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THE EVIDENCE FOR LIFE ON MARS

THE recent discussion on man's place in the universe has raised once more an old controversy. The question whether other worlds are habitable was found long ago to be in the abstract an unprofitable matter for dispute. One might admit the possible existence of beings constituted to enjoy the fierce sunshine that beats on Mercury, or the dismal cold in which Neptune moves, and at the same time deny the probability that they would have developed on lines so nearly parallel to ours that we could form any conception of their life. Even in the case of the planets Venus and Mars, that seem more suited to our own ideas of living, sound opinion is sceptical. As Sir Oliver Lodge says, in the *Commonwealth* for April: "We sometimes think that the planet Mars is inhabited. Perhaps it is; but I venture to think that on the whole it is most probable that we are at the present time the only intelligently inhabited planet in the solar system." He might have added that direct evidence of such intelligent inhabitation is still more probably for ever out of the question. Only by a glimpse of their works on a gigantic scale we might know that there are inhabitants on Mars, and at the best an argument based upon the interpretation of unnatural looking detail as artificial involves a conception of artificiality entirely our own. From admitting that a planet is habitable to proving that it is inhabited must, therefore, be a long step.

This step, however, Mr. Percival Lowell resolved to take. Determined to see for himself what could be done with the best telescopes under the best possible conditions, and grasping the all-important fact that in such an enterprise fine and steady air is the first necessity, he fitted out an observatory expedition to Flagstaff in Arizona, and delivered in Boston, before he started, a characteristic lecture, announcing that he was on the eve of pretty definite discovery in the matter of life on other worlds. Nor was Boston disappointed. Within a year, after one short season's observation, he wrote a very entertaining book, "Mars," full of drawings of what he claims as intelligent design on the part of the Martians; for they are a design whose meaning we can comprehend, of a purpose which we can assign to an intelligence not unlike our own. The Martians, he asserts, enjoy a climate not more unlike ours than ours is unlike itself in different parts of the earth; the air is thin and almost cloudless, and the country badly watered; the people must irrigate to live; and the complex system of Schiaparelli's "canali" is the evidence of their irrigation works.

It is no common testimony to the interest of the book that this confession of personal bias has not deprived his work of serious consideration. But, indeed, confessed or not, the bias is evident. He seems to select the order in which each point should appear, and finds at once "phenomena so startlingly suggestive of this very thing as to seem its uncanny presentment," when one might prefer to say, startling phenomena so canniiy suggested as to seem their very presentment. His enthusiasm at each designed coincidence is paralleled only by Paul Bertillon's exclamations over the *bordereau*: "Imagine my astonishment! The coincidence was exact."

And yet this estimate of the work is superficial. It is based upon an easy misconception of the scope of a book which one ought not to judge by the usual canons. One is accustomed to see an astronomer's results presented first as a series of dry facts; speculation as to their meaning should be

kept to a separate chapter, and then, if the speculation be proved wrong, there is no damage to the credit of the facts. This method may seem dull, but it is safe. Mr. Lowell's is neither. He is not concerned with stating the bare facts that he has discovered—and this is why he sometimes seems to mistake well-known things for new—but he is engaged in constructing an argument from them to prove what he wants to prove, that Mars is inhabited by an intelligent race. Facts and theories are so tangled that it is impossible to judge how the facts would appear by themselves, before they were woven into the web of the argument.

But this difficulty has been removed by the later publication of two splendid volumes of "Annals of the Lowell Observatory." The first contains in order the details of all the observations that were drawn upon to make the book. With the finished drawings are the pencil sketches from which they were drawn; the notes of changes first suspected, and then better seen, and at last made plain; records of the steadiness of the air, and the figures of the measurements, and the little notes of doubts removed and difficulties gradually cleared up which go far towards conviction. The trouble about this Mars observation has always been that the detail of the planet is so hard to see. Very few people believed Schiaparelli at first, because no one else could see his canals. Now, as Mr. Lowell pleasantly observes, it is the fashion to see them. And just because it is the fashion there are still some astronomers who doubt the truth of these straight, hard lines that are drawn on the map of Mars, and for their benefit Mr. Lowell has written "that they are straight is certain—a statement I make after having seen them, instead of before doing so, as is the case with the gifted objectors."

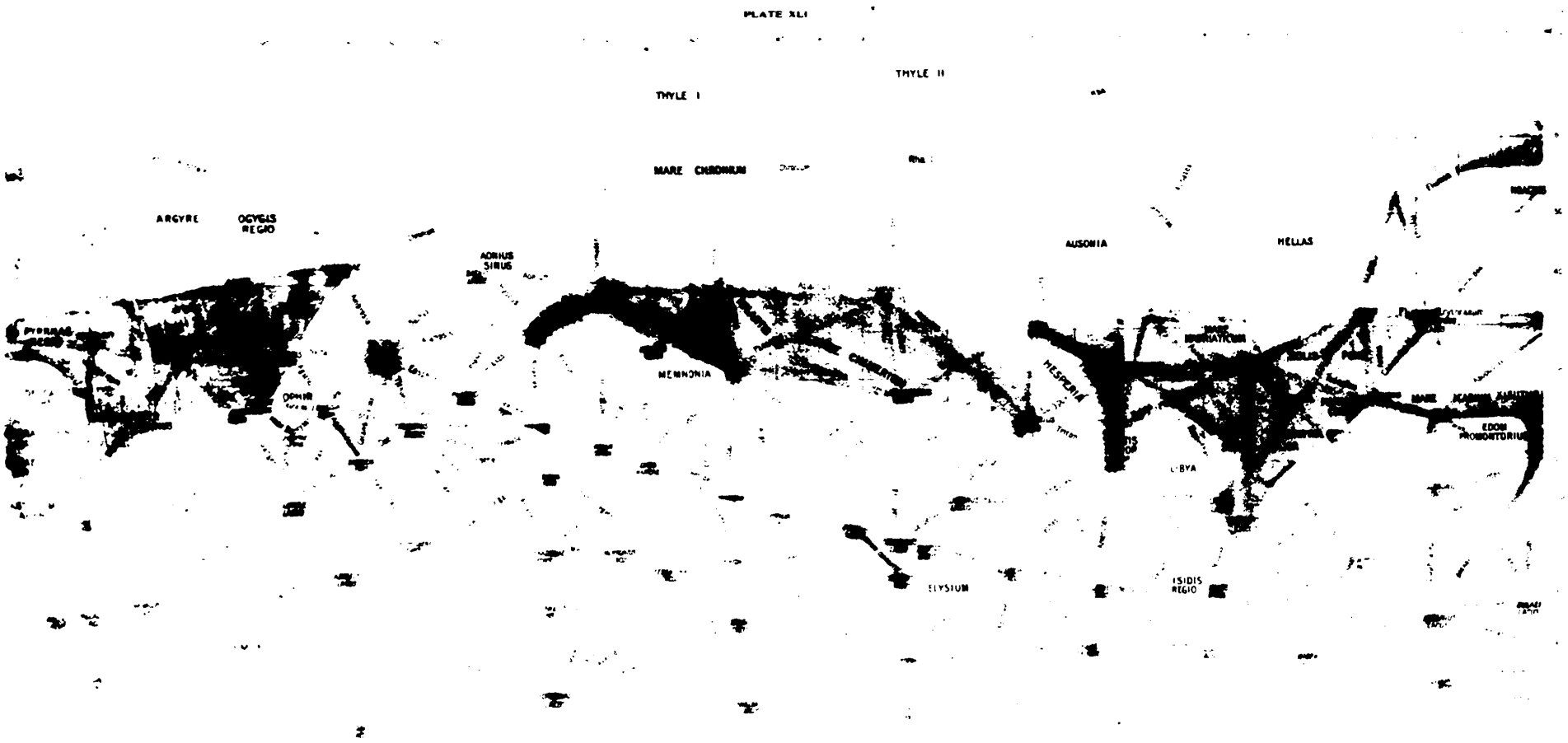
It is very hard to deny the force of this contention, that no one has a right to an opinion about the truth of the drawings but those who have worked for months in a climate as good as the Flagstaff, where they were made; and there is perhaps only one other observatory in the world under a sky so fine, the

southern station of the Harvard College Observatory at Arequipa, in Peru, which has no very powerful visual telescope—its energies are photographic. Mr. Lowell's reply to criticisms on the facts must therefore be accounted good; it is at least possible that none but himself and his assistants have been in a position to see what he has drawn. And if it is objected that there may have been a kind of a competition to see what was expected—admittedly the observers did not see the finer detail until they had learned gradually *at the telescope* what they might expect to see—the objection can scarcely be sustained. Mr. Lowell has done his best to dispose of it by leaving almost entirely to his assistant, Mr. Douglass, the preparation of the second volume of the Annals, with the results for the work of the season 1896–97. They began this campaign at Flagstaff with a bigger and much better telescope than the old one; they escaped the snowy and windy winter of Arizona by a timely removal of the whole observatory to Mexico; came back in the spring to avoid Mexico's summer storms, and finished the work in the old place. We miss in Mr. Douglass's volume the picturesque arguments and the gentle digs at critics that made the first delightful, but there is a sober array of drawings and notes that is more convincing. Mr. Lowell's earlier results are by no means always confirmed; there is room for wide revision of the conclusions about atmosphere and climate; but the maps of the hard, permanent features, the canals and the gulfs and the oases, are essentially the same. In spite of the fact that there are acute observers who have worked in favourable conditions, and who still assert that they have never seen anything remotely resembling a geometrical arrangement, we take it that there can be hardly a doubt that there is substantial truth in the representation of the surface of Mars which Schiaparelli drew, and which has been confirmed and elaborated by Lowell and Douglass.

The map gives a clearer idea than any words of the configuration of the planet's surface. Provisionally we may call the bright areas land and the dark areas seas, and we must

bear in mind that the map is on Mercator's projection, which swells the polar regions out of all proportion and makes Greenland look as big as South America. It appears that the northern hemisphere of Mars is nearly all bright, and a great part of the southern equatorial regions is dark. The bright land is covered by a network of narrow streaks which are straight: that is to say, they run on great circles of the sphere, they are the shortest distances from point to point along the surface. And they are not arranged haphazard. In a belt about north latitude 50° there is a row of places that look for all the world like railway centres, whence the main lines diverge and join them to other places further south. On the borders of the seas there are other centres to which the lines converge as to great ports; and at all the principal junctions there are dark spots and patches like big towns. Trunk lines run due north and south at roughly equal distances apart, and others run at a long slant across the planet, keeping straight on their course for a thousand or two thousand miles. We have spoken of railway centres and ports and main lines thus deliberately because a nomenclature is wanted that does not involve for the present anybody's theory of their real nature, yet expresses at the same time their very artificial look.

Schiaparelli, who drew them first, was impressed with this strangely unnatural geometrical arrangement, like a railway system or a diagram of the principal stations and connecting lines of a great geodetic triangulation; and he went so far as to admit that some people might deem them artificial. "I am very careful not to combat this theory, which includes nothing impossible," he wrote with truly scientific moderation. Mr. Lowell is not prepared to admit any other than the artificial view. They exhibit "a hopeless lack of happy irregularity," he says; "the crossings seem to be the end and aim of the whole system." And this is only a small half the truth; the greater is that the crossings lie strung four or five together on great circles, which is doubly artificial. It is not true of an earthly system of railway junctions, for the railways had to go



MAP OF MARS 1896

Map of Mars

where the towns lay. It is not true of the points of a survey, which must be selected by the configuration of the ground. Some Czar of all the Martian dominions might have taken his ruler and said, The line between my capitals shall run straight, thus, and twelve chief cities of the Empire shall be moved on to the same line, and there shall be no city that does not lie in line with five others at the least. That is the curious point of this system of Martian markings. If it is artificial, it is artificiality unlimited by natural restrictions. If we tried to interpret the "canali" as railway lines we should have to explain how it is that the lines can be driven straight without regard to the lie of the land, and how it is that the towns are arranged in such an unnatural manner.

And now to come to the explanation of this system, in which Mr. Lowell works out a suggestion made by Schiaparelli; they are irrigation canals, or rather, the tracts of vegetation on each side of the main canals. Mars, he says, is very badly off for water, "so badly off that the inhabitants of that other world would have to irrigate to live. As to the actual presence there of such folk, the broad physical features of the planet express an opinion beyond the silence of consent." Without venturing ourselves to interpret this eloquent silence in a manner so advantageous to any theory, we may even accept for the moment the notion that the canals are artificial, constructed by beings whose intelligence we can comprehend, and see how Mr. Lowell develops the working of this irrigation system, granting him the inhabitants and the drought. Although there is an apparent absence of water, and not much evidence of cloud in the atmosphere, at least over the equatorial regions, a large polar cap forms late every winter and rapidly melts. This polar cap has always been supposed to be snow, and it is made the reservoir to supply the water for the spring irrigation. The appearance round it of a belt of blue or green, which represents the water from the melting snow, is the beginning of a "wave of seasonal change," which in the hemisphere's spring sweeps down to the equator, and perhaps

beyond it. At the end of the winter the canals are invisible; with the melting of the snow they appear progressively, and by the time the equatorial regions have been watered, the polar sea is dried up. The actual water in the canals is, of course, not seen; it is the burst of vegetation as the water is led over the land that makes them visible.

Having granted the drought and the need of irrigation, we may admit that the melting of a polar snow-cap, which forms quickly and must be thin, can supply water enough to irrigate many hundred thousand square miles of country; we may grant everything that is demanded for the scheme to make it work, and yet find difficulties. A great deal has been made of the statement that the effects of the north polar flood extend beyond the equator to the south, and *vice versâ*. If it is true, the canals would have to be constructed so that water would run both ways in them, which is a serious difficulty, even in a land where gravitation is so much less effective than it is with us. And it is awkward that there are canals in the seas. The dark areas to the south of the equator, the so-called seas, grow lighter in patches towards the end of the summer, and then it is seen that the dark canals which thread the land are continued uninterruptedly across the seas. The seas, it is true, are probably not open water but well-watered vegetation; but that makes it the more unlikely that the Martians should be at such pains to irrigate them when water is so scarce elsewhere; that in the very regions where, if anywhere on the planet, vegetation can flourish naturally, they should spend water in keeping green long strips a hundred miles across at a season when things do not require to be kept green, but left to ripen. These canals persisting in their straight lines through the dark areas were most of them seen for the first time by one of the observers at Flagstaff. They are a new feature, and it is unfortunate that they should be so disposed to hoist with a home-made petard Mr. Lowell's great scheme of Martian engineering.

But it would be wasting words to insist further on a local

Map of Mars on Mercator's Projection

difficulty when there is much in the whole irrigation theory that is hard to understand. In Mars' northern hemisphere there are about five million square miles to be supplied with water from the pole. How would an engineer proceed? We must admit many things in his favour which he would not find on earth. The country must be dead level, or the canals could not be driven straight. It must be uniformly fertile, or the strips of vegetation along their banks would not be uniformly straight, as they are. It would seem simplest to run a set of radiating canals down the lines of longitude; and this is conspicuously not the main feature of the plan. The longest canal of all runs at a small angle to the equator half way round the globe. It is inconceivable why such a canal should be dug to bring water from the poles. And the argument applies with scarcely less force to half the system. They are transverse, cutting across the main feeders, joining points hundreds of miles apart which must be very nearly at the same level.

Again, what explanation are we to find of the circular spots at all the more important junctions? Mr. Lowell has termed them "oases," with the suggestion of increased fertility at the meeting of many canals. He has even said that a circular spot is what we might expect; the greatest area could thus be irrigated from a given centre with the least labour. But this argument would be correct only if the canals were employed to bring water to certain centres without distributing any *en route;* whereas the very visibility of the canals is explicable only on the supposition that they water fifty miles of country on each side. Nor is the difficulty lessened when we remember that many of the biggest "oasis" junctions lie on the edges of the dark areas, which if they are not seas are at least well watered; they are the ports of our railway simile.

There is something more, then, in this scheme of canals than a means of irrigating a maximum of country with a minimum of labour. The cross canals would be intelligible if the water supply were more abundant in some longitudes than

in others, owing to differences of level; but this is negatived by the straightness of the canals. They would be explicable if some regions were more fertile than others; but the uniform width of the canal belts of vegetation argues a uniform fertility. It is no help to understanding them to suppose that the oases represent centres of population, for again we are met by the difficulty that they are disposed eight or ten in a line. There is something underlying this arrangement which is neither natural nor intelligent, so far as our experience of nature or our measure of intelligence goes. With everything granted in its favour—dead level, widespread fertility, ample water supply at the poles, people of Herculean power and singleness of purpose—we cannot conceive how the scheme would work. Are we justified in assuming that this is only because we are not intelligent enough? We are not willing to commit this intellectual suicide. We may admit that these researches into the topography of our near celestial neighbour have led us to the threshold of a better acquaintance with that world, without allowing the propriety of offering the Celestial insult of performing a happy despatch on the doorstep. To have made the best map of another world is a notable feat. To say that it represents a scheme of intelligent design, and a particular scheme, irrigation, which may not appear workable, but must be so because nothing else has been suggested, is neither good science nor good sense.

The manner in which Mr. Lowell's enterprise has been presented to the world is so curiously unnatural as to suggest artificiality in itself. His verdict was anticipated in the lecture which he gave before he looked through his telescope; he summed up the case from his point of view in the book "Mars"; then he published a volume of evidence, the first of the Annals. And when it came it proved to be but the evidence for the grand jury. A true bill was clearly returnable; and the real trial commenced in the second season's campaign of the new observatory, with the bigger telescope and the higher training of the observers who had by that time grown

old to the work. It is interesting, therefore, to compare the second volume with the first, to see how far early views are confirmed by prolonged gazing, and how far it is likely that if Mr. Lowell were to rewrite his book now he would be able to maintain some of his conclusions in the light of greater experience. Fortunately for our purpose the inquiry need be neither minute nor long; there is a crucial point on which the evidence is brief and clear.

The whole basis of the irrigation scheme is obviously the assumed sufficiency of water from the melted polar snow-cap. Schiaparelli has described the dark belt that surrounds the northern cap as it is disappearing, and suggests that it is a flood caused by the melting snow. Mr. Lowell extended these observations to the south. At the very beginning of his first season's work the southern cap was in active process of dissolution. Around it was the "polar sea"—blue, and therefore water, though we find afterwards that the dark areas farther south are blue—and vegetation. The sea quickly disappeared, and progressively the canals came out dark. It is easy to find the suggestion of the irrigation theory here, and to understand how each item of the seasonal changes that followed may well seem confirmation—until one begins to ask how it all works. And yet it is probable that if the observations had been commenced a few months earlier the scheme would never have suggested itself at all. This idea is to be found in Mr. Douglass's discussion of the second season's work. It has always been supposed that the polar cap is snow, in spite of the fact that it has more than once been observed that it did not form until after the vernal equinox, and began to melt at once. This late appearance hardly bears out the notion that the snow can be of any thickness, and it would take a deal of melting to provide water for a whole hemisphere. And now it seems that the greater part of the cap may not be snow at all, but cloud. Mr. Douglass sums up the changes which he observed in the north polar cap of 1896–97 thus: In Martian January the cap was "undoubtedly cloud, perhaps accompanied

by vegetation," for a dark green border was sometimes seen. In February "it was composed of a wide non-continuous cloud zone, and an occasional glint of real snow," and in some longitudes it had a grey or black border. In March it was considered a real snow-cap, large and invariable, "and undoubtedly by the moisture of its melting it supported a dense vegetation on its border and in its lower areas." In April it acted like real snow and grew steadily smaller in extent. By June 1st it was reduced to a very small snow-spot near the pole, surrounded by a considerable cloud-zone.

These observations are by far the most interesting result of the Lowell's Observatory's second season's work on Mars, and it will be readily seen how entirely they have altered the complexion of affairs. The part played by snow in the north polar cap seems to be relatively small; it is mainly cloud. Before the snow falls there are evidences of vegetation or water, and as the snow apparently covers the ground yet melts quickly, the former is more probable. Until the vernal equinox there is little snow at all, and what there is is already melting to support vegetation. The evidence for a northern polar sea has almost disappeared. What Schiaparelli took for it Mr. Douglass now thinks may be vegetation, for it was there before the snow came. The corresponding early phases of the southern cap were missed in the first season at Flagstaff, and it seems fair to suppose that could that work have begun a little earlier we should never have had there the suggestion of a polar sea at all. But this is fatal to the irrigation theory altogether. There were always grave difficulties about the adequacy of the water-supply. They were put aside for the time when it was a question of seeing whether the irrigation scheme would work with unlimited water. Now that the later evidence fails to show the existence of any considerable body of water at any time, we need have no hesitation in passing upon the case for which Mr. Lowell is advocate a verdict of not proven. We are tempted to add a rider to the effect that it is much to be regretted that the book "Mars" was written upon evidence

which was so incomplete. It is a dangerous thing to appear to lend countenance to the idea that astronomical results are arrived at in so light-hearted a spirit. It leads people like Mr. Nikola Tesla to stir a watch-night meeting with a message by wireless telegraph from another world, "One! two! three!"

There remains the difficult question, How far is it possible to draw any conclusions at all from the apparent artificiality of the markings upon Mars, in the absence of an intelligible explanation of what the artificiality may mean? So long as their purpose cannot be explained, we ought not to deny that they may be natural, even though nothing like them had ever been observed in nature. The essence of Mr. Lowell's argument is that nature is haphazard; a geometrical construction on a grand scale must be due to man's intelligence, because upon earth natural geometry is found only in small things, in the forms of crystals and the patterns on the scales of insects. But we need go no further than the moon to find an example of natural geometry on a scale as large as that of Mars. Any one who has looked through the smallest telescope is familiar with the bright streaks that radiate from Tycho and some other of the grander craters. They have precisely the more remarkable characteristics of Martian canals, radiating six or eight from a point, straight like the spokes of a wheel, regardless of the inequalities of the ground. There is no explanation of them, though we can examine the moon at close quarters. It is rash beyond legitimate scientific boldness to deny *in toto* a natural explanation for geometrical markings not unlike these, on a world more than a hundred times as far away. We dare not assume in our dilemma that human knowledge covers the whole range of nature's operations.

The special question, how we are to recognise life on another world, is small compared with the general, what we are to recognise as life. But it is of more immediate interest to our limited powers of conception, because in asking it one tacitly assumes that the life is to be such as ours, recognisable

by works which we can conceive ourselves constructing if we were placed in a similar position. And if evidence of what we may call human design is to be found anywhere outside our earth we should look for it first upon Mars. The things that have been discovered in the last few years may even give rise to the hope that we are at last on the right track through the tangle, but it is a pity for people to shout as if they were already out of the wood.

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