

and of their habits, is now published in Germany; nevertheless few Englishmen will have as yet seen the account.

In the German paper he justly compares, as far as function is concerned, the winged males and females of the one form, and the wingless males and females of the second form, with those plants which produce flowers of two forms, serving different ends, of which so excellent an account has lately appeared in NATURE by his brother, Hermann Müller.

The facts, also, given by Fritz Müller with respect to the stingless bees of Brazil will surprise and interest entomologists.

CHARLES DARWIN

Feb. 11

"For some years I have been engaged in studying the natural history of our Termites, of which I have had more than a dozen living species at my disposition. The several species differ much more in their habits and in their anatomy than is generally assumed. In most species there are two sets of neuters, viz., labourers and soldiers; but in some species (*Calotermes* Hg.) the labourers, and in others (*Anoplotermes* F. M.) the soldiers, are wanting. With respect to these neuters I have come to the same conclusion as that arrived at by Mr. Bates, viz. that, differently from what we see in social Hymenoptera, they are not modified imagos (sterile females), but modified larvæ, which undergo no further metamorphosis. This accounts for the fact first observed by Lespès, that both the sexes are represented among the sterile (or so-called neuter) Termites. In some species of *Calotermes* the male soldiers may even externally be distinguished from the female ones. I have been able to confirm, in almost all our species, the fact already observed by Mr. Smeathman a century ago, but doubted by most subsequent writers, that in the company of the queen there lives always a king. The most interesting fact in the natural history of these curious insects is the existence of two forms of sexual individuals, in some (if not in all) of the species. Besides the winged males and females, which are produced in vast numbers, and which, leaving the termitary in large swarms, may intercross with those produced in other communities, there are wingless males and females, which never leave the termitary where they are born, and which replace the winged males or females, whenever a community does not find in due time a true king or queen. Once I found a king (of a species of *Eutermes*) living in company with as many as thirty-one such complemental females, as they may be called, instead of with a single legitimate queen. Termites would, no doubt, save an extraordinary amount of labour if, instead of raising annually myriads of winged males and females, almost all of which (helpless creatures as they are) perish in the time of swarming without being able to find a new home, they raised solely a few wingless males and females, which, free from danger, might remain in their native termitary; and he who does not admit the paramount importance of intercrossing, must of course wonder why this latter manner of reproduction (by wingless individuals) has not long since taken the place through natural selection of the production of winged males and females. But the wingless individuals would of course have to pair always with their near relatives, whilst by the swarming of the winged Termites a chance is given to them for the intercrossing of individuals not nearly related. I sent to Germany, about a year ago, a paper on this subject, but do not know whether it has yet been published.

"From Termites I have lately turned my attention to a still more interesting group of social insects, viz., our stingless honey-bees (*Melipona* and *Trigona*). Though a high authority in this matter, Mr. Frederick Smith, has lately affirmed, that "we have now acquired almost a complete history of their economy," I still believe, that almost all remains to be done in this respect. I think that even their affinities are not yet well established, and

that they are by no means intermediate between hive- and humble-bees, nor so nearly allied to them, as is now generally admitted. Wasps and hive-bees have no doubt independently acquired their social habits, as well as the habit of constructing combs of hexagonal cells, and so, I think, has *Melipona*. The genera *Apis* and *Melipona* may even have separated from a common progenitor, before wax was used in the construction of the cells; for in hive-bees, as is well known, wax is secreted on the ventral side: in *Melipona* on the contrary, as I have seen, on the dorsal side of the abdomen; now it is not probable, that the secretion of wax, when once established, should have migrated from the ventral to the dorsal side, or *vice versa*.

"The queen of the hive-bee fixes her eggs on the bottom of the empty cells; the larvæ are fed by the labourers at first with semi-digested food, and afterwards with a mixture of pollen and honey, and only when the larvæ are full grown, the cells are closed. The *Meliponæ* and *Trigonæ*, on the contrary, fill the cells with semi-digested food before the eggs are laid, and they shut the cells immediately after the queen has dropped an egg on the food. With hive-bees the royal cells, in which the future queens have to be raised, differ in their direction from the other cells; this is not the case with *Melipona* and *Trigona*, where all the cells are vertical, with their orifices turned upward, forming horizontal (or rarely spirally ascending) combs. You know that honey is stored by our stingless bees in large, oval, irregularly clustered cells; and thus there are many more or less important differences in the structure, as well as in the economy, of *Apis* and *Melipona*.

"My brother, who is now examining carefully the external structure of our species, is surprised at the amount of variability, which the several species show in the structure of their hind legs, of their wings, &c., and not less are the differences they exhibit in their habits.

"I have hitherto observed here 14 species of *Melipona* and *Trigona*, the smallest of them scarcely exceeding 2 millimetres in length, the largest being about the size of the hive-bee. One of these species lives as a parasite within the nests of some other species. I have now, in my garden, hives of 4 of our species, in which I have observed the construction of the combs, the laying of the eggs, &c., and I hope I shall soon be able to obtain hives of some more species. Some of our species are so elegant and beautiful and so extremely interesting, that they would be a most precious acquisition for zoological gardens or large hot-houses; nor do I think that it would be very difficult to bring them to Europe and there to preserve them in a living state.

"If it be of some interest to you I shall be glad to give you from time to time an account of what I may observe in my *Melipona* apiary.

"Believe me, dear Sir, &c.,
"FRITZ MÜLLER"

M A R S *

IN the previous article were mentioned some of Professor Kaiser's conclusions. We are induced to add a few further remarks, from their general applicability. The delineation of the heavenly bodies, he says, is always a very difficult task, especially when, as in the case of Mars, we have to deal with features more or less indistinct, delicately and gradually shaded. With the most powerful telescopes the disc is but small; and on it we find a mass of ill-defined and frequently very feeble spots, which require close attention for their disentanglement, and it is hard to obtain a clear conviction as to the outlines and shadings that have to be drawn. The difficulty is much increased by the incen-

* Continued from p. 289.

sant undulations of the air; and in the seldom-recurring moments of stillness so much under good circumstances is visible, that even the best artist cannot draw it all in half an hour, a period during which usually there are but a very few tranquil glimpses, and after which the planet will have materially changed its aspect from rotation. Even were it easier to distinguish what is actually visible, it requires great practice to represent it faithfully; and whoever has had personal experience of the difficulties of such designs will have but a limited confidence in the various portraits or the supposed changes that they represent. As a further illustration of these difficulties he refers to the representations of the Orion nebula by Rosse, Lassell, Secchi, and Liapounov (he could have added Herschel II.); or the portraits given by Bond, and others, of Donati's Comet. He might have cited, had he known of it, Prof. Young's remark as to the solar corona (where, however, these difficulties are heightened by the excitement of the moment), that "the drawings made by persons standing side by side differ to an extent that is sometimes really ludicrous, and has induced more than one astronomer who had not himself seen an eclipse, but judged only from the written accounts and sketches, to declare his belief that this whole outer corona is a mere subjective phenomenon."

The justice of Kaiser's remarks will readily make itself felt, but they do not exhaust the subject; something may perhaps be added as to the "personal equation" of vision. Independently of mechanical defects in the eye, there are inaccuracies of perception; and even if the rays have kept an uninterrupted and undeviating course to the retina, they do not always produce corresponding impressions on the mind. Whatever may be the cause, we frequently meet with defects in the sense of form, or proportion, or inclination, or even the presence of features which are not the immediate objects of attention. Comparisons of size are often very erroneous; craftsmen well know the meaning of "a true eye;" and the expression "I did not see it," is constantly employed with reference to a thousand objects whose representation on the retina is all the while unquestionable. It is in these respects that celestial photography is invaluable as recording everything and putting everything in its proper place; but photography, as Kaiser observes, is inapplicable to the light of Mars. Another point, too, might have admitted of notice. Although we may certainly, with him, be baffled in reconciling Rosse and Lassell, we may bear in mind, as regards the comparison of larger and smaller instruments, Dawes's important remark to the effect that a certain relative proportion of light and power may be essential to the visibility of some classes of difficult objects.

Without subscribing implicitly to the whole of Kaiser's views, some of which admit of doubt—as, for instance, when we contrast his assertion that the spots are never sharply defined, with the clearness and keenness of outline occasionally recorded by Lockyer and others—we may well admit their general accuracy. But we find it more difficult to accompany him in his inferences as to the planet's physical constitution.

The earth-light upon the moon having been found by Schröter more conspicuous when it proceeded from the hemisphere of our globe containing the largest amount of land, Kaiser implies that it has hence been inferred that (as it is difficult for us not to imagine other planets constituted like our own), the brighter and darker portions of Mars are equivalent to land and water. Whether such an opinion may have been arrived at in this circuitous way or not, it seems highly probable without any reference to lunar appearances. The eminently absorptive power of water is well known; even a thickness of seven feet will, it is said, diminish the incident light by one-half; and below 700 feet it is quenched in unbroken darkness; and the quantity of diffused light reflected from its surface

would be inconsiderable, while the solar image at the distance of the Earth would be too minute, in all probability, to be visible. This reasoning would seem fairly to hold its ground against that of the Leiden astronomer, who does not believe that seas so looked upon would show such innumerable gradations in tone, or be so invariably ill-defined at their edges, while the same telescope gives perfect sharpness to the polar snows. He goes in fact so far as to say that if we may form any conclusion from their aspect, it is, that they cannot resemble seas such as our own. But as to distinctness of boundary, his experience is not accordant with that of other excellent observers, especially Lockyer, who remarks that "the effect of a cloudless and perfectly pure sky both here and on Mars appears to be, that the dark portions of the planet become darkest and most distinctly visible; the coast-lines (if I may so call them) being at such times so hard and sharp that (as has been mentioned by Mr. Lassell) it is quite impossible to represent the outlines faithfully." A more natural inference, it seems to the writer, would be that these fluid masses contain large areas of very slight depth, that the edges are in many places very shelving, and that possibly they may be the more transparent from the absence of salt. Other astronomers, Kaiser tells us, but without mentioning their names, have reversed the idea, and thought the bright parts to be seas, but they do not thus escape his objections on the score of definition, nor account for the dusky tracts which some of the great bright expanses contain. He has perhaps got hold of a more substantial difficulty in the aspect of the north polar region, where the white spot is often encompassed by a widely-extended dark zone with many gradations of tint. The width of this belt, very great when foreshortening is taken into account, is no doubt variable: Beer and Mädler ascribed it to the non-reflective power of the damp surface bared by the rapidly melting snow. On the whole, when Kaiser considers that nothing is established with certainty but the existence of an atmosphere and the connection of the polar spots with the seasons, we hesitate to follow him; and we should prefer the conclusion of Phillips, adopted by Lockyer, that "over a permanent basis of bright and dusky tracts, a variable envelope gathers and fluctuates, partially modifying the aspect of the fundamental features, and even in some degree disguising them under new lights and shades, which present no constancy, a thin vaporous atmosphere probably resting on a surface of land, snow, and water." A more protracted course of observation may possibly modify in some way this result, but so far as past investigations extend, we may say that nothing has been detected inconsistent with it. Could we be actually transported to that far distant surface, we should probably find much to astonish us that we cannot so much as conjecture here; it was a sound remark of Schröter's that unity in variety is the universal character of creation; and the spectroscopy of Huggins has already in this instance confirmed it by the detection of absorption-lines the cause of which is utterly unknown. Our future inquiries should be conducted in that impartial spirit which is equally ready to admit the indications of discrepancy and of resemblance, and which is more anxious to ascertain facts than to seek their premature elucidation. We have as yet read but a part of the inscription on that golden shield: some of it has probably been deciphered correctly; how much of the remainder may give way we know not; but the whole, it will never be given to us to understand.

The extensive researches in which Dr. Terby of Louvain has for some time been engaged, and in which he has shown unwearied diligence and perseverance, if embodied, as we trust they will be, in one comprehensive result, will give material assistance in disentangling and concentrating our present scattered and discordant materials, and we may look forward with hope to the very

promising opposition of 1877; when, if the seasons on both planets are as favourable as their mutual proximity, we may reasonably expect some advance to be in store for us. The great object will naturally be the identification of the dark spots, as well as a more careful delineation of their boundaries: attention will doubtless be paid towards obtaining a definitive value for the rotation; but in this direction progress is not very material, as we have already a sufficient approximation. Those who would see an extraordinary instance of the most painstaking and protracted efforts to get rid of a trifling uncertainty may apply themselves to the 23 pages of Kaiser, in which all kinds of varied combinations are tried to reconcile some conflicting decimals of a second, for to these the question is reduced at last. Cassini, as far back as 1666, had fixed the rotation at 24h. 40m. with surprising correctness for his day. Herschel I. brought it to 24h. 39m. 21.67s. but, as Beer and Mädler perceived, the omission of one rotation, and of the effects of phasis and aberration, vitiated the result. They in turn gave 24h. 37m. 23.7s. Kaiser, from many elaborate comparisons, deduced a mean of 22.62s., but Proctor having found a value of 22.735s. the former, who thought the English astronomer's coincidences illusory, went into the whole subject afresh with marvellous minuteness, and got out a final mean of 22.531s., discovering by the way some unexpected inaccuracies, convincing himself that the correctness of the best drawings has been greatly over-rated, and finally, in much mortified perplexity, leaving it to every one to choose his own combination. No computation, he says, can make us sure to the hundredth of a second; and unless observations become very much more precise, it will be several centuries before such a result will be obtained: how much the wiser mankind would be for it, is another question, which we need not discuss here. But there is, perhaps, no great difficulty in divining the cause of the Professor's troubles. Epochs of rotation could only be safely taken from drawings made with that special object, and few such probably exist; the designer usually either contenting himself with a general likeness, or being occupied about details, the study of which would of itself render him less attentive to mere position. In future, these objects might be better separated; and while the artist busies himself with the *minutiae* of the picture, the rotation-seeker should employ himself exclusively in estimating the co-ordinates of some conspicuous points—a process which admits of a mean taken between many proportional valuations.

Several other desirable matters of inquiry will readily offer themselves. Measures of ellipticity have as yet yielded only contradictory results. The inclination of the axis, last deduced by Oudemans in 1852, may be susceptible of correction; and the excentric position of one or both of the snow-spots, and the unsymmetrical position of the isothermal poles, would be matters of interesting investigation. The amount of the latter deviation, first measured by the elder Herschel, has been given so very differently by different observers, even at the same opposition, that it evidently is open to fresh determination. The well-known colours will of course catch the eye; and attention may be paid to the question whether the green, or as others think blue, tint of the dark parts (which Kaiser saw as grey only) is really, as Herschel II. implies, the mere result of contrast. The effect may be possibly thus heightened; but no one who saw one of the great seas as the writer did with a 9 in. silvered speculum on April 4, 1871, could doubt the independent existence of a beautiful clear blue-grey tint, the more certain as a shading on another part of the disc was of a brownish hue: nor does it seem to have been noticed that no effect of contrast has been traced in the polar snows. The luminous and occasionally coloured patches and segments on the limb should receive attention, and the position of "Dawes' ice-island" be scru-

tinised; such a brilliant speck I witnessed at the above epoch, but I believe in another situation. Black points should be looked for, as such have been detected by Mitchell and Dawes; and it should be noted at the time of any conspicuous feebleness of the markings, whether the sharpness of the limb indicates the cause to be further distant than our own atmosphere: and in general the "daily—nay, hourly—changes in the detail and in the tones of the different parts of the planet, both light and dark," described by Lockyer, should be carefully watched and recorded;

"In tenui labor;"

nevertheless, none of these little matters will be considered insignificant by those who love to behold in such things the footsteps of Creative and Upholding Power.

T. W. WEBB

NOTES

WE have received some interesting notes of the work done by the eminent Russian explorer, Dr. von Miclucho-Maclay, which we hope to publish next week. Contrary to the advice of everyone, this intrepid traveller and true devotee of Science is determined upon again visiting the east coast of Papua. When his researches here are complete he intends to visit some of the islands of Polynesia and certain parts of the coast of Australia. This, he calculates, will take up five or six years. The Governor of the Dutch East Indies, like a true man of Science, had given Dr. Maclay, for the last six months, roomy and comfortable quarters in his palace at Buitonrov. It would be well if all in high position would imitate this kind of "patronage."

THE Meteorological Committee of the Board of Trade have resolved to commence the issue of lithographed copies of the twenty-four hourly tabulated readings, taken at their seven observatories, for every element which is observed continuously, commencing with January 1, 1874. The sheets will be issued quarterly, and the issue will be a limited one. The subscription for a copy is 1*l.* per annum, to cover a portion of the expense of production. The sheets will not be distributed with the publications of the office.

M. L. QUETELET, the founder and director of the Brussels Observatory, died in Brussels on Monday night, aged 77. He leaves a son, M. Ernest Quételet, who inherits the scientific enthusiasm of his father.

THE letter which has been received from Consul Prideaux, and the extract from Cameron's letter published in the *Academy*, adds but little to the details we gave some time ago concerning Livingstone's reported death. Lake Bemba is identified by Consul Prideaux as Lake Bangweolo, and a letter from the Arab Governor of Unyanyemba fixes the spot where the great traveller died at Lobisa. A letter to Dr. Petermann from the German African traveller and Austrian Consul at Zanzibar, Mr. Richard Brenner, merely repeats the statements already known. Dr. Kirk, under date Feb. 12, writes to the *Academy* as follows:—"This morning I have heard indirectly from Zanzibar, and find people there who could judge, still question the truth of the story of Livingstone's death. Like us, they see nothing but native report to base it on." Let us hope that this is the real state of the case. As Zanzibar and Ujiji are at present at peace it is expected that there will be no difficulty in getting the Doctor's valuable journals. It is gratifying to see from Mr. Markham's letter in yesterday's *Times* that through Sir Samuel Baker's determined energy, the route to Zanzibar has been virtually opened up from the north.

THE letter above referred to from Consul Brenner, states that a German botanist, M. Hildebrand, has been preparing, for a year past, to undertake a journey into the interior of the Galla country and Somali Land.