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The Other Man

By THEODORE STURGEON

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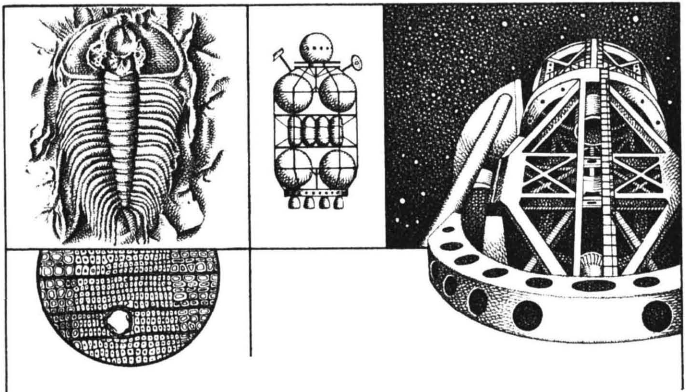
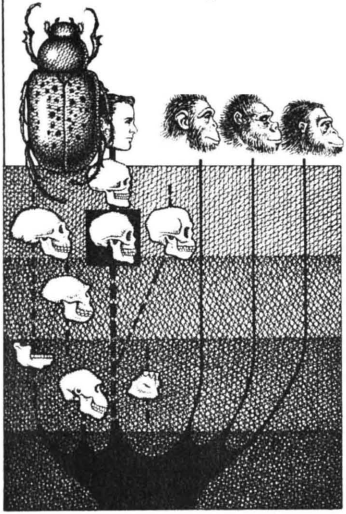
AND OTHER STORIES



for your information

By WILLY LEY



PROJECT VANGUARD

AGAIN this is a column which is written entirely in response to letters received from readers—a fairly high percentage of the mail during the last few months has been asking about Project Vanguard, the official name for the satellite shots. Why, several correspondents wanted to know, why has GALAXY, of all magazines, been so silent on Vanguard?

Well, there are several intertwined answers to this query. To begin with, I explained various possible methods of shooting a satellite, in GALAXY, just a short time prior to the official announcement that the United States would shoot a satellite during the International Geophysical Year of 1957-58. When the announcement was made — the date was July 29, 1955 — there was nothing new that could be added for a considerable while.

Some of the letters I received reminded me of a press conference I attended, where a newspaperman said to a government scientist involved in Vanguard: "You boys have changed your story around several times; why don't you stick to one line?" Whereupon the scientist answered truthfully that nobody had changed a story around, but that the facts were released as the scientists made up their minds what to do.

Incidentally I still don't know just what that newspaperman meant when he accused the scientists, or the public relations officers, of having "changed the story around." Each release merely added more facts. He must have considered it a case of malicious duplicity that the first release spoke about *a* satellite, while later releases upped the figure to ten. Now the figure has been raised to twelve and sixteen units are on order, presumably to allow for possible failures.

BEFORE telling what has been decided upon, it might be wise to mention the fundamental facts briefly. A body will become a satellite of Earth if it has a certain and rather high velocity, parallel to the ground, outside the atmosphere. Which velocity is required depends on the distance from the ground, but for those heights now within reach, say from 200 to 800 miles, the required velocities are all quite close to 4½ miles per second. Let's assume the body needs 16,000 miles per hour to stay in its orbit. To impart such a velocity on something with the use of present-day fuels requires a three-stage rocket.

The problem of producing a permanent satellite may therefore be described as consisting of two successive steps. The first one would be to lift the artificial satellite beyond the atmosphere, about to a height of 200 miles. The second would be to provide it with velocity parallel to the ground.

In reality, these two steps are not so strictly separated. The lifting itself could and would provide some of the velocity needed.

If every one of the three rockets which make up the three-stage rocket were to fire just as soon as the preceding stage has used up its fuel, it could easily happen that the burn-out point of the third stage is still in the atmosphere. Now the orbit begins at the burn-out point of the final stage of the assembly. This means that the artificial satellite, each time it has completed one revolution around the Earth, would go through that burn-out point.

Since the Earth has meanwhile turned on its axis, that point would be somewhere else with reference to the ground.

But this is another problem. The important fact here is that the satellite would have to go through the altitude of the burn-out point of the final, third stage. If that burn-out point were at a height of 80 miles, the satellite, each time it comes around, would dip into the atmosphere to an Earth-nearest point, the perigee, only 80 miles up. Each time it does that, air resistance would kill off some of its momentum. Hence it would not be a permanent satellite, but a temporary one.

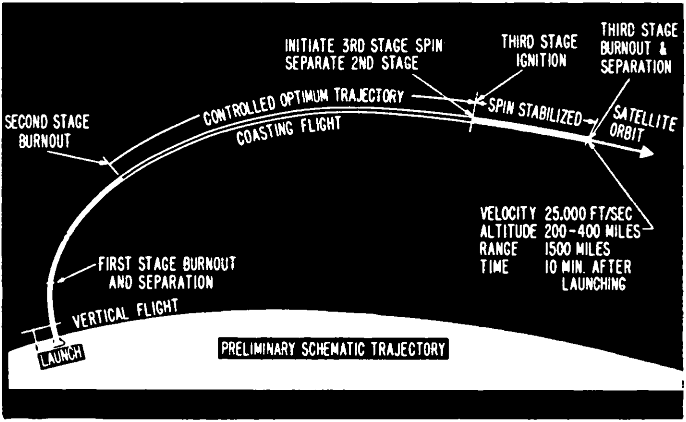
A few satellite shots will certainly be made with the perigee of the orbit inside the atmosphere, just because measuring the changes in the orbit which occur as a result of the grazing of the atmosphere would give us figures for atmospheric density at such great heights.

But if you want a permanent satellite, a burn-out point in the atmosphere will not do. You want the final burn-out point to be located outside the atmosphere. And this can be done by taking advantage of the well-known fact that a rocket does not stop moving just because its fuel supply has been used up.

After the period of "powered flight," there comes the period of "unpowered flight" for every rocket. And if, at the moment of burn-out, the trajectory pointed upward, as is usually the case, the gain in altitude *after* burn-out is considerable. In the nearly vertical high-altitude shots of the V-2 program, the burn-out altitude of the rocket was always quite close to 20 miles. The peak altitudes reached were from 85 to 114 miles.

The three-stage Vanguard satellite carrier will lift vertically at first. After it has gained an altitude of two or three miles, it will be tilted in an easterly direction. This tilt eastward will take advantage of the fact that the Earth turns in an easterly direction, so that the rocket receives a kind of free velocity gift.

The firing site for Vanguard is going to be Patrick Air Force Base, near Cape Canaveral in Florida. The rotational velocity of the Air Force Base being around 1300 feet per second, the rocket gains this 1300 feet per second by moving eastward after takeoff.



The official schematic drawing of the satellite shots. The term "range 1500 miles" on the diagram refers to the expected impact point of the second stage, about 1500 miles from the takeoff site.

(If one insisted that it should move westward, it would need extra fuel to kill off these 1300 feet per second, obviously an illogical procedure.)

When the first stage stops burning, the whole will be about 36 miles above sea level and, measured horizontally, about 25 miles to the east of the firing site. At this moment, the second stage ignites and lifts itself out of the first stage. The first stage will go through a normal ballistic trajectory, which will carry it to a maximum height of roughly 65 miles above sea level. This highest point of its trajectory will be about 120 miles from the takeoff site, measured horizontally. The first stage will find its end by smashing into the Atlantic Ocean 230 miles from the takeoff site.

Meanwhile, the second stage has used up its fuel and acquired a velocity that is roughly half of the necessary orbital velocity. At the moment of burn-out, it will be 140 miles above sea level and at least that far from the firing site, measured horizontally. Now it coasts upward at a very shallow angle. It may to all intents and purposes be beyond the atmosphere at 140 miles altitude, but it is safe to make sure.

The second stage will be permitted to coast without power to an altitude beyond 200 miles. In fact, it will probably reach around 300 miles. While gaining altitude as it coasts along, it unfortunately loses velocity. The loss due to whatever air resistance there might still be left will probably be so small that it could not even be measured, but the rocket is coasting upward against the gravitational attraction of the Earth. And that is a loss that can be calculated and is noticeable.

When the second stage has coasted to the highest altitude it can attain, it must of necessity be moving parallel to the ground. It is now at the halfway point of its trajectory. From now on, it will lose altitude and gain speed again, following the gravitational attraction of the Earth. At the point where it is highest, moving parallel to the ground—and incidentally moving at its slowest, which is still pretty fast—the third-stage rocket will separate from the second stage.

The horizontal distance from the launching site at that moment is 700 miles. The height is right. The direction of movement is right, too. All that is still lacking is velocity. It is up to the third stage to make up the difference between what it has and what is required. Nobody can tell precisely at the moment just how much that will be, but the third stage will probably have to supply half of the total velocity.

A PERIGEE of 300 miles is either outside the atmosphere or still inside, depending on whose figures you are willing to accept. If we take the highest figures available, a satellite with a perigee 300 miles up will last a year. Taking the lowest figures, it will be permanent, at least as compared to the human life-span. Its actual lifetime will probably be somewhat in between—after all, this is one of the things we want to find out.

So much for the performance of the satellite carrier. Now for its appearance and dimensions.

The overall appearance of the Vanguard three-stage rocket will be precisely that of an enormous rifle cartridge—no fins. Fins are not needed because the rocket motors of the first two stages will be mounted on gymbals, just as were the motors of the Viking rockets. Balancing during the first few seconds following takeoff and tilting thereafter will be accomplished by deflecting the exhaust blast slightly, as needed.

At takeoff, the satellite carrier will be 72 feet tall, with a largest diameter of 45 inches. It will be an exceptionally long and slim rocket. The total takeoff weight will be around eleven tons, which is less than the takeoff weight of the V-2. The first stage will be guided and controlled, but the guidance and control instruments will all be located in the second stage. One may say that the first stage is essentially a booster of large dimensions, the device to supply the first heavy push. The fine work is all done by the second stage.

The second stage operates on other fuels than the first, the main reason being that the liquid oxygen used in the first stage is not really storable. Once you have fueled a rocket operating on liquid oxygen, it is time to fire it. Therefore the two upper stages of Vanguard must have storable fuels. That of the second stage is unsymmetrical dimethyl-hydrazine, burning with nitric acid which acts as the oxidizer. The fuel of the third stage will be a solid fuel, precise composition not yet decided on.

As has been mentioned, it is the second stage which does all the fine work. It controls the first stage and later it controls itself. And because it puts itself in the proper position and fires the third stage at the proper moment, it may be said to control the third stage, too. Technically, the third stage is an unguided rocket, just something that is aimed (by the second stage) and fired at the right moment.

THE third stage and the artificial satellite on top of the third stage will be completely encased by the nose cone of the second stage. After second-stage burn-out, this nose cone will split open and be shed, exposing the third stage and the satellite. They had to be protected against air friction on the way up, but after reaching 140 miles, they do not need protection any more. The third stage is supposed to spin around its longitudinal axis for stability. This spin must be induced by a mechanism in the second stage and it might be this spin which is used to get rid of the protecting nose cone of the second stage.

Nothing much is yet known about the third stage, except for the fact that it will be a solid-fuel rocket to simplify firing procedure. Nor can much be said about the satellite itself, except that there will be various satellites. The one most talked about will be spherical, of the same diameter as the third-stage rocket — expected to be 20 inches — and contain instruments which report their findings to the ground by means of a battery-powered radio transmitter. It might be necessary to separate this satellite from the third-stage rocket. This could be done most simply by mounting it on a tensed spring which is released by a timing device.

If such separation of satellite and third-stage carrier is necessary and is carried out, we'll get two satellites for the price of one. The third-stage rocket is in the same orbit as the satellite. It is only a few feet per second slower than the satellite (which got a slight additional push from the tensed spring) and it has no reason to fall back to Earth.

Satellite and third-stage rocket will move along the same orbit, drawing apart very slowly, and will afford a fine comparison of the behavior of two satellites in the same orbit, but of different shapes. The latter only matters, of course, as far as residual air resistance is concerned.

If no separation is needed, the satellite proper would simply be the nose cone of the third-stage rocket. It is quite possible that a specialized satellite would be essentially attached to the third stage, with a few sensing elements sticking out from it.

Still another possible form of artificial satellite that has been discussed in the past would be uninstrumented and large. One could fill up the whole nose cone of the third stage with a compressed plastic foam that is permitted to escape to form a large foam bubble around the third stage. Or it could be a non-elastic plastic balloon which is inflated from a pressure capsule carried along.

This latter type of artificial satellite would have a very fine visibility. It would not report to the ground by means of radio, but it would reveal very many things we want to know because of the shape of the orbit it will assume. And in order to observe this well, the satellite must be easily visible.

I may add that it is planned to inform the public via the newspapers and radio when the artificial satellites will be visible for a certain area. They will be naked-eye objects, faint stars that can be told from the real stars because of their visible movement. But, of course, these faint moving stars will only be the vanguard of much bigger ones to come.

THE YEAR ON MARS

IN the January issue this year, I answered a question from a reader concerning a calendar for Mars. Not only the reader whose question I answered — or thought I did — but half a dozen others have written in in the meantime, telling me that I had not been explicit enough. A few of them had tried to construct Martian calendars on the basis of my reply, but found they did not have enough information to go by.

Since Mars is near right now, interest in the construction of a calendar for Mars for the convenience of future explorers might be more widespread than at other times and I'll therefore go into the subject at greater length and with more detail. The two natural units on which any calendar is based are the length of the day, which is the time needed by the planet to turn around its axis, and the length of the year, the time needed by the same planet to move once around the Sun.

Mars needs 687 days to go around the Sun once, but these are Earth days. The Martian day is 37 minutes and about 23 seconds longer than the Earth day; hence there are 668.59905 Mars days in a Martian year. For the sake of convenience, let's round this off to 668 6/10th days; we can take care of the tiny difference later. Using that figure, we find that five Mars years contain 3343 Martian days. Since for purposes of calendar making, every year has to have a number of full days — you cannot end a year with half a day and three-tenths of a day — the five years comprising such a five-year cycle must be of unequal length.

Breaking up the five-year cycle is naturally an arbitrary procedure which could follow any one of several different schemes. Three possibilities are these:

First Year	669	days
Second Year	669	"
Third Year	669	"
Fourth Year	669	"
Fifth Year	667	"
	3343	days

Or:

First Year	668	days
Second Year	668	"
Third Year	668	"
Fourth Year	668	"
Fifth Year	671	"
	3343	days

Or:

First Year	668	days
Second Year	669	"
Third Year	668	"
Fourth Year	669	"
Fifth Year	669	"
	3343	days

In short, you can either have four years of equal length, with the fifth year two days shorter or three days longer than the others; or else you can alternate with each fifth year one day longer than it would come out if alternation were carried through.

ANOTHER and in some of spects better way would be to follow a ten-year cycle with alternating years. During such a ten-year cycle of 6686 Martian days, the five "short" years of 668 days each would have accumulated 3340 days and the five "long" years of 669 days each would have accumulated 3345 days, totaling 6685 days. This is one day short, so every tenth year would have to have one additional leap year's day to make the cycle come out even.

So far, so good, but how do we divide the years into months?

Using the ten-year cycle, Dr. Robert G. Aitken, former director of the Lick Observatory, devised a calendar in which each year had sixteen months of six weeks each.

In an odd-numbered year, the four months of spring would all begin on a Sunday and the first

	SPRING							SUMMER						
	S	M	T	W	T	F	S	S	M	T	W	T	F	S
								-	-	-	-	-	-	1
First Week	1	2	3	4	5	6	7	2	3	4	5	6	7	8
Sec'd Week	8	9	10	11	12	13	14	9	10	11	12	13	14	15
Third Week	15	16	17	18	19	20	21	16	17	18	19	20	21	22
Fourth Week	22	23	24	25	26	27	28	23	24	25	26	27	28	29
Fifth Week	29	30	31	32	33	34	35	30	31	32	33	34	35	36
Sixth Week	36	37	38	39	40	41	42	37	38	39	40	41	42	-

	AUTUMN							WINTER						
	S	M	T	W	T	F	S	S	M	T	W	T	F	S
	/	-	-	-	-	1	2	-	-	-	-	1	2	3
First Week	3	4	5	6	7	8	9	4	5	6	7	8	9	10
Sec'd Week	10	11	12	13	14	15	16	11	12	13	14	15	16	17
Third Week	17	18	19	20	21	22	23	18	19	20	21	22	23	24
Fourth Week	24	25	26	27	28	29	30	25	26	27	28	29	30	31
Fifth Week	31	32	33	34	35	36	37	32	33	34	35	36	37	38
Sixth Week	38	39	40	41	42	-	-	39	40	41	42	-	-	-

Scheme for a Martian calendar for a "short" year as devised by Dr. Robert G. Aitken three of these four months would have 42 days each, but the fourth spring month only 41 days. Consequently the four summer months would all begin with a Saturday; the first three of them would have 42 days each and the fourth summer month again only 41 days. Therefore the four autumn months would all begin on Fridays, again with the fourth month having only 41 days, so that the four winter months would all begin on Thursdays. Since again the fourth winter month is only 41 days long, the whole year has used up 668 days.

The next year, logically, has to be an even-numbered year beginning on a Wednesday. Again the four spring months all start on the same weekday, and since the fourth spring month is 41 days long, the four summer months all begin on Tuesdays, running through the schedule of 42, 42, 42 and 41 days. This makes the four autumn months begin on Mondays and the four winter months on Sundays. But in an even-numbered year, *all four* winter months are 42 days long, so that the next odd-numbered year also begins on a Sunday, as did the preceding odd-numbered year.

This scheme can run with utmost rigidity for nine years, but the tenth year must have an extra day to complete the cycle. This extra day will be outside the scheme and not be assigned to any week or month. It will be, in name as well as in spirit, a Holiday.

The more recent calendar for Mars, devised by Dr. I. M. Levitt, director of the Fels Planetarium in Philadelphia, is based on a five-year cycle with a sequence of 668, 669, 669, 668, 669 days. It has twelve months, like the terrestrial calendar, but with eight weeks to the month. A "short" year of 668 days would look as shown in Table II.

As can be seen, at the end of each season there would have to be one "short week" of only six days. The absence of one day per season would have to be disregarded in assigning weekday names. By doing that, every week throughout the whole year (and of course every month, too) would begin with a Sunday. In the "long" years, the month of December would have 56 days, so that a "long" year would have only three "short" weeks instead of four.

This takes care of everything except the small difference caused by rounding off the Martian year to 668.6 Martian days. That simplification causes every calendar year in both these calendars to be 0.00095 days too long, which builds up to very nearly a full day in a thousand years. The adjustment would consist in making

JANUARY
APRIL
JULY
OCTOBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49
50	51	52	53	54	55	56

FEBRUARY
MAY
AUGUST
NOVEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49
50	51	52	53	54	55	56

MARCH
JUNE
SEPTEMBER
DECEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49
50	51	52	53	54	55	-

Scheme for a Martian calendar for a "short" year according to Dr. I. M. Levitt

what would normally be a "long" year into a "short" year every millennium.

Dropping one day every millennium is certainly an easy, uncomplicated method of adjustment, but the fact is that this adjusts the calendar a bit too much. After a mere twenty thousand years, the error will have added up to a full day, so the adjustment consisting of changing a "long" year into a "short" year must be omitted every twentieth millennium.

Well, this ought to be detailed enough for the making of a Martian calendar. The difference between terrestrial and Martian day, by the way, is within the adjustment spread of a better-class watch or alarm clock. If you want to, you can have a "Martian clock" just by adjusting one to be 37 minutes and 23 seconds "late" according to Earth time. Once you have accomplished this, and don't forget to keep it wound, the time shown by the hands will make no sense whatever after only a week. However, it will be correct Martian time, for some place on Mars.

— WILLY LEY

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