

in summer; one fairly longs and yearns for the blooming time to hasten, once it seems about to arrive. But one cannot have this royal flower in the winter season without great expense, and then not always in a satis-

factory way. The plan here outlined offers delightful opportunities of rose-enjoyment at a time of year when roses are not only scarce, but are positively unknown in the ordinary house. And they will be real

roses too, but strangely artificial ones that are sometimes offered to the enjoyment of the rose lover, who, however, knows but the real flower, and can have no patience with the most skillful imitation.

# INTELLIGENCE ON MARS OR VENUS.\*

## THE EVIDENCE PRO AND CON.

BY N. W. MUMFORD.

THE study of the possibility of reasoning existence on other worlds is of perennial interest, but intelligent speculation on the subject must be confined to the solar system, on account of the immensity of the void existing between that system and any other. Study of the habitability of the eight known major planets leads at once to the elimination of six of them. The habitability of the earth is a matter of constant observation; that of Mercury may be negated on account of extreme solar proximity and lack of atmosphere, and of the four outer planets Jupiter, Saturn, Uranus, and Neptune, their remoteness from the central energy, as well as other conditions not discussed herein, may well remove them from the field of consideration. Observation upon the four has yielded negative rather than positive results in numerous ways, so that with the exception of Jupiter, it cannot be certainly stated that any extensive parts of their actual surfaces have been seen. So far is this true, that the times of rotation of Uranus and Neptune remain to be determined, although some recent observations have assigned to their rotation periods 10.1 hours and 12.86 hours respectively.

The two solar satellites, Venus and Mars, nearest neighbors to the earth, with the exception of the moon and the minor planet Eros on an occasional opposition, are left for discussion; and in this it is intended that the assumption of the possibility of life in some form shall be granted, having only in mind the question as to the adaptability of either or both of the planets to the support of that form of life that is called intelligent or reasoning, though of course not necessarily, in physical aspect, resembling man.

Literature upon the appearance and characteristics of the two planets is very plentiful, but is far from evenly distributed. The mass of writings whose subject is the smaller and outer planet is much in excess of all that has ever been written upon Venus and the problematical existence of the Hesperians. This literary favoritism to Mars may be properly attributed to the greater ease of observation of Mars, and the larger rewards for attention given him. The difficulty with which Venus can be viewed, and the little information that she returns for all the astronomer's labor, has kept speculation upon Venus within quite narrow limits though in several important particulars she more nearly resembles the earth than does any other known heavenly body.

In diameter Venus is about 100 miles less than the earth, which is reckoned at 7,926 miles. This resemblance is close, strikingly so; there is no member of the solar system that in this respect at all approaches these two, according to terrestrial standards. The outer major planets are giant globes, measuring from four to ten times the diameter of the earth. Mercury is about 3,000 miles through, and the moon a quarter of the earth's axial measurement. Mars has a trifle more than half the apparent measure of the earth and Venus, or 4,210 miles.

The identity in size between the earth and Venus is followed by another similarity of equal importance, in the study of habitability from the human standpoint; namely, the correspondence in density between the two, which is practically the same. On the other hand, the density of Mars appears to be about seven-tenths that of the earth. Likewise the masses of the planets are as 1 for the earth, 0.8 for Venus, and about 0.11 for Mars, hence would follow a wide disparity between the gravitational force exerted on the surfaces of the pair, and that on the outer planet. But this disparity is modified, for the fact that gravity varies with the inverse square of the distance, acts as a counterpoise in the case of Mars for his inferior mass. Taking the radial measurements, objects upon the surface of Mars lie only about 2,000 miles from his center of attraction, whereas that distance is about doubled for Venus and the earth. The force of gravity at the earth's surface reckoned as 1 is for Venus nearly the same, and for Mars about 0.38; so that a man weighing 150 pounds, transported to Mars would find his weight reduced to about fifty-seven pounds.

The chief interest in these comparisons attaches to their resultant effects on the volume and mass of the planets' atmospheres. The study of the air surround-

ing the two neighboring planets gives the following results: taking the volume of the earth's atmosphere as one, that of Venus is approximately 0.92, and that of Mars about 0.22; and in regard to mass, the earth's being reckoned at one, the mass of Martian atmosphere seems to be not over 0.10, and that of Venus not much more than the earth's. Observation of Venus indicates a dense atmosphere, but its true density is unknown. It is interesting to note the theoretical height of the barometer under such varied conditions. Normally at sea level, the terrestrial barometer records thirty inches, while on Mars its height would be about 2.5 inches, and on Venus approximately twenty-seven inches.

The conclusion to be drawn from the study of atmospheric conditions, seems to be decidedly more favorable to the presence of life, as known on earth, upon Venus than upon Mars. Further light may be thrown upon an examination of the subject, by a consideration of the kinetic theory of gases as related to atmospheric air.

The molecules of air are constantly in motion at prodigious activities, and are sustained with, or bound to, the governing body by its force of gravity. Nevertheless there are certain constituents of the earth's atmosphere that are continually flying off, or escaping into space, such as hydrogen, free hydrogen forming no appreciable part of the air. Upon experiment it is found that atmospheric molecules are continually controlled and held in sway, up to a certain limit of activity; beyond which limit of speed, which is called the velocity of escape, the molecules will tend to fly off and disappear from terrestrial constraint. The velocity of escape for molecules of the earth's atmosphere is found to be 6.95 miles per second, a speed so high that it is only in the case of the very lightest gases that terrestrial atmosphere is drained of any of its constituents. The velocity of escape upon Venus is almost as high, namely, 6.37 miles per second, or quite sufficient to withhold water vapor, the prime essential with atmospheric air. On the other hand, the velocity of escape upon Mars is computed at 3.13 miles per second, a speed high enough to retain carbonic acid gas, and parts of the terrestrial ingredients, but theoretically very little of the vapor of water. Telescopic examination of Mars seems to point to an almost entire absence of clouds, in an atmosphere exceedingly thin and clear. Some doubtful objects noted above the surface may properly be attributed to sand storms. On the other hand, the consensus of opinion on the question of water vapor on Venus is largely in favor of a very moist atmosphere, heavily laden with clouds. But on this point there are the Flagstaff observations, which deny the existence of clouds.

The Flagstaff observations command attention, and introduced a view radically different from the foregoing as to the possibility of life on Venus. A publication on the subject from the Lowell Observatory states that the first essential for animate existence is the alternation of day and night. Observation at Flagstaff fixes the rotation of Venus as synchronous with her revolution, causing the planet to turn forever the same face to the sun, as does the moon to the earth. The result is one hemisphere of excessive oven-like heat, while the opposite hemisphere lies under perpetual glacial ice. The atmosphere is described as yellowish and free from clouds or apparent moisture. The surface shows distinct markings, strangely enough resembling those originally drawn by Schiaparelli from Mars, similar markings to which the Flagstaff observers also depict as present on Mercury. The synchronous rotation of Venus coincides with the distinguished Italian's observations.

In spite of the seeming period hereby put to the discussion, the thoughtful observer will still detect the possibility of animate existence upon Venus. It may be questioned whether the prime essential to life is axial rotation. If the choice of evils were allowed the human race, it would no doubt agree to dispense with rotation, rather than with eighty per cent of the earth's atmosphere and water and conform to Martian conditions.

Here one may pause on a point of speculative interest. Will the dissolution of animate life on earth, unnumbered ages hence, follow the slow development

said to be presented by Mars, or pass through those dying phases of which Venus is said to show an example? Will tidal friction at the last put a stop to the sure and steady clockwork of rotation, and reduce one hemisphere to a desert, jeopardizing or annihilating all existence, or will that phase arrive long after the earth has reached and passed through the Martian stage, when by absorption into the earth's crust and evaporation, and by leakage into space, it has lost all moisture and atmosphere? The struggle for existence may be acute, indeed, upon Mars, and may be equally so upon Venus for fundamentally different reasons. Will humanity at the last take part in a struggle of both kinds?

Upon considering the factors bearing upon both questions, it seems likely that the present phase of Venus more nearly resembles the earth's ultimate condition than the observed state of things upon Mars. The slowing down and eventual stoppage of terrestrial rotation may be incalculably tedious and distant, but the period of time to elapse for the disappearance of air and water is infinitely long and must remain so, while the earth retains anything like its present mass, and the law of gravity continues unimpaired.

The difficulty of observation of Venus has already been referred to. The work was carried on at Flagstaff principally in the daytime, night observations being hindered by earth vapors, or by proximity to the horizon, since, at her greatest elongation, at sunset Venus is only forty-seven degrees above the horizon, a little more than half-way to the zenith.

In refutation of the observed absence of clouds above noted, their presence on Venus may be inferred from the very high albedo, or ratio of the light reflected from the planet to the total sunlight falling upon her. This ratio is much higher for Venus than for any other planet, a fact attributable possibly to the presence of masses of cumulus clouds.

The remaining known characteristics of the planets may be briefly stated. The average distance of Venus from the sun is nearly 0.7 that of the earth, while Mars's distance is 1.5 times that of the earth. In regard to insolation or direct rays of the sun's light and heat received by the three bodies, if unity represents the earth's amount, Venus will receive 1.9 as much, and Mars 0.43 of the same amount. Theoretically the temperature of black bodies at the known distances from the sun will vary as 176, 80, and -22 deg. F. The implication is not that such temperatures actually obtain, but experience shows that the figure set for the earth is not very wide of the reality. The apparent size of the sun's disk from the earth is a little over half a degree in diameter, seen from Venus he appears thirty-eight minutes in diameter, and from Mars twenty-one minutes in extreme width. The absence of a vapor blanket is consistent with the drought conditions said to obtain on Mars, but is highly inimical to the preservation of an equable temperature from day to day, since there is nothing to prevent the sun's heat being radiated at once, upon that luminary's setting. The rotation of Venus is unknown, or is once in 225 days; and that of Mars is performed in thirty-seven minutes more than the earth's, or 687 times in the Martian year. Here the resemblance to terrestrial conditions is more apparent than real. The resultant speed at the surface at the earth's equator is about 1,000 miles per hour, while on Mars the equatorial surface rate is approximately 537 miles. If Venus presents always the same face to the sun, her axial inclination cannot, of course, have the smallest influence on her climate. The axial inclination of Mars is 24 deg. 50 min., or 1 deg. 20 min. greater than the earth's; hence the seasonal changes would much resemble those on the earth, other conditions being similar. The Martian poles present white caps in winter, whose areas are much diminished in summer. The complete disappearance of the white cap is on record at least once. The surface presents telescopic lines, which the Flagstaff observers have made very numerous and very fine. An objection to the theory that the lines may be areas of irrigation is found in the fact of their immense length in some cases, and their geometrical straightness. Observation indicates that the Martian surface is not a smooth, even plane, yet the feat of conducting water in every direction to great distances by

\* Popular Astronomy.

the shortest arc, has not seemed to baffle the Martian engineers. Similarly the imagination must be staggered at the apparent extent of surface covered by irrigation at the seasonal changes. The so-called fruitful areas are depicted as extending from the polar caps across the equator to thirty-five degrees south or north latitude, with the arrival of the northern or southern summer, as the case may be.

Many of the Flagstaff observations are unconfirmed by other research, though not necessarily rejected, as the instruments and atmospheric conditions at the Arizona station are acknowledged to be of the best. It has been pointed out that markings similar to the grosser ones on Mars have also been described at Flagstaff as present on Venus and Mercury, a coincidence that is singular enough to verge on the incredible.

Upon returning to the original inquiry, from the foregoing considerations which of the planets—Mars or Venus—appears to be better adapted to sustaining intelligent life? It can hardly be denied that the conditions on Mars, where life may be granted to exist, must have modified the Martian species quite out of all form or semblance to those with which the human race is familiar. It is likely that only among the lowest forms of life would the botanist or biologist from the earth look for similar species, and the ages would naturally have evolved a ruling race, adapted to great extremes of temperature, excessive drought and rarity of air, with form and characteristics that altogether baffle speculation. To admit so much is to admit the habitability of Mars after that planet's kind.

For Venus we have observational assurance of a world remarkably like the earth, in several features that are commonly considered essential to the existence of the human race. The older observations on Venus, which established her day as somewhat like the terrestrial day in length, must be allowed to have established the possibility, the probability indeed, of highly developed animal life.

But let it be granted that the rotation of Venus has been determined at the rate of once in the Hesperian year. In the gradual slowing down of the planet's rotation through the ages, would not the intelligence of her inhabitants have risen steadily to each occasion's height, and have met finally the last catastrophe when the scorched and barren hemisphere forever faced the sun? Here, in reality also, we cannot begin to speculate on the outward form of the Hesperian. In much diminished numbers and of slight physique, he was driven back, first to the poles for water and coolness, from thence to spread once more over his planet in the twilight zone of perpetual spring, when for him rotation had ceased. On one side of him lies half the world, a veritable furnace, and on one side eternal night binds the hemisphere in an iron frost that no life can endure. Between the two he is reconciled to a life strange enough, indeed, to human conceptions. Dr. Heward thus describes the supposedly habitable belt: "Between the two separate regions of perpetual night and day, there must lie a wide zone of subdued rose-flushed light, where the climatic conditions may be well suited to the existence of a race of intelligent beings."

It may be imagined that economic existence to the inhabitants of Venus would present few problems with an unlimited supply of water stored up on one hand and unlimited heat on the other. It would seem likely that they have long become accustomed to cyclonic disturbances, and have settled in the more favored tracts out of the regular trade of the winds. They are bereft of a satellite no doubt, but did such exist, its station would be one of unstable equilibrium above the desert hemisphere, and at a great distance.

To observers on the earth, Venus at elongation has always been an object of delight and interest, in her unrivaled splendor and apparent proximity. But a little consideration will show that as a spectacle that exhibition cannot compare with the earth-moon system as seen from Venus. When at her inferior conjunction and invisible to the earth, the sun's light strikes the full earth, with its moon, and reflects to the inhabitants of Venus a glorious star, incomparably finer than anything in their whole sky; casting, no doubt, a distinct and appreciable light upon their darkened portion. As compared with the light from Venus at her greatest brilliance, the earth's reflected light when in opposition to Venus must be far more intense, because at such times, the earth is only 26 million miles from Venus and reflects an entire hemisphere, instead of the half-moon phase, such as Venus presents at her brightest. In addition there is the reflection from the moon's surface, so that the system presents contrasting colors to the Hesperians, a splendid golden star attended by a silver satellite of one-fourth the size.

## URANIUM AT JOACHIMSTHAL.

### THE CHIEF SOURCE OF RADIO-ACTIVE MATERIALS.

UNTIL quite recent years Joachimsthal, from a mining point of view, was known only for its past history as a silver-producing center. It was the birthplace of the thaler in the sixteenth century, and was at one time one of the most important contributors to the total output of silver in Europe. However, after diminishing continually in output, silver mining has within recent years been entirely given up, and at the present time work is restricted to uranium ore or pitch-blende. The number of miners in the town has now fallen to between one and two hundred.

This district has for many years supplied the great bulk of the pitch-blende used in the manufacture of the uranium salts of commerce; but with the discovery of radium the mining received a great fillip, as a demand arose for low-grade ore. It may as well be stated that amounts of silver and other metals continue to be produced, but only as by-products, at the uranium factory, the pitch-blende, though mostly of great purity, being sometimes associated with small quantities of silver, bismuth, cobalt, nickel, arsenic.

The seat of greatest activity is not at the government mine, as one might be led to imagine from some of the newspaper reports, but at the two mines belonging to a private Saxon mining company. Most of the older shafts are now closed, and the ore now being obtained by the Austrian government comes from the Elias shaft, nearly two miles from the town. The shaft, which is a very old one, is inclined, and there is a drainage adit which commences near the railway station. It is the water from this adit that has the highest radio-activity of all the mine waters analyzed on either the Bohemian or Saxon side of the Erzgebirge. Whether there is any particular benefit to be derived from drinking this radium water is a medical question which will not be discussed here; but it may be stated that the local authorities are working hard to make Joachimsthal a watering place, and last year they had a modest list of 200 *kur-gästen*. The rustic open-air pump, from which the patient at present obtains his beverage, is to be replaced by arrangements more on a par with what one finds at Marienbad and Karlsbad. Naturally these proceedings have not escaped notice in the Kingdom of Saxony, and only a few miles away, over the mountain, a close and comprehensive examination of the mine waters for radio-activity has recently been carried out by Prof. Schiff-

ner, of the Freiburg School of Mines, on behalf of the Saxon government. If the public flock to Joachimsthal we shall probably hear of an opposition radium watering place being started in Saxony.

The geological features of the district are masses of granite inclosing mica-schist, and at times limestone and dolomite. There are seventeen lodes extending east and west, and a similar number crossing them more or less at right angles. The two mines belonging to the private Saxon company are known as *Gewerkschaft Hilfe Gottes-Zeche*, which started operations in 1852, and the *Gewerkschaft Sächsischer Edelleutstollen*, which commenced in 1856. A few details of the latter mine will be of interest. The two lodes now being principally mined are the *Franciski* and the *Zeidler*, and they are worked by an adit 1,000 meters long, partly driven, as it is said, at least 600 years ago. The lodes are of variable width, ranging from  $3\frac{1}{2}$  yards to 1 inch, the pitch-blende occurring as detached lumps imbedded in the mica-schist. Some of these lumps may weigh several pounds, but a large amount of the ore mined does not run above 3 or 4 per cent of uranium oxide, which has the chemical formula  $U_3O_8$ .

The dressing plant at the mine, though at first sight of somewhat rough-and-ready construction, appears to give quite satisfactory results, and the management see no advantage in adopting the more modern machinery so common in other mining fields. In the case of the rich ore very little treatment is required, hand-picking being followed by grinding in a ball mill, the product assaying about 60 per cent uranium oxide. The poorer ore goes to a crusher preparatory to being fed to a battery of wooden stamps, from which it is taken on to a series of wooden percussion tables. These tables, which are made on the spot, are actuated by cams on a 3-foot diameter wooden driving-shaft. The ore from the tables assays on an average 55 per cent uranium oxide.

The bulk of the ore from these two mines is sold by arrangement to the factory of the Austrian government, who are now utilizing the old silver smelter near the new railway station as a uranium factory. The railway, it may be said, is a single line, 5 miles long, built a few years ago, to connect the town with the private *Buschtiehrad* line, which runs from Prague to Eger. Adjacent to the uranium factory is the quite

modern radium laboratory, also belonging to the government, and under the management of Dr. Step. This is the spot whence most of the hospitals have drawn their supplies of radium. Practically the only competitive uranium works to those at Joachimsthal are at Brunswick, and it is here that the radium salts are to be extracted from the Cornish pitch-blende, there being at present no factory in England where uranium ores are worked up.

Up to the present, for a considerable number of years, the market prices of uranium salts have been entirely in the hands of the Austrian government, the output in Saxony having dwindled considerably. As America and Spain contribute only a few tons of very low-grade ore, there are only the two producing districts of Joachimsthal and Cornwall to be considered. Statistics available at the moment show that in 1906 Austria produced 16 metric tons of ore, valued at 10,901*l.*, while the Cornish output in 1906 was 11 tons, of a value not stated. In 1907 the Cornish figure was 71 tons, valued at 6,500*l.*, and the advance statistics for 1908 show very similar figures. Presumably this was all yielded by the Grampound-road mine, so that when the figures for the present year come to be published we may expect a considerable augmentation from the St. Ives district. It will thus be seen that the position of Austria in the uranium market is being strongly attacked by Cornwall. As a metal there is no present demand for uranium, and the ores are all converted into salts, such as the acetate, nitrate, and sulphate, used in photography, and in the chemical laboratory. As sodium uranate there is a considerable application for uranium in glass and porcelain manufacture. As regards the price, it will not be far from the mark to put the retail cost of the pure salts at 2*s.* per ounce. The output of these salts appears to be in the neighborhood of 15 tons per annum, and it is a moot point whether the market can absorb much more.

What the prospects are of mining pitch-blende mainly with a view to the production of radium salts will not be discussed here. An important point, however, may be just mentioned, and that is, that radium as used by the medical specialist apparently retains its virtues for an unlimited time, and we may expect, therefore, that after a time, when the requirements of the hospitals have been met, the demand will fall off.—Engineering.

### DECREASE IN RAILROAD FATALITIES.

SEVERAL railroads of this country have recently issued reports that are particularly gratifying in that among the large number of passengers carried there have been no fatalities. Among the first of these to make such a report was the Pennsylvania R. R. which carried 142,676,779 passengers in 1908 with not a single accident due to inefficient operation, exclusive of accidents at crossings or the result of the passengers' own carelessness in getting on or off a moving

train. Other reports followed which are equally favorable showing that the Chicago & Northwestern Ry. carried 25,994,182 passengers in the year ending June 30th, 1909, without a single fatal accident, the Chicago, Rock Island & Pacific Ry. 18,743,022, the Chicago, Burlington & Quincy Ry. 20,000,000, the Atchison, Topeka & Santa Fe Ry. 22,605,697, the Lehigh Valley R. R. 4,877,801, while the Erie R. R. reports 125,000,000 passengers carried in the past five years without a fatality. These figures make a total

of 330,000,000 passengers carried in the past year without fatalities, and it is interesting to note that the roads helping to make up this record are many of them Western roads some of which are operated on single track. It is understood, of course, that a number of roads of lesser mileage have made the same enviable record in this respect, for the instances mentioned above are remarkable only from the magnitude of the traffic involved.—Railway and Engineering Review.