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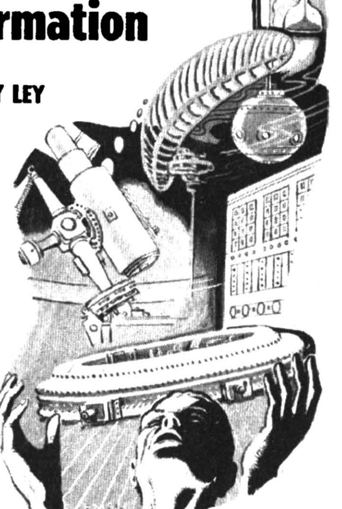
For Your Information

By WILLY LEY



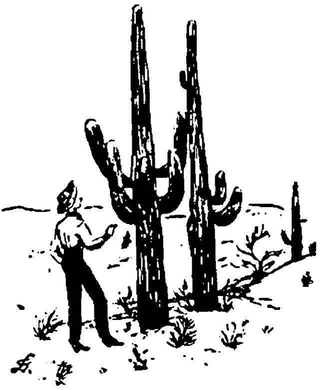
Scientific Journey

GRAB yourself a botanist from the region of the Iron Curtain—either side of it. Fly him some 8000 miles along a Great Circle route, timing your arrival to coincide with daybreak. Then parachute him to the ground, after having made sure first that there is no road sign, no store front, no advertising of any kind and in general no scrap of reading matter for miles around—and also nobody who could answer a question. Instruct your botanist that he'll be picked up just as soon as he convinces you by radio that he has identified his location; general terms like "the Kalahari desert" or "Java" will be acceptable.

The very first thing your botanist is likely to see will make him believe that the task is an easy one . . . a road, lined on both sides, as far as the eye can reach, with eucalyptus trees. There are also small groves of eucalyptus off the road; in fact, three or four different varieties can be found within easy walking distance. Now, eucalyptus is as typically Australian as the platypus—but what may cause our botanist some dismay is that clumps of bamboo nestle between and near some of the tall trees. Seeing these, he will probably wish that he had read something on the flora of Australia more recently than at the time he took his degree. The climate of northern Australia, of course, is such that bamboo can grow there—but does it? Possibly it has been introduced by Whites, or by the Chinese who can't live without bamboo—but once you start considering artificial introduction, you have to be twice as careful.

Walking along, our botanist will see something that is also very typical . . . of a landscape half way around the planet from Australia. There are half a dozen century plants, growing close to each other. Their place of origin is, of course, the southwestern part of the North American continent. Eucalyptus and century plants cannot occur together without the intervention of Man, our botanist thinks. Therefore, one has been introduced. He notes that the century plants are in the minority by far.

AT the turn of the road, the landscape suddenly changes. There is a big grove of lemon trees, which normally would point



to the Mediterranean—but this is a plantation. And beyond the plantation of comparatively small lemon trees, there are the heavy green-and-gold fountain sprays of date palms, scores and scores of them. This, of course, should indicate the general region of Arabia, Turkey, Palestine or North East Africa—but high above the date palms stretch lofty Royal palms, and other slender stems in the distance might well be coconut palms.

Nearby, three banana plants rise from a clump of short bamboo, but the fleeting impression of Central America — the climate doesn't feel right either — is destroyed by a row of still *another* kind of palms. These startle the European botanist for a moment. They certainly aren't date, nor are they the Royal Palm, even though at first glance they bear some slight resemblance to each. Searching back through his memory, he may conclude that they are the type called Washingtonias; trouble is, he has specialized in the flora of the northern tundra. If there were only something he could be *sure* of . . .

Here is a stand of pines. From a distance, they look somewhat like poor specimens of the European *Pinus sylvestris;* and the resemblance holds in some respects even when they are seen close by. Still, there are pronounced differences—and not far from that stand of pines, sheltered by two big eucalyptus trees and flanked by several century plants, there grows a tree fern!

By this time, the botanist is either ready to weep or is already doing so because of the hopelessly tangled botanical mess around him. So we may as well take pity on him and tell him where he is:

San Diego County, in California.

No, I do not seriously advocate kidnapping botanists from the Iron Curtain area and flying them non-stop to San Diego; these were just some idle thoughts that crossed my mind as Chesley Bonestell drove me through this complex landscape on the road from San Diego to Palomar Mountain.

What got me going was the fact that the plants which really belong there are around, but in a minority. The only native plant which appeared in any quantity was the Torrey pine, which does not grow elsewhere but which also requires specialized knowledge (or experience) to label properly. Practically all of the rest—the easily identified plants which greet the eye everywhere—are imports. The half-dozen varieties of eucalyptus are there because somebody in California once thought that eucalyptus was a valuable timber tree, whereas actually its wood is not good for building, is poor for furniture and not even good for firewood. The millions of date palms were planted for obvious reasons, not primarily to provide Hollywood with Arab settings. The lemon and orange groves do not really require explanation — but they dominate the landscape.

WHAT happened to me is that I spent all of March on the road, if that phrase can be used with reference to a trip which was made exclusively by air. On the flight home from Denver (where I merely changed airlines) I added it up: the total was around 11,000 miles. It was a lecture tour—several cities in Oklahoma and eastern Texas, then El Paso (no time for a side trip to the White Sands Proving Ground, unfortunately), then Pasadena, and after that home to New York, with lecture stopovers in Utah and Wyoming. I have spoken with other people who have gone on such tours and they often used terms like a "grind," or "hard work" and so forth. I don't deny that it is hard work, but it was certainly not a "grind"—I found something interesting to see wherever I went.

One night professor Dr. Hubertus Strughold, the head of the Air Force's Department of Space Medicine, drove me around. There were clumps of opuntias growing along the roadside, and he told me how local farmers, using surplus flame throwers, burn the spines of the plants, while their cattle wait eagerly behind them "as if those things were baked apples." Strughold did not tell this as a simple fact; it was somewhat more of a complaint—for he had told the story at a party in Washington, and somebody had remarked skeptically that "Dr. Strughold has the most unusual ideas of what can be done." It was not until *Life* magazine ran a picture-spread on this practice that he was believed.

This conversation took place while we went to see Dr. Ulrich C. Luft, former member of a Mt. Everest expedition and expert on medical problems of high altitude aviation. We were still talking about it when Dr. Luft's son brought in a bucket of fossils which they had found while gardening. Question: "What are they?"

For once I was lucky. Even without any reference books, I could see that they were the shells of ammonites, shelled octopi which were quite common in the seas of the Jurassic and Cretaceous periods. Judging from the locality I could be even more specific: ammonites from the

Niobrara sea of the Upper Cretaceous. I don't know the opinion of the local chamber of commerce, but to me San Antón is the place where I had to classify a bucketful of fossils without preparation or warning.

Likewise, El Paso is not merely the airport nearest the White Sands Proving Ground, but the city where three unexpected events happened all in one day. One of them was that I unexpectedly met Clyde Tombaugh, the discoverer of Pluto, who had come to my lecture. The second was that I saw my first genuine western dust storm—I know they're not rare, but I had never been in one before. My companions were somewhat unhappy about it, because they had wanted to show me their city from a lookout point—and if it had been my fifth or sixth dust storm, I suppose I might have felt the same way. As it was, I welcomed it, as I did my first earthquake twelve years ago (Bob Heinlein still claims that he arranged it for me).

The third unexpected event had actually preceded the dust storm; I had been informed in the morning that a visit to Fort Bliss would be welcomed and that the commanding officer, General Mickelsen, had set some time aside for me. Then I was informed that a number of their "graduates" were assembled in the basement of building such-and-such, and that it would be appreciated if I spoke to them.

On the way over, I tried to think of something that the "graduates" of Fort Bliss might not know about rockets or missiles.

WHEN I got there my problem was still unsolved. But, leaning against a *Nike* missile, I saw the pumping unit of a V-2, and then I had something to tell. The only danger left was that Wernher von Braun, from whom I had the story, had told it to these people also.

In a small liquid fuel rocket, as most of the readers of GALAXY *Science Fiction* are apt to know, you can feed the rocket motor by simply pressurizing the two tanks holding the fuel and the oxidizer. Of course, fairly strong tanks are required to withstand a pressurization of some 250 pounds per square inch, but in a small rocket this does not constitute much of a problem. As the rocket grows in overall size, however, a considerable weight penalty begins to creep in if you continue pressurizing the tanks; and once the rocket has a take-off weight of, say, a ton or more, you have to pump the fuel. Then the tanks can be comparatively light, since they hold the fuel in the same manner as the fuel tanks in cars and planes, while the job of force feeding the motor is done by the pumps. It was at the time when the Peenemünde Institute was doing preliminary work on the V-2 that the pump problem came up in earnest.

Wernher on Braun first assigned a man to make a general study about pumps; the man came up with the reply that there didn't seem to be anything which spoke very strongly either in favor or against piston pumps or centrifugal pumps and that the choice would depend on the "status of the art"—the actual accomplishments of pump builders.

A conference with a manufacturer was set up, and von Braun arrived with some preliminary specifications, convinced that at one point or another the engineers would tell him that this or that "simply couldn't be done." He began by telling them that he needed two pumps, each of which would have to handle some 150 pounds of liquid per second.

This was greeted by a respectful silence.

He continued that the low pressure end would be just about 16 lbs. per square inch, while the high pressure end would have to deliver some 320 lbs. per second. Still silence.

Then he added that the pressure at the high pressure end would have to be kept within a fraction of one per cent of the value.

Still silence.

It was necessary, furthermore, he explained, that the pump should not need more than a very few seconds from standstill to full delivery pressure. And since nobody had yet said that all this was impossible, he concluded by pointing out that these pumps must be capable of being stored for many months, yet at any time must be ready for instant use.

Whereupon one of the pump engineers said that all this simply amounted to a plain, everyday firefighters' pump.

Such a pump has to have high delivery pressure, because the firefighter has to shoot the water jet over a considerable distance. The pressure must be very steady; otherwise the fireman couldn't aim properly. And since fires happen relatively infrequently and at unpredictable moments, the equipment obviously must function perfectly after long storage and reach full delivery pressure swiftly, since in fire fighting seconds may count.

The moral of the story is, of course, that if you build a spaceship and need a synchronized double hyperframmis, don't sit down and design it . . . it might be in use in the biscuit industry.

PHOENIX, Arizona, is "in the valley of the sun," and is a prime tourist attraction. Everybody is greatly surprised to learn that you came there on business. But, as usual, I learned a few things.

It was one of the rare times in my life when I got a naked-eye view of the planet Mercury. In fact, there was quite a nice astronomical display: Venus was brilliant in the evening sky (the telescope proved her to be in the phase which is called *luna fallax* when applied to the moon); Jupiter was higher up, and Mars off to one side of Venus.

But what was more interesting to me was the collection of bells at the college in Tempe, Arizona.

Ranchers and farmers continually find them, and when they see that there are two stars on one side and the letters U.S. on the other, they assume that the bells are government property and turn them in to the college—which doesn't bother to pass them on, because the government doesn't care anymore.

The bells are camel bells.

Shortly before the Civil War, a number of people reasoned as follows: "We are now conquering the West. The area between present-day forts and present-day and future settlements is mostly desert. In North Africa, no animal is as useful in the desert as the camel. Hence camels will be useful in the West."

U. S. officers were sent to Egypt to buy camels and import camel drivers. Camels were bred in this country and sent West. There were the beginnings of a U.S. camel cavalry—but then things began to go wrong. The Civil War came along and interrupted proceedings; also, it turned out that while the camel's feet are admirably suited to the *sandy* deserts of Africa and Arabia, they do not stand up well in the *stony* deserts of our West.

For a while camels did industrial load carrying. A number escaped; others were set free by disappointed owners, who turned to horses and burros instead. There were wild camels for a short time, but they made themselves quite obnoxious—no difficulty at all for a camel—and were shot.

Only two things remain of this episode—the bells, with the letters U.S.; and rumors that offspring of those camels still roam the western deserts. The scientists at Tempe are certain that no camels roam in their vicinity; but they concede that possibility for the areas bordering Mexico, where there are sandy deserts.

Speaking about the difference in the deserts: you can't grow the desert plants of Africa in the Arizona desert—the sun will kill them off. This, at least, is the experience of the experts in the fabulous Desert Botanical Garden near Phoenix.

When I got there—my hostess at the Hudson Lodge had insisted this was something I had to see—I was puzzled by a metal structure. It did not look reasonable, being merely a skeleton of angle iron supporting a lot of parallel metal slats. It certainly would not keep out the rain (if that was the intention), and the plants growing there did not look as though they needed anything to hold onto while climbing. In fact, they didn't look as if they *could* climb, even if you promised them fertilizer. Well, as old Dr. W. Taylor Marshall explained, it was supposed to do something entirely different—namely to provide a diffused shade for his collection of African desert plants.

IT was also Dr. Marshall who told me a large number of facts about the giant *saguaro* cacti, which is the way they spell the name in Arizona—in botanical handbooks, the spelling *sahuaro* seems to be preferred. In Europe, they are known as "pillar cacti," which I consider a nice descriptive term. The botanical name is *Cereus giganteus.*

Easterners who see them for the first time in their natural habitat often wonder whether the plant is still alive. There it stands, stiff and inflexible, dusty and dry in the desert. Many of them are covered with holes, about an inch across, made by woodpeckers. After the woodpeckers leave, a tiny sparrow-sized bird, the elf owl, takes over the hole.

Those *saguaros* are among the slowest-growing plants. Dr. Marshall has a collection labeled by age—5, 10, 15, 20 years and so on—all of which you could keep on your desk in pots so far as size goes—a 40-year-old specimen was barely higher than my knee. But those that grew outside were more than, ten feet tall; they count a century of growth for every six feet.

When they are very young, the sun is their enemy, for a one-year-old saguaro, being about the size of a pea, can grow only in the shade of a bush. Fifty years later, the bush is gone, and yet the cactus is still very young, but strong enough to live in direct sunlight.

They don't have a tap root, but a horizontal root system which, in an old and massive specimen, may cover a circular area sixty feet in diameter. When it rains, they can absorb water at a rate which is not rivaled by any plant on earth; and they are built accordingly. When you look at them, with their vertical ridges, you visualize a wooden skeleton something like that of an airliner's fuselage: long stringers held in place by circular members. Well, it is somewhat like that—the long stringers, vertical in this case, are there. But they join at irregular intervals, and each joint is between two "stringers" only; there are no circular members; the plant can expand *fast* when there is a chance of getting water.

When you see a picture of a *saguaro,* you usually recognize it by its odd branches; but every once in a while you find one which really looks like a pillar. I wasn't there long enough to see one in person, but I was shown a photograph of a 14-foot straight and unbranched specimen, which had grown up in a sheltered spot. According to Dr. Marshall, this would be the norm if they were all sheltered — the branching merely serves to balance the plant. They have 60-mile winds on occasion, and since *Cereus giganteus* does not have a tap root, such a wind often forces it out of plumb. Then it simply grows a branch to stabilize itself. It is not known just how this works —Dr. Strughold, with whom I discussed this later, guessed that it might be the tensed tissue. At any event, the branch does not stop growing when it is large enough and heavy enough to serve the purpose of balancing—it keeps growing, overbalancing the whole in the other direction, and so a new branch has to form to counteract the first. Dr. Marshall told me that he did not feel certain whether he should accept this explanation, and took a straight saguaro cactus, planting it at an angle.

It branched . . .

I can't leave off without telling the best remark I heard during the whole trip. The scene: a restaurant at the San Diego waterfront, at dinner time. The participants: two scientists from the Scripps Oceanographic Institute at La Jolla, California, Chesley Bonestell and myself. The topic of discussion: oceanographic expeditions—in particular, the last one of the Scripps Institute.

"Yes," said Dr. Hamilton, talking about the expedition: "they went to the Marquesas, and to the Tonga islands. They made a side trip to Samoa, and then went to Oahu. And then they came home to La Jolla and demanded a vacation!"

—WILLY LEY

ANY QUESTIONS?

I am annoyed by the nonsense of "weightlessness." Far out in space, if we could get there, maybe, but why should something be *weightless close to Earth? Recently some scientists have even said that one could be weightless in the atmosphere. If rockets got to be weightless, they would fly off into space and not fall back.*

Charles D. Collins
15203 *Fairway Dr.*
Santa Maria, Calif.

It is evident that you think "weightlessness" means that the body which is weightless is outside any gravitational field, specifically that of the Earth. Just because Jules Verne and H. G. Wells indulged in muddled and inconclusive thinking about the actions of gravity, this does not have to go on forever.

Let's try to clear up the problem by first stating what "weight" is. The definition which should be taught in school (but isn't, as I well know) is that weight is the result of fighting or impeding the pull of gravity.

As I sit here in front of my typewriter, my body cannot follow the pull of gravity. It is supported by a chair, the chair is kept from following the pull of gravity by the floor, the floor is, in turn, supported by the ground. The result is that I am prevented from falling, which gives the sensation of weight. If I were not prevented from falling—in other words, if I could follow the pull of gravity freely—I would not feel any weight.

Therefore: a rocket which falls back from its peak altitude of, say, 110 miles is under the influence of gravity, all right, but weightless since nothing impedes its fall until it enters the denser layers of the atmosphere.

Recently I heard a scientist say that a body could be weightless and still have its full inertia. Did I understand this correctly and if I did, how can this be?

W. A. Robertson
2233 *Canyon Drive*
Santa Monica, Calif.

First, please read my reply to Mr. Collins as to the definition of weight. But whether weightlessness occurs inside a gravitational field, near a space station, for example, or so far from any gravitational field that it is due simply to the absence of gravitation, the inertia of a moving body is not changed.

This can be realized best by looking at the formula for the inertia (more precisely the kinetic energy) of a body. It reads m/2 times v^2; you multiply half of its mass by the square of its velocity.

No factor which has anything to do with a gravitational field

appears in this formula. It is merely a question of the body's mass and its velocity. While the concept of something as massive as an iron ball, without weight but with all its inertia, might be strange at first glance, it is nevertheless correct.

The question voted among us as "the question we'd most like Ley to discuss" is the following: What is the basis of Einstein's Theory of Relativity?

Martin Evans, Pres.
Miami Beach S.F. Club
1329 *Penn Ave.*
Miami Beach 39, *Fla.*

This is a hard question indeed, partly because of the subject matter, partly because different people are likely to have different opinions as to what they regard as the most important tenet; the tendency then being to regard this as the "basic" idea.

One man may quote Minkowski's statement "space in itself and time in itself sink to mere shadows and only a kind of union of the two retains an independent existence" and consider the concept of space-time the "basis." Another man may feel that the elimination of the "ether" and the explanation of gravity as a kind of "illusion" is the most important. Still others might insist, with much justification, that the "basic" thoughts are those which got Einstein started; like the "contraction" of George Francis FitzGerald, published by him in 1892 and, about half a year later, by Hendrick Antoon Lorentz, and now usually called the Lorentz-FitzGerald contraction. Or the concept of the velocity of light as the limiting velocity, first published by Jules Henri Poincaré in 1904, a full year before Einstein announced his.

Poincaré stated *le principe de la relativité* by saying that the laws of physical phenomena must be the same both for a fixed and a uniformly moving observer, so that the observer himself cannot possibly tell whether he is in motion or not. Then he continued that this required *une mécanique entièrement nouvelle, qui serait surtout caractérisée par ce fait qu'aucune vitesse ne pouvait dépasser celle de la lufière.*

In English: "an entirely new concept which, above all, is characterized by the fact that no speed can surpass that of light."

Any one of the concepts mentioned may be considered "the basis," but I think that most physicists might agree that Poincaré's enunciation of the principles is "it."