will serve a useful purpose.