SCIENCE IN THE MAGAZINES.

A FULLY illustrated description of Mr. Maxim's experiments in aerial navigation is contributed to the *Century* by Mr. Maxim himself. The account of the new flying machine and its various parts is the best we have seen. The total result of Mr. Maxim's experiments is now fairly well known. It has been proved that a machine, carrying its own engine, fuel, and passengers, can be made powerful and light enough to lift itself in the air. The experiments also prove that an aëroplane will lift a great deal more than a balloon of the same weight, and that it may be driven through the air at a very high velocity, and with an expenditure of power very much less than that required to drive a balloon at even a moderate pace. In addition to this, they have clearly shown that a well-made screw propeller obtains sufficient grip on the air to propel a machine at almost any speed, and that the greater the speed the higher the efficiency of the screw. These results have certainly forwarded the problem of aerial navigation. The *Century* also contains an article on customs, fêtes, and celebrations in American Colleges for Women; and, in the same magazine, a brief description is given of the new anti-toxin treatment of diphtheria.

In the *National*, Mr. Stanley Lane-Poole pays tribute to the memory of the late Sir Charles Newton. (A notice of some of the researches of this distinguished archæologist will be found on p. 250.) Prof. Foxwell replies, on behalf of professed economists, to Lord Farrer's article in the October number of the same review, upon the Standard of Value. Towards the end of a contribution on the present state of the Royal Navy, Mr. W. Laird Clowes expresses himself upon the subject of the education of naval officers. Referring to the training of a naval officer, he remarks: "A century ago . . . it was not necessary that he should know anything of chemistry, of engineering, of hydraulics, of pneumatics, of electricity, and of half a dozen other subjects concerning which he must now know more than a little. . . . But at present, if an officer goes to sea, he has to suspend, in a great measure, the progress of his education. Theory is at the base of nearly all of it, and the theory is just as requisite as the practical experience, and, indeed, in some matters, even more so. . . . The seaman is in process of becoming the engineer; every year he becomes more and more the engineer; and I am certain that a much briefer experience of the sea than was formerly needed is now required towards the formation of a good officer. *Per contra*, he who would be a good officer requires very many things which are more easily obtainable at Portsmouth than in mid-Atlantic. We may regret the change, but we must not shut our eyes to facts. And I think the sooner the change is fully recognised, and the whole scheme of the education of naval officers is radically altered, the better will it be for the service." Mr. Clowes, however, does not seem to have sufficiently taken into account the difference between the duties of the navigating officers of the navy, and the engineers. Naval engineers at the present time receive admirable training in both the theory and the practice of the machinery with which a modern battleship is equipped. Does Mr. Clowes hold that navigating officers should receive the same kind of training? The statement that the seaman is in process of becoming the engineer, will hardly be accepted literally by those acquainted with the naval service. The engineers and engine-room artificers are fast becoming the most important men on board, but the distinction between them and the navigating staff is as hard and fast as ever it was.

In the *New Review* are some verses having a singularly strange and appropriate rhythm, by the late R. L. Stevenson, in which he has expressed his keen sense of the struggle for existence; and we find in the critical article upon this last among the many losses of 1894, by Mr. Archer, how profoundly modern scientific thought had affected his philosophy. There is also the first instalment of an eccentric story by Mr. H. G. Wells, in which, after certain rather paradoxical dealings with the four dimensions, a "Time Traveller" starts into futurity upon a *Time Machine*. What he found there remains to be told in a subsequent number, but there certainly seems scope for the scientific imagination in such a story.

A paper on "Feeling of Beauty in Animals," in *Chambers's Journal*, will interest students of nature. So long ago as 1866 a letter was published in the *Athenæum* under the same title, and attracted the notice of Charles Darwin. Birds offer, perhaps, the best proofs of a feeling for beauty exterior to themselves. There are the Bower Birds of Australia, and the Gardener Bower Bird of New Guinea, each of which decorates its bower with various objects. The Hammerkop or Hammerhead also nourishes æsthetic tastes, and other instances of birds showing a decided taste for ornament are described in the article referred to.

A passing notice will suffice for the remaining articles on scientific subjects in the magazines received by us. Some interesting reminiscences of the late Oliver Wendell Holmes as professor of anatomy, are given by Dr. T. Dwight in *Scribner*. *Good Words*—the first number of a new series—contains the first part of a paper on Sir Isaac Newton, by Sir Robert Ball; and some speculations by the Rev. Canon Scott on the physiographical consequences that would have resulted if the earth rotated from east to west instead of west to east. Mr. Grant Allen writes another "Moorland Idyll," in the *English Illustrated*. To the *Humanitarian*, St. George Mivart contributes the concluding part of his popular exposition of the doctrine of heredity. We are glad to note that the second number of the *Phonographic Quarterly Review* contains several scientific articles, each of which will help to familiarise phonographers with scientific phrases. The *Contemporary* has an article on the London County Council, by Mr. Sydney Webb, in which the work of the Technical Education Board is incidentally referred to. In addition to the magazines and reviews named in the foregoing, we have received the *Fortnightly*, *Longman's*, *Cornhill*, and the *Sunday Magazine*; but in none of these is science given a place.

SEASONAL CHANGES ON MARS.[1]

FOR the substantiation of changes on the surface of Mars, it is of paramount importance that the drawings to be compared should all have been made by the same person at the same telescope, under as nearly as possible the same atmospheric conditions. So much, at least, is fulfilled by the drawings referred to in this paper. For they were all made by Mr. Lowell at the same instrument, under the same general atmospheric conditions. Even the different eye-pieces used vary chiefly in a manner to minimise, if anything, and so emphasise the differences observed. For with increasing image the higher power used tends to decrease the contrast. The result is that it largely offsets the difference in contrast due to nearer approach, and leaves simply a case of magnification, with the values untouched.

Since, furthermore, the drawings were all made in the months preceding and following one opposition, secular changes are practically out of the question; and any changes that appear, are presumably of a seasonal character. They constitute of themselves a kinematical as opposed to a statical study of the planet's surface.

The resulting phenomena are much more evident than might be supposed; indeed, they are quite unmistakable. As for their importance, it need only be said that deduction from them furnishes, in the first place, strong inference that Mars is a very living world subject to an annual cycle of surface growth, activity, and decay; showing, in the second place, that this Martian yearly round of life must differ in certain interesting particulars from that which forms our terrestrial experience.

The phenomena evidently make part of a definite chain of changes of annual development. So consequent and, in their broad characteristics, apparently so regular are these changes, that it is not difficult to find corroboration of what appears to be their general scheme in drawings made at previous oppositions. In consequence it will be possible in future to foretell, to some extent, the aspect of any part of the planet at any given time.

The changes in appearance presented by the planet described by Mr. Lowell, refer primarily not to the melting of the polar snows, except as such melting forms the necessary preliminary to what follows, but to the subsequent changes in appearance of the surface itself. To their exposition, however, the polar phenomena become inseparable adjuncts, since they are inevitable auxiliaries to the result.

With the familiar melting of the polar snow-cap, therefore, this account properly begins, since with it begins the yearly round of the planet's life. With the melting of the Earth's Arctic or Antarctic cap might, similarly, be said to begin the

[1] Abstract of a paper by Mr. Percival Lowell, in *Astronomy and Astro-Physics* for December.

Earth's annual activity. But there appears to be one important difference here at the very outset between the two planets. In the case of the Earth, the relation of the melting of its polar snows to the awakening of surface activity is chiefly one of *post hoc* simply; in the case of Mars, it seems to be one of *propter hoc* as well. For unlike the Earth, which has water to spare, Mars is apparently in straits for the article, and has to draw on its polar reservoir for its annual supply. To the melting of its polar cap, and to the transference of the water thus annually set free to go its rounds, seems to depend all the phenomena upon the surface of the planet.

The observations upon which this deduction is based extend over a period of more than five months; from the last day of May, 1894, to the 7th of November. They cover the regions from the south pole to about latitude thirty degrees north. It is probable that analogous changes to those recorded, differing, however, in certain marked particulars, occur six Martian months later in the planet's northern hemisphere. For though it is likely that the general system is one for the whole planet, it is also likely that the distribution of the planet's surface details alters the action to some extent.

In order to appreciate the meaning of the changes, it should be borne in mind that the vernal equinox of Mars' southern hemisphere occurred on April 7, 1894; the summer solstice of the same hemisphere on August 31; and that its autumnal equinox will take place on February 7.

On the 31st of last May, therefore, it was toward the end of April on Mars. The south polar cap was then very large, upwards of 45° across, and already in active process of melting. The tilt of the planet's axis towards the Earth enabled it to be well seen, and disclosed the fact that it was bordered persistently by a dark band, broader in some places than in others, but keeping pace with the snow's retreat. The average breadth of the dark band was, in June, 220 miles. It was the darkest marking on the disc, and was blue.

As the season advanced and the snow cap diminished, its dark girdle diminished in breadth, with fluctuations dependent, doubtless, on the draining capacity of the ground. In August it showed as a slender dark thread.

This formation was water, beyond a doubt; for it was of the colour of water, it faithfully followed the melting of the snow, and it subsequently vanished—three independent facts mutually confirmatory to this conclusion.

That it was the darkest blue marking on the disc, implies that it was the deepest body of water on the planet. That it subsequently entirely drained off, implies that its depth could not have been very great. Both facts together make a first presumption in favour of its being not only the chief body of water on the planet, but the only one of any size.

This polar sea plays *deus ex machina* to all that follows.

So soon as the melting of the snow was well under way, long straits of deeper tint than their surroundings made their appearance in the midst of the dark areas. They were already there on the last day of May. The most conspicuous of them lay between Noachis and Hellas in the Mare Australe, and thence through the Mare Erythæum to the Hour-glass Sea (Syrtis Major). The next most conspicuous one came down between Hellas and Ansonia. Although these straits were very distinguishably darker than the rest of the seas through which they ran, the seas themselves were then at their darkest. The fact that these straits ran through the seas, suffices to raise a second doubt whether the seas be seas. The subsequent behaviour of the so-called seas renders their aquatic character still more doubtful.

At the initial stage of the Martian Nile-like inundation, the seas were at their darkest. This is probably due both to the fact that some water had already found its way down from the pole, and also to the fact that moisture had been deposited there on the water's journey up, and had quickened the vegetation of those relatively amphibious lands.

For some time the dark areas continued largely unchanged in appearance; that is, during the earlier and most extensive part of the melting of the snow-cap. After this, their history became one long chronicle of drying up. Their lighter parts grew lighter, and their darker ones less dark. For even to start with, they were composed of every grade of tint. Indeed, one of the most significant features about them was that at this epoch it was impossible to fix any definite boundaries to the south temperate chain of islands. The light areas and the dark ones merged indistinguishably into each other. Viewed from the standpoint of maps of Mars, the landmarks of this whole region lay obliterated by a deluge; not directly, but indirectly. Probably the region was in various stages of vegetal fertility in consequence of a comparatively small body of water then inundating it. The colour of the dark areas was then, and is now, to my eye, a bluish-green; quite unmistakably so. This tint gradually faded out to give place to orange-yellow.

The first marked sign of change was the reappearance of Hesperia; this took place in July. It was not till the end of October, on the 30th, that Atlantis was caught sight of. About the same time the straits between the islands, Zanthus, Scamander, Ascanias and Simois, came out saliently dark, a darkness due to contrast.

Meanwhile the history of Hesperia continued to be instructive. From having been invisible in June, and conspicuous in August, it returned in October to a mid-position between the two. Vacillating as these fluctuations may seem at first sight, they will all be found to be due to one progressive change in the same direction, a change that showed itself first in Hesperia itself, and then in the regions round about it. From June to August, Hesperia changed from a previous blue green, indistinguishable from its surroundings, to yellow, the parts adjacent remaining much as before. In consequence the peninsula stood out in marked contrast to the still deep blue-green regions by its side. Later the surroundings themselves faded, and their change had the effect of once more partially obliterating Hesperia.

While Hesperia was thus causing itself to be noticed, all the rest of the south temperate zone, as we may call it for identification's sake, was unobtrusively pursuing the same course. Whereas in June all that part of the disc comprising the two Thyle, Argyre II. and like latitudes was chiefly blue-green, by October it had become chiefly yellow. The separate identity of these islands became then for the first time apparent. Still further south, what had been first snow and then water turned to yellow land. This metamorphosis went on till, on October 13, the remains of the snow-cap entirely, or practically entirely, disappeared—the first complete disappearance of it on record. After this event the whole south polar region was one yellow stretch.

Toward the end of October a strange and, for observational purposes, distressing phenomenon took place. What remained of the more southern dark regions proceeded unexpectedly to fade in tint throughout. This was first noticeable in the Cimmerium Sea; then in the Sea of the Sirens, and in November in the Mare Erythræum about the Lake of the Sun. This fading steadily progressed until it got so far that in poor seeing the markings were almost imperceptible, and the planet presented a nearly uniform yellow disc.

Now, this fading out of the dark areas is a highly significant fact, with a direct bearing upon their constitution. For it is not simply that portions of the planet's surface have changed tint, but that, taking the disc in its entirety, the amount of the blue-green upon it has diminished, and that of the orange-yellow proportionately increased. Mars appears more Martian than he did in June. Now, if the blue-green areas represent water, where has this water gone? Nowhere on the visible disc. That is certain. For in that case the amount of the dark areas should not be perceptibly lessened—which it is. Nor can it all very well have gone to that part of the planet that is hidden from view. For Schiaparelli's observations in 1882 go to show that the northern snow-cap forms late—one month *after* the vernal equinox of the northern hemisphere on that year. Since, therefore, the water fails to prove an *alibi*, presumption is instantly raised in favour of the alternate hypothesis, that the blue-green areas represent vegetation, fertilised by a comparatively small amount of water whose direct presence or absence is not very perceptible to us, but whose indirect effects are. For vegetation might change from green to yellow without requiring any corresponding inverse change elsewhere.

Now, though the passage of the water may not be traced by its amount, there is a further change which has lately appeared on the disc which hints at what has become of it. The canals have darkened. What is more, their darkening has pursued a perfectly definite course, proceeding steadily from south to north.

The following observations show, first, that the canals are not equally visible at all times; and secondly, that their invisibility is a matter of the Martian seasons.

In June the canals were very faint markings indeed. The least faint were those in the Solis Lacus region. As the planet

approached us, they all became naturally easier to make out; but until October no change apparently occurred in any of them, except those in the region about the Lake of the Sun. These by September were already dark. In October they began to show symptoms of growing lighter again. At the next presentation, in November, they showed further signs of change, though not differing as yet very unmistakably in tint. Meanwhile, when the Sinus Titanum region came round in November, I found that its canals had begun likewise to darken. The canals were not only darker relatively to the Mare Cimmerium and the Mare Sirenum than they had been, but actually darker themselves. In the next few nights the more northern canals about Ceraunius had followed suit. They had darkened relatively to the southern ones about the Lake of the Sun.

Now, on looking at a map of Mars, it will be seen that the Solis Lacus region is that part of the continental areas which lies nearest the south pole. Similarly, that the region about Sinus Titanum is the next farthest south. The matter of latitude therefore affects the point.

The canals and so-called lakes share, therefore, in the annual metamorphosis, with a season change dependent in a general way upon their latitudes. A wave of deepening tint passes successively through the blue-green regions from south to north, timed to the seasonal wave that travels from pole to pole. From being pale in winter, their colour comes with the spring, deepens through the summer, and dies out again in the autumn. In any given locality the change comes early or late, in proportion as the place lies, other things equal, distant from the pole.

That this change of tint is due indirectly to water, and directly to the vegetation that water induces, seems probable. For just as there is great difficulty in disposing of the water on the first supposition, so the second would lead us to expect just the phenomena observed. It may therefore be concluded that the formations known as the seas of Mars are probably midway in evolution between the seas of Earth and the seas of the Moon. That is to say, they are not barren ocean beds, but are in that half-way stage of the process when their low-level helps them catch what water still voyages upon the planet's surface, though they have long since parted with their own.

Throughout all these interesting changes that follow the seasons across the face of Mars, there is but one feature approaching permanence—the great continental areas. Except for a possible variation in brightness here and there, this great area has remained unchanged. Like the reddish desert regions of our Earth, its colour and immutability point to like character for cause. It does not change because it is already past such possibility. It is one vast desert waste.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A NEW post has been created under the Education Department for the purpose of obtaining special information and issuing special reports, from time to time, in relation to educational work at home and abroad. The frequent demand for fuller information on many educational subjects, and the great increase of purely administrative work, both at the Education Department in Whitehall and at the Science and Art Department, have made it desirable to have a separate officer in charge of a small additional branch for the above-named purpose, who will be designated "Director of Special Inquiries and Reports." This appointment has been accepted by Mr. M. E. Sadler, Student of Christ Church, and Secretary of the University Extension Delegacy at Oxford.

THE Technical Education Board of the London County Council will be prepared early in July, 1895, to award not more than five Senior County Scholarships of the annual value of £60 in addition to the payment of college fees, tenable for three years, and subject to annual renewal. The scholarships are intended to provide the means of obtaining advanced technical training in a university, university college, or technical institute of university rank for students (young men or women) of exceptional ability who would otherwise find it impossible to secure such training. Candidates must, as a rule, be under nineteen years of age on September 1, 1895, but the Board is prepared to consider very special cases in which the candidates are above that age. The scholarships are offered with the view of encouraging the study of science or art, with special reference to industrial requirements, and will be tenable at such institutions giving appropriate instruction within the statutory definition of technical instruction as may be selected by the scholars and approved by the Board. In the selection of scholars the Board will have regard, in the first instance, to the past achievements of the candidates, but the Board reserves the right to require any or all of the candidates to undertake an examination if it think fit. No candidate will be eligible whose parents have an income from all sources of more than £400 per annum.

SINCE November 1893, the Technical Education Board of the London County Council have awarded 721 Junior County Scholarships, each of the value of £20 and two years' free schooling. More than three thousand candidates presented themselves in competition for the scholarships, which are restricted to children whose parents are in receipt of not more than £150 a year. A detailed analysis of the occupations of the persons whose children competed for these scholarships is given in the *London Technical Education Gazette*. It indicates that the highest percentage of candidates who received scholarships is to be found in the leather trades, and next to these in the printing trades and jewellery and fine instrument trades. After these come the artistic trades and crafts, but the most remarkable feature is the comparatively poor results obtained by the children of clerks, agents and warehousemen, and the very poor success achieved by the professional classes. The time is not far distant when the scholarships granted by the Board will amount to the value of £30,000 per annum.

SCIENTIFIC SERIALS.

The Mathematical Gazette, No. 3, December, 1894.—The eccentric circle of Boscovich. In this continuation the editor considers a special case in which the centre of the eccentric circle lies on the straight line whose points of intersection with the conic are required. He then discusses the method as one of transformation, and finally points out a connection between reversion and perspective projection.—Dr. Mackay, in Greek Geometers before Euclid, writes upon Pythagoras and the Italic school.—Cajori's "History of Mathematics" is an all too short notice, by Dr. G. B. Halsted, of a book that has come in for a fair amount of praise and blame. There are some very interesting problems, solutions of examination questions, and questions for solution.—Prof. A. Lodge supplies an addition to his previous article on approximations and reductions.—We note, with pleasure, that in future the *Gazette* is to be enlarged to twelve pages. This additional space will greatly help to increase the use of this journal, which has so quickly made its way in school circles.

Bulletin of the American Mathematical Society (2nd series, vol. i. No. 3, December, 1894).—The group of Holoedric Transformation into itself of a given group, by Prof. E. H. Moore, is a paper read before the Society at its November meeting. The remaining article is by Dr. G. A. Miller, on the non-primitive substitution-groups of degree ten. A list of these was given in the *Quarterly Journal of Mathematics*, vol. xxvii. pp. 40–42. A result of the article before us is that the following six groups should be deleted from that list, viz. 200_2, 200_7, 200_8, 100_3, 50_2, 50_3.—In the *Briefer Notices* short accounts are given of H. Hertz, "Gesammelte Werke," Band iii. This volume, the first one as yet issued, contains a memoir on the principles of theoretical mechanics and mathematical physics, which was composed during the last three years of the author's life. The next notice gives a sketch of a new edition of Grassmann's mathematical works. It is to be hoped that, as was recently suggested in NATURE by Prof. Genese, a translation into English of the *Ausdehnungslehre* may soon be made, for the convenience of many students in this country. The other notices summarise the contents of the *Jahresberichte der Deutschen Mathematiker-Vereinigung* (vol. iii. 1893), of the *Proceedings* of the American Association—for the forty-second meeting, held at Madison, Wis. (August, 1893); of "Le Livret de l'étudiant de Paris" (Paris, 1894).—The *Notes* comprise accounts of the November meetings of the American and London Mathematical Societies. By the way, the reporter, who is a member of the latter Society, gives one of the names of the Council incorrectly. There is also an ac-