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Can Men Visit the Moon?

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A QUESTION WHICH, SENSATIONAL AS IT MAY SEEM, YET DOES NOT GO BEYOND THE LIMITS OF SCIENTIFIC POSSIBILITY—HOW WE MIGHT CONCEIVABLY REACH THE MOON, AND HOW WE MIGHT MAKE THE EARTH'S SATELLITE OF GREAT VALUE TO MANKIND.

IN any age but the present this question, if seriously asked, would have been answered by a chorus of jeers. So far beyond the pale of possibilities has the visiting of other worlds always appeared that writers of fiction have felt free to treat the idea sportively, describing thrilling journeys through space in impossible vehicles, while their readers have no more been misled than by a tale of Aladdin's lamp.

Nevertheless, the thought of exploring distant planets, pausing en route to view the further side of the moon, so tantalizingly turned from us, is one that fires the human imagination most profoundly. It is a dream to wake the enthusiasm of children and the keen interest of sober maturity. Moreover it is not, like perpetual motion or squaring the circle, a logical impossibility. The worst that can be said is that it now looks as difficult to us as the crossing of the great Atlantic must once have appeared to the naked savage upon its shore, with no craft but a fallen tree and no paddle but his empty hands. The impossibility of the savage became the triumph of Columbus, and the day-dream of the nineteenth century may become the achievement even of the twentieth.

One of the most inspiring facts of history is the acceleration in the rate of human progress. For many millions of years the earth was given up to the brute creation. For perhaps a hundred thousand, less or more, it was the home of the savage. For about seven thousand years man has been climbing the steeps of recorded civilization; but the nineteenth century, just closed, has seen more progress in science and mechanical invention than all the millenniums before it.

Having thus observed that skepticism rather than faith is the illogical attitude with regard to the future, let us see what is really involved in the problem of navigating empty space. The limits of this article will require that some statements be made *ex cathedra*, without explaining fully the data on which they are based.

The first thing to remember is that space is indeed empty, in a sense which no man-made vacuum can approach. A Crookes tube may be so perfectly exhausted as to contain less than a millionth part of the original air, yet a space the size of the earth, if empty in that limited sense only, would contain a thousand million tons of matter. But in reality a portion of outer space the size of the earth contains absolutely nothing, so far as we know, but a few flying grains of meteoric stone, weighing perhaps ten or fifteen pounds in all.

In the invasion of this empty realm man would encounter five difficulties, the first four of which are easily disposed of.

THE DIFFICULTIES OF SKY-TRAVEL

The first is the absence of anything to breathe. But in an air-tight chamber he could readily carry a bit of the earth's atmosphere, while a cargo allowance for each passenger of ten pounds per day would be sufficient to cover not only food and drink, but oxygen—liquid, of course—to revivify the air, and quicklime to cleanse it of impurities.

Next is the terrible cold, for it is probable that a thermometer alone in space would register two hundred degrees below zero in the sunlight, and four hundred and fifty degrees below in the cone of the earth's shadow. This could be mitigated by having the walls of the sky-ship heavily padded for the retention of heat, while large parabolic mirrors outside would throw concentrated beams of sunlight through the windows till the room within was warmed.

Then we must consider the possible absence throughout the voyage of all apparent weight, which will make ordinary walking impracticable, and will cause the dishes to rest as securely, or rather as insecurely, on the ceiling as on the table. Inside a flying shell there can be no pressure analogous to gravity between the vessel and its cargo, except when the projectile is being started or stopped through some force other than gravitation. But dishes could be fastened to the table, and people could leap and float, even if they could not walk.

Fourthly, when one rises above the protecting air-blanket, there will be the danger of collision with meteoric stones, whose average speed is a hundred times that of a cannon-ball. But estimating the number to strike the earth's atmosphere at twenty millions per day, a sky-ship fifty yards in diameter would be hit only once in ten years, while such a pin puncture clear through the ship as would be made by one of these little grains would only occasionally be a fatal accident.

THE QUESTION OF MOTIVE POWER

We now come face to face with the one capital difficulty in the way of locomotion through space—that of motive power, or means of travel. Balloons and flying machines, of course, are out of the question, for they can work only in the earth's atmosphere. Yet there are five conceivable methods by which inventive man might rise higher than the air—the **Tower Plan**, the **Projectile Plan**, the **Recoil Plan**, the **"Levitation" Plan**, and the **Repulsion Plan**. Not one of the five is theoretically impossible, though none is at present practically available.

THE TOWER PLAN

The earliest know attempt to reach the sky was the Tower of Babel, but that enterprise would have ended in failure quite apart from any confusion of tongues. Man has built an Eiffel Tower nine hundred and eighty feet high. The combined wealth of all nations might construct an edifice of solid steel eight or ten miles in height, but not much more, for the simple reason that the lower parts could not be made strong enough to bear the weight that must rest upon them. Not to mention the financial question, nor the disastrous effect of the earth's rotation, we cannot raise a tower as high as the moon till we have a building material about five hundred times tougher than armor-plate, and such may never be discovered.

THE PROJECTILE PLAN

A second plan, more than once employed in current fiction, is that of a projectile. This comes far nearer to feasibility than the tower of steel, yet the difficulties are of a higher order than might at first be supposed. The requisite muzzle velocity, if the moon is to be reached, is seven miles a second, which must, however, be largely increased to allow for the resistance of our air. Such a speed is beyond the power of present-day explosives. With improvements in ammunition it may possibly be that a shell will yet be thrown to the moon from a cannon less than a thousand feet in length, even as Jules Verne imagined; but that human beings should travel in such a shell and survive the shock of starting is absolutely impossible.

No conceivable arrangement of cushions and springs could alter the case in the least. We all know how unpleasantly a train's sudden start can jerk us against the back of the seat; and inside the above shell, changing within the eighteenth part of a second from a state of rest to a speed of seven miles per second, all loose bodies would be crushed against the floor with twenty thousand times their normal weight. If the cannon were made longer and the start more gradual, the shock would be diminished: but even if the gun barrel had the impossible length of forty miles, the poor passenger would be subjected for eleven seconds to a pressure equivalent to a hundred men lying upon him. It is doubtful whether even the expedient of lying face downward in a trough of steel, carved to preserve each feature by fitting it like a glove, could preserve life through such an ordeal.

Even if it could, we must not forget that no projectile falling from outer space upon the moon can strike its surface at a lower rate than a mile and a half per second. So unless our bullet-ship can carry on its nose a pile of cushions two miles high on which to light, the landing will be worse than the starting!

THE RECOIL PLAN

A third plan, quite tempting at first sight, is based upon the recoil of a gun. A rifle with properly constructed cartridges would both shoot and kick in a vacuum; and if only it recoiled hard enough, frequently enough, and in the right direction, the gun might kick its way up through the heavens to any desired goal.

Mathematical analysis, however, shows that the bullet in this case serves merely, through its inertia, as a feeble and transient physical support from which the gun may leap or shoot itself, and to be effective its weight should equal or exceed that of the gun itself. The next to the last bullet should then equal the weight of the gun and last bullet combined, and so on up the geometrical progression to impracticable dimensions. An original outfit as big as a mountain chain would be necessary in order to land even a small cage safe upon the lunar surface. The Recoil Plan, in fact, is only a disadvantageous modification of the Projectile Plan.

THE LEVITATION PLAN

We must now consider a theory based not upon ascertained forces, but upon the possibility of our discovering a screen that will protect bodies from the pull of gravitation, thus leaving them free to fly without limit, by virtue of their inertia, in whatever direction they were previously moving. Such a lightening process, the converse of gravitation, has been nicknamed "levitation." Now we must bear strictly in mind that while we know too little of the ultimate nature of gravitation to affirm that no such discovery will ever be possible, science at present has not the slightest clue that could lead to its realization. Only one inventor, I believe, and that a man of sanguine temper, has ever hinted that he was on the track of such a clue.

Supposing for a moment, however, that the grand discovery will some day be made, several of its consequences are very interesting, and quite different from the statements made by inexact story-writers. A body on the earth's equator is traveling with the earth's rotation at a speed of more than a thousand miles an hour. If relieved of gravity, it would not fly suddenly off, like a cannon-ball, and disappear into space. For several seconds its rise from the surface of the earth would be so slow as to be practically imperceptible, owing to the small difference between a straight tangent line and the earth's slow curvature. Gradually, however, its apparent upward velocity would increase, so as to lift it some sixty-five yards the first minute, and more than a hundred miles the first hour. The exact distance would vary with the time of day, because of the curvilinear motion of the earth in its orbit.

It would travel two hundred and thirty-nine thousand miles, the distance between the earth and the moon, in ten days; and if suitably exposed to the earth's attraction, acting as a brake, while screened from that of the moon, its landing could be made gentle and safe. Strangely enough, the unturning attitude of the lunar surface in relation to the earth makes the return voyage absolutely impossible save by a tedious roundabout journey of many months, involving the circumnavigation of Mars.

THE REPULSION PLAN

There remains, in the fifth place, a method more rationally hopeful than any of the foregoing, based on some form of repulsion which may overbalance the attraction of gravity. That repulsive forces do exist is well known. Two bodies bearing similar electrical charges repel each other, and when light enough they fly apart. The like poles of two magnets repel each other, but at long distances the force is scarcely perceptible. Two parallel and opposite electric currents repel each other.

Light exerts a repulsive pressure on all bodies upon which it falls, though the force is so extremely small as only recently to have been discovered. Theoretically the electric waves which Marconi employs must exert a similar pressure on any body which arrests their progress. Sun-heat, for a different reason, appreciably repels dark bodies in a vacuum that is not too nearly perfect. Lastly, the sun drives from itself the tails of comets, and perhaps its own corona; but whether the force involved is identical with one of the foregoing is still uncertain.

Now it is perfectly true that man is unable, at present, to create and control any form of repulsive stress on a sufficiently large scale to drive a ship away from earth and up through the heavens; yet it is along this line that fruitful discoveries may not unreasonably be expected. And there is no doubt in the mind of the present writer that, before many generations pass, scientists will begin to treat the question of sky travel as a problem worthy of careful and systematic investigation.

WHAT WE MAY FIND IN THE MOON

The query may now arise: "What is the moon good for, even if man succeeds in reaching it?" We know it to be a barren, rocky world, without air or moisture, unspeakably cold at night, and below the freezing point even at noon. However, men could abide there for a time in thick-walled, air-tight houses, and could walk out of doors in air-tight divers' suits. Scientists would find in the lunar wastes a fresh field for exploration. Astronomers could plant their telescopes there, free from their most serious hindrance, the earth's atmosphere. Tourists of the wealthy and adventurous class would not fail to visit the satellite, and costly hotels must be maintained for their accommodation. Then it is quite probable that veins of precious metals, beds of diamonds, and an abundance of sulphur might be discovered on a world of so highly volcanic a character.

These, perhaps, will be for a time the only uses for our satellite; but if we let the prophetic fancy play about the remote future of civilization, we come to possibilities which appall us. The world's population is capable of great increase, even if synthetic chemistry does not make support by agriculture unnecessary. And the world's need for motive power is increasing much more rapidly than the population. Our supply of coal and timber is limited, and will all too soon be exhausted. What shall civilization do to save itself from retrogression?

Waterfalls can do much. Windmills can do not a little. Solar engines, with concave mirrors to gather the sun's rays, have lately been put to practical use, and these in the future will accomplish wonders, yet even their resources, in our heavy, cloudy atmosphere, are not boundless. But solar engines could work to much better advantage on the moon than on the earth, owing partly to the absence of cloud and haze, but chiefly to the low temperature at which the condensed vapors could be discharged from the cylinders.

The total energy of the sun's rays falling on the satellite is twenty-five millions of millions of horse power, working continuously. It is said that Niagara would turn all the machinery in the world to-day, but even one per cent of this lunar energy would equal fourteen thousand Niagaras. The suggestion is a daring one and may, of course, never be realized, yet already the possibility of transmitting power from a distance without wires is being discussed in the public prints.

The foregoing pages may seem filled with "the stuff that dreams are made of," yet most of their assertions are based on the hard facts of mathematics and physics. History is not always particular to follow the precise path laid out for it by prophets, yet in the long run it never fails to achieve larger things than the seer dared to predict.

Is it too much to suppose that after visiting the Queen of Night, our only near neighbor, pioneers will try the long voyage to Venus, Mars, and other planets of our system, finding some of them even more interesting, more inviting, and more useful to man than the pale moon which first tempted him to try his wings in outer space?"

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