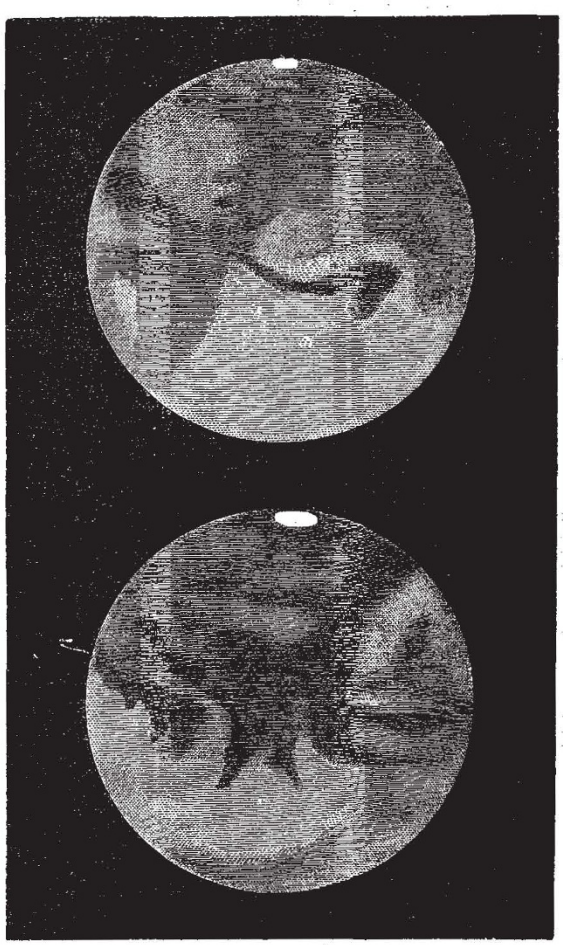
## *MARS*

THE characteristic appearance of this planetary body, long familiar to astronomers, has of late become generally known. Remarkable neither for situation, magnitude, brilliancy, retinue or complexity of arrangement, inferior in each of these respects to some, and in many of them to several of the members of the solar family, one circumstance alone invests it with a peculiar interest—its resemblance to ourselves. Such a resemblance obviously does not exist in the mightier and more nobly attended external planets : the banded skies of two and the strong atmospheric absorption of the two others revealed by the spectroscope, sufficiently show that they belong to classes



MARS IN 1862

mutually indeed dissimilar, but each differing, and perhaps widely, from our own. With the swift and fiery Mercury we can have as little sympathy ; and though Venus would offer a more promising analogy, the configuration of her beautiful surface is not well seen or readily interpreted. Mars therefore remains ; and while, fortunately for astronomers, he occupies such a position that his features are fairly accessible, they bear an aspect so comparatively intelligible that, whatever may be the case as to our other fellow-subjects in the solar monarchy, we are ready to claim that globe as a close relation of our own, inferior indeed in magnitude and importance, if importance is indicated by an attendant, but arranged in a corresponding manner by the Great Creator as the seat of life and intelligence.

Such a supposition has been gradually and surely advancing from an early period of telescopic astronomy. The polar whiteness detected by Huygens and Cassini I. as far back as 1672 would naturally suggest the idea of a snowy deposit, which assumed almost the form of certainty, when the elder Herschel showed that its extent was regulated by the Martial seasons, and that it wasted steadily down with the advance of vernal heat. From the obvious division of the surface into brighter and darker portions, the existence of an atmosphere at least would be inferred, so long as they were supposed to be variable ; but as the evidence of their general permanence increased under the eye of Herschel I. about a century ago, this impression gave place to the more definite recognition of something corresponding to the outlines of lands and oceans, with occasional variation from atmospheric condensations ; and thus by degrees we have been led to acknowledge, in that remote and otherwise unimportant globe, a most interesting counterpart of our own.

This conclusion has not, however, been attained by an uninterruptedly continuous or an uniformly satisfactory process of deduction ; and even at the present time it is perhaps not universally received. Schröter referred the darker portions to atmospheric obscuration, a notion which pervaded others of his investigations, not to their advantage ; and a more recent observer of considerable ability, the late Prof. Kaiser, of Leiden, whose decease in his 64th year took place July 28, 1872, has, in a very elaborate and interesting report of the work done on the planet at that observatory, expressed his doubts as to the certainty of the more customary inference. Whatever may be our own impressions on the subject, his criticisms and conclusions exhibit so much of the genuine spirit of an impartial student that some notice of them, as they are found in vol. iii. of the Annals of the Leiden Observatory, may be worth the attention of our readers. This observatory, it should be noted, is provided with a Merz achromatic of 7 (French ?) inches aperture, and was therefore, under Kaiser's superintendence, fairly competent for physical researches commensurate with the present demands of science ; as it is well known, and indeed especially brought out by the observations we are about to notice, that much larger telescopes are not invariably, or even generally, available in proportion to their magnitude. The addition, in 1872—too late therefore for a share in the professor's observations—of an 8½ inch With-Browning reflector, will hereafter not only afford an interesting comparison of instruments, but if the result corresponds with others obtained elsewhere, will be found a step in advance as regards efficiency.*

In selecting Mars as the subject of special inquiry, Prof. Kaiser laid a solid foundation by consulting every work within his reach, representing or describing the physical aspect of the planet, from the earliest and rudest efforts in 1636 to the elaborate delineations of the present day. No less than 412 drawings thus passed through his hands : upwards of 320 others he could not procure ; and the aggregate is doubtless much in defect of the existing total. He did however well in securing so many ; more, probably, than any other areographer, if such a word may be allowed. But the result of their comparison and discussion was not as satisfactory as might be wished. The first specimens of representation were of course mere rude attempts. Those of Huygens, however, in 1659, discovered by Kaiser in his "day-book" (of which the most valuable portion was edited by him in 1847) are comparatively well drawn ; and Hook, in 1666, caught the true character of what he saw, though Kaiser doubts whether his spots could be as readily identified as has been supposed. We next find Herschel I. taking up the subject

* A curious error on the part of Prof. Kaiser may here be noticed. He has referred (p. 23) to a drawing of Mars by Browning as having been taken with a silvered mirror by Barnes. This gentleman was merely the proprietor of the speculum, which, like the others mounted by that optician, was th work of a most accomplished artist, Mr. With, of Hereford.

in 1777, and continuing his observations till 1783. He first noticed the eccentric position of the two white spots in the polar regions, as well as their diminution from solar action; 5 out of his 31 figures show a broad white band passing obliquely across the disc, and he speaks of changes in the markings from passing clouds and vapours: some of his dark spots can be identified with more recent representations, but not the whole. Of the numerous drawings (217) of Schröter, Kaiser was unable to avail himself, as the Areographische Fragmente, rescued from the disastrous fire at Lillenthal in 1813, were left unpublished at his death. These, however, through the intervention of Dr. Peters of Altona, have subsequently been traced to their safe custody in the hands of Schröter's descendants, and have recently been thoroughly examined by Dr. Terby of Louvain, whose report has been published by the Belgian Académie Royale des Sciences. From the figures contained in this, and another interesting essay by the same astronomer, it appears that many coincidences may be traced between the views of Schröter and other observers, though his preconceived idea of the vaporous nature of the darker features deprived his observations of some of the value otherwise due to them as the results of eminent zeal and perseverance.

Passing by several observers of minor note, of whom Kaiser has given a minute enumeration, we reach the opposition of 1830, which the near concurrence of the aphelion of the Earth and the perihelion of Mars rendered eminently favourable, enlarging the apparent diameter of the latter to 23″·1. The close and systematic investigation then entered upon by Beer and Mädler forms a most important epoch in the progress of areography, and for the first time a series of drawings were executed, little resembling anything previously known, which have ever since been referred to with confidence as a starting point for future inquiries, and which, it might have been hoped, would have set many questions at rest: and so they did; but as Kaiser remarks, later representations have again unsettled points which had been supposed to have been then decided. The comparative failure of the same observers in subsequent oppositions admitted of explanation from the increased distance and altered presentations of the planet; and little advance was made by Mädler in 1841, even with the renowned refractor at Dorpat, to the care of which he had succeeded: the apparent diameter, then, however, was only 15″·1, its minimum, attained in 1837, being 13″·3. Of the near approach in 1845, when the disc was enlarged to 23″·5, no observations seem to have fallen into Kaiser's hands, excepting those of the American astronomer Mitchell. Confining ourselves still to the more important representations, at the expense of doing scanty justice to the Professor's elaborate memoirs, we find that 1854 produced the beautiful designs of Jacob, and 1856 the still more delicate ones of De La Rue, both great advances on anything previously published. In 1858, Secchi, who had been for some years at work at Rome, brought out a series of drawings in much harmony with themselves, but only partial agreement with previous delineations. At length came the favourable opposition of 1862, when the point was taken up by many of the first observers armed with some of the most powerful telescopes in existence; but the result, we regret to add, was very different from what might have been anticipated. Secchi, with his magnificent achromatic, Lassell and Rosse with their colossal reflectors, produced such an unsatisfactory and in part contradictory set of drawings as had never been published before. The weather was not always in fault; and though Mars was rather low, Lassell repeatedly found very sharp definition; Lord Rosse's excellent draughtsman once used a power of 1,200; and the quality of Secchi's instrument and sky compensated to a great extent for his smaller aperture; but then the expected clearing up of difficulties terminated in the annoyance of disappointment. Kaiser assures us that nowhere are there such discrepancies as between Rosse and Lassell, even when the same hemisphere was obviously in sight; it could hardly be imagined that they had the same spot in view: and Secchi is so far from setting the matter straight, that his figures scarcely seem to refer to the same body; and for any purpose of accurate deduction the Leiden Professor felt obliged to put all three aside, He is even induced to say, "the largest telescopes give the worst results, and show themselves very liable to mislead the observer: correct delineations of the celestial bodies require before all things a very practical designer that gives way to no fancies; and such a designer is not apt to possess the most powerful telescopes of the earth." We are here merely reproducing the censor's words, without venturing an opinion as to the soundness of his criticism.

But, fortunately as it would seem for areography, instruments of more moderate dimensions were employed to better purpose during that and the subsequent opposition of 1864; and the agreement of the beautiful designs of Lockyer in the former year with those taken by Kaiser himself, then and in 1864, as well as with those of Schmidt and Phillips, was far more satisfactory: and the same might be said to a considerable extent as to Dawes, whose instrument, however, was of a superior rank.* The difference between Lockyer and Lassell, in one instance, was so wide, that identity of date alone proves that they had the same hemisphere under their eyes; while, on the contrary, the concurrence between Lockyer and Kaiser, though the latter speaks with great diffidence of his own designs, justified him in believing that a pretty correct representation had been attained of a broad girdle round the equator.

The labour which the Leiden professor has bestowed upon a comparison of all the least discordant drawings, and the punctilious accuracy of his protracted discussions, would be little appreciated from so brief a sketch of them as can be attempted here. He was himself so little pleased with the result as to express an opinion that the only safe inference from the oppositions of 1862 and 1864 is, that the art of drawing celestial objects is at much too low a pitch to justify accurate deductions as to their physical character. And this, though it looks like the language of disappointment, and is hardly reconcileable with the striking agreement which he often remarks between the drawings of different observers, or the same observer at different times, seems to have been his deliberate impression. He ascribes the variations in part to the differences of presentation and perspective, in part to faulty delineation; and while he admits that atmospheric condensations may have occasioned small apparent changes, he thinks on the whole that they are evidences of the unsteadiness of our air, leaving almost always an uncertainty as to the minuter spots and shadings, and a want of confidence in the correctness of one's own delineation. The discrepancies among his 412 designs are so "enormous" that no one would believe that they were intended for the same body. These differences arose, however, in part from natural causes. Even in the most favourable case, the spots are only seen with any distinctness or in their true form in the centre of the disc; those lying near the limb being greatly foreshortened and not recognisable in their real shape; and this difficulty is very considerably enhanced by the imperfect transparency of the planet's atmosphere and its frequently strongly illuminated precipitations. The inclination of the axis may vary its position at different times about 60° as regards the spectator, and consequently different oppositions bring before him entirely different features in that central position where alone they can be well observed or drawn.

* It is much to be regretted that only a part of the drawings of this great observer have as yet been published in *fac-simile*. Those given in the Monthly Notices (XXV., 225) omit, as Kaiser remarks, some of the most curious presentations of the globe; and the reproduction of others by Proctor does not profess minute accuracy.

And to these sources of difficulty it might, we think, have been added that, in consequence probably of our study of geography from projections of the globe in which the effect of perspective is designedly counteracted as much as possible, we are apt to have a very defective idea of the amount of apparent distortion which it occasions towards the edges of the visible hemisphere. But even when all this has been allowed for, we find, the professor tells us —nor indeed do we need opportunities as extensive as his to convince ourselves of it—that the differences are much too great to be altogether thus explained; and he concludes that the more conspicuous ones are errors in representation. If there is occasional agreement as to the forms, there is still much risk in referring them to the same object, until it has been ascertained by computation that the presentation of the globe towards the spectators was nearly the same. Fortunately, during any given opposition, the position of the planet's axis shifts but little, and in other oppositions the same presentation recurs from time to time; but instead of the correspondence naturally anticipated, the differences are for the most part, as he expresses it, "enormous." And yet amongst them all, coincidences come to the surface, too remarkable to admit the idea of fortuitous resemblance; and we must suppose that many who have taken pencil in hand have not been sufficiently careful as to form and shading, but have followed arbitrary and perhaps very mistaken impressions, from which nothing but absurd and absolutely contradictory inferences of a physical nature could be drawn. T. W. WEBB

(*To be continued.*)

## *THE ADMIRALTY CHARTS OF THE PACIFIC, ATLANTIC, AND INDIAN OCEANS* *

THESE charts have been compiled by Captains Evans and Hull, of the Hydrographic Departments of the Admiralty, from Maury's pilot charts, Fitzroy's and Fergusson's wind charts, charts issued by foreign Governments, and from the works of Dovè, Neumayer, Buchan, and documents in the Hydrographic Office of the Admiralty. They show for the four seasons the pressure, winds, and temperature over the parts of the globe covered by the sea. January, February, and March are properly grouped together into one season, these being the three coldest months as regards the oceans in the northern, and the three warmest in the southern hemisphere.

The most important piece of new work in these charts is the "isobars," or lines of equal barometrical pressure, which are given for the seasons. These isobars for the sea, taken in connection with Buchan's isobars published in 1868, may be regarded as the first approximation to a complete representation of the earth's atmosphere over both land and sea. We have minutely examined these isobars, comparing them with the large amount of new information collected during the past five years from many places situated on the coasts of the continents, or in islands scattered over the ocean, and can come to only one conclusion, viz., that the greatest care has been taken in their construction. Among the very few cases to which slight exception might be taken is the isobar of 29·7 in. of July, August, and September, drawn to southwards of Japan, which observations do not appear to warrant. It should also be pointed out that a serious omission has been made in not stating how the ship barometric observations were reduced to the mean pressures from which the isobars have been drawn.

We are now in a position to draw one or two general conclusions of great importance regarding the distribution of atmospheric pressure over the ocean. In the ocean, to westwards of each of the continents, there is at all seasons an area, or patch, of high pressure, from 0·10 inch to 0·30 inch higher than is found on the coast westward of which it lies. The distance of the centre of the space of high pressure from the coast varies from 20° to 35° of longitude, the average distance being nearly 30°. The position of the centre of the space varies from about 22° to 35° north or south latitude, or stating it roughly it lies about the zones of the tropics. In these spaces the absolute pressure is greatest during the winter months of the respective hemispheres—a condition of things probably due to the fact that during the winter season of the northern hemisphere the great mass of the earth's atmosphere is disposed about the tropic of Cancer, and during the winter season of the southern hemisphere, about the tropic of Capricorn. The position and shape of the isobars seem to be largely determined by that of the continents adjoining. Thus the rounded form of the southern portion of North America, the bending eastward of the west coast of South America from Payta to Arica, and the form of the north-western part of Africa and its "lie" from S.W. to N.E. are all more or less impressed on the isobars bounding the contiguous spaces of high pressures. These spaces are less prominently marked west of those continents which have the least breadth in lat. 30°; thus the area of high pressure is less marked west of the Cape than it is west of Australia, and still less than to the west of North America. The isobars are much farther apart on the western than on the eastern side of these areas of high pressure; indeed in many cases they are as it were drawn out so as almost to reach the continent lying to westward; and in some cases there is even a tendency towards, or the actual appearance of, secondary areas of high pressure to eastwards of continental masses. This is most distinctly seen to eastward of Australia.

We have dwelt thus particularly on these spaces of high pressures because of their importance in atmospheric physics, but more especially because of their vital connection with prevailing winds and the general circulation of the atmosphere. Out of these high pressures, the wind blows in all directions anti-cyclonically in accordance with the well-known "Buys Ballot's Law of the Winds," of which relation the wind charts before us afford abundant confirmation. Keeping this relation between wind and pressure in view, we have presented in these high pressures the proximate causes of the prevailing winds over the greater portion of the ocean; and through the prevailing winds, the drift currents and other of the surface-currents of the sea; and thereby the anomalous distribution of the temperature of the sea as seen in the Chile, Guinea, and other currents, and the peculiar climates of the coasts past which these currents flow.

The small area of high pressure to the east of Australia may be singled out as perhaps the most interesting of the new facts in the charts. During winter the winds along the east and south of Australia blow inwards upon the interior of that continent, whereas in New Zealand the prevailing winds at the same season are north-westerly and westerly, the directions being thus generally opposite on these two coasts facing each other. The space of high pressure between gives a ready explanation of the direction of these winds, as well as of the heavier rainfall on the west of the South Island of New Zealand as compared with that of the North Island, and of the south-east as compared with the south-west of Victoria.

Like praise cannot be given to the charts of the isothermals of air for January, April, July, and October. In the October chart, the isothermal of 60° cuts the east coast of South America near lat. 27°; now at Monte Video, the mean temperature of October is 61·2°, at Buenos Ayres 61·3°, and at Bahia Blanca, in 38°·4 S. lat. 59°·7; that is, the isothermal of 60° should cut the South American coast 11° of latitude farther to the south. The January isothermal of 60° is drawn passing through New

* "Wind and Current Charts for the Pacific, Atlantic, and Indian Oceans," published at the Admiralty, October 1872, under the superintendence of Rear-Admiral G. H. Richards, C.B., F.R.S., Hydrographer.