



... "But it's a mirror image of the whole sky; the constellations are reversed in their relations to one another. ... It is as though the galaxy were spread out on a sort of mercator's projection!"

The Gimlet

By Victor Endersby

IF we give the subject any consideration at all, doesn't it seem as though man really leads nearly a two-dimensional life? He has never risen a thousandth part of the diameter of the earth above its surface; he has never gone but a fraction of that distance below. How far has man gone below the liquid plane of the ocean? What might not be hidden within the bowels of the earth? More and more we turn our minds toward the further delving within the ocean depths and within the depths of the earth. And it seems to us not altogether reasonable that we should assume that there would be nothing new to be found at the greatest depths. Our new author has devised a truly ingenious method for "looking inside the earth" in this clever yarn, though he adheres closely to sound scientific facts, which, being an engineer, he is qualified to do.

Illustrated by MOREY

"HRRARPH!" remarked George Balsey, sailing his magazine at the fireplace with more emotion than accuracy. The unfortunate volume, which happened to be mine, struck the mantel and fluttered to the floor, where its spread-eagled leaves curled gently in the heat from the grate.

"Now what?" I inquired, with a bit of warmth of my own.

"Oh, these so-called 'interplanetary' stories! If the writers were all lumped together they would assay about enough real imagination to enable a cat to come in out of the rain!"

"What?"

"You heard me! Look through forty carloads of this trash"—he waved disdainfully at the abused magazine—"and see whether you can find in one single 'interplanetary' story the glimmer of anything except combinations and recombinations of functions, mechanisms, and emotions all too familiar on the home-ball of dirt, tinkered together with all the lively spontaneity likely to be displayed by a farmer building a hen-house! And when they try to liven things up with a bit of 'love-interest'—gosh!"

This was getting a little too much. Although my course was engineering, astronomy was my hobby, and some of the stories thus severely criticized—George was so intense—supplied the starting point for trains of imaginative thought, which decidedly moonlighted the sober college pathway paved with mathematics and mechanics of materials.

"Well," I said, "it's a pretty well-known psychological fact that nothing can be conceived whose elements at

least do not lie in past experience. It's so in all literature and art. The imagination comes in the construction of new combinations from the old elements."

"All right; but why be so stultified? I could go out here on the campus and in fifteen minutes find two brains, whose respective outlooks and thought-flavoring would present more contrast than any difference I have yet seen described as existing between human beings and inhabitants of other worlds. Yet the most primary common-sense shows that such inhabitants would of necessity be so differently organized from us, as to be wholly beyond our power of conception. Flammarion, the first real speculator on these things, showed that very clearly. Now to my way of thinking, we ought to do something to explore the infinitely more interesting—and more accessible—regions near at hand, instead of sterilizing our brains on these long trodden treadmills."

"What regions, for instance?"

Balsey leaned toward me, his long nose quivering with eagerness and a glinting light in his eye.

"Go two miles into the ground," said he, "and you will be in space never yet penetrated except by the power of imagination; go ten, to find matter in states of which physics gives us only the most fallible and speculative ideas; go two thousand, and you will find yourself in the heart of the most contradictory mystery—short of Einstein's brain—which has ever perplexed a respectable branch of science. And as an honest-to-goodness student of geology—I said *student*, not a college boy tossing an occasional sop to the faculty in the way of study just to be able to hang on to the academic social whirl—I know what I'm talking about!"

"All right, Mista Bones. What's the big mystery?"

"This. The calculated weight of the earth gives it an average specific gravity about five to six times that of water. The surface rocks only run about two and a half, most of them less. There are something like three different ideas as to why this is; various authorities calculate that the core is composed of unusually heavy stuff running anywhere from gold to iron, with the size of said core necessarily varying. One duck says glass—why, I don't know and neither does he.

"Under tidal action the whole globe shows a rigidity about that of steel, which seems to check up with the calculated weight more or less. But now look at this: (Incidentally I am aware that you know all this, but I'm showing you how to *think* about it.) An earthquake sets up two kinds of earth waves; one runs around the crust and the other goes straight through the material direct to the seismograph. But if the center of shock is so far around the curve that the straight line wave path cuts below a certain depth, *it doesn't get there*. That indicates one of two things—either the core is pretty completely liquid, or it is hollow; the wave just falls into a vacuum, as it were. Liquid doesn't jibe with the rigidity; a liquid core of that size would leave the earth about as resistant to tidal action as a rubber balloon filled with mush. And there is no known sanction in physics for a hollow center—in fact it would upset our entire physics of astronomy, to say nothing of the weight business."

"Well," I said practically, "just what do you propose to do about it?"

GEORGE suddenly shed all levity.

"Bill," he stated, "this thing has haunted me for years. We actually know a thousand times more of the composition and life-history of the farthest visible star than we do of the deeper rocks under our feet. I can put up with a large volume of the unknown when I can look at the location of it with my own eyes; it takes the curse off the mystery; but the stars are prosaic as compared with the unfathomable underfoot; an unfathomable volume, whose surface manifestations from time to time mean life or death to the human race. Some day, so help me Hannah, I'm going to poke a hole into this crust, further than anyone has ever dreamed of going—except in fiction!"

"Then, as a matter of practicability, you're biting off a bigger chunk than any interplanetary dreamer. So far as they've gone with the rocket idea of flight, there is no engineering impossibility in traveling to the moon. When some bright lad finds out how to do it and get there alive, it may actually be done. But Lord, look at what you're up against to go even a few miles into the crust." I began to warm up to the subject a bit myself.

"Suppose we take as a minimum weight for the sub-surface rocks, one hundred and fifty pounds per cubic foot; or for simplicity call it a hundred and forty-four which gives one pound pressure per square inch for each foot depth. At a mile you have over five thousand pounds per square inch, which is crushing stress for plenty of rocks. To get the crushing strength of steel, you have only to go seventy thousand feet, or about thirteen miles. At that depth practically any known rock would flow. A few miles further and no known material, in however small a tube, would keep a hole open. Yet even there you will only have scratched the orange peel, while the deepest holes ever actually sunk have been about eight thousand feet—in a California oil-

field. Get down a thousand miles, and you have over five million pounds per square inch! No one can guess in what state matter would exist at that depth.

"But we have not even bothered with the matter of temperatures. At such depths, provided the increase of temperature holds with accepted observations, any known substance could exist only as vapor, except under tremendous pressure. As to keeping an open hole—! No, George, you'd better turn your efforts in the direction of a journey to Mars, with the object of proving how unimaginative the fictionists are. There's at least *some* hope in that direction."

"And after all that verbiage," George remarked sarcastically, "all you've said is that the job can't be done with *ordinary* methods!"

"Nor with any extraordinary ones conceivable to the mind of man!"

"Of course you have bounded the infinite and unscrewed the inscrutable long since, with your engineering formulas and characteristics of materials. But I just have a dim shadow of an idea that there may be a totally different method of attack outside the realms of engineering as now known—that there *might* be some way of holding back those pressures, of neutralizing those temperatures, with materials and energies yet to be developed."

"Well," I said, "there is *one* type of wall capable of standing such pressures—the wall of an atom!"

George gazed at me solemnly, a kindling fire behind his eyeballs.

"Gosh, that's a thought!"

It hadn't occurred to me that it was; I felt flattered.

"All right, then," I said, "when you get your trained atom ready to sink to the center of the earth, and get yourself comfortably seated on the nucleus, just call me and I'll come take a look!"

That didn't register; George had obviously started off on some inner trail, dropping a portcullis behind him; and the conversation feebly petered out for lack of nourishment, until I gave it up and turned to on my books. George spent the rest of the evening mooning in a concentrated manner, and scratching aimless diagrams which occasionally approached a semblance of sense but never quite reached it.

In succeeding days I became aware of the fact that that careless conversation had bitten deeper than I had anticipated; George had seen an opening into one of those fool problems which periodically engrossed his speculative attention, and I became slightly conscience-stricken over the heedless words which had led him to waste time on such a wild-goose chase.

I became considerably more concerned at the beginning of the next semester, when he registered for an extra course in intra-atomic physics, while his reticence indicated that he was actually following up the dumb idea, but was taking no chances on being laughed at over it.

I THINK that in course of time he would have gotten over it, but for an incident during our graduate year, which threw him back hard upon his hobby for an interest to keep on living by. His girl died. That doesn't amount to so much these days ordinarily; but George's life had been wrapped up in that girl for several years, without any apparent decrease of fervour—not that I could blame him—judging by what I knew of her. The shock quite jolted him loose from normal things, and tasting by

experience the sweet forgetfulness which comes from intense concentration, he turned all his energies along the lines of his increasingly absorbing interest—apparently afraid to let himself think of other things. It was all a great grief to me; these real and deep attachments—like what the Victorian novelists used to write about—are so rare in these days of matings and partings as casual as those of cats on the back fence, that it seemed an intense pity that two, who could have known deeper things than ordinary people; should have been pried apart like that.

Anyhow, even before the completion of our course, George and I, though as friendly as ever, had drawn markedly apart in mutuality of interests; and the subsequent five years deepened the gap. I worked hard at my profession in this and that hole and corner; George went into the research laboratories of the Universal Electric Corporation, relegating his old love, geology, to second place. After four years of that, during which one or two bright ideas had elevated him somewhat above his contemporaries, but not to any special place of eminence, he came into a wad by inheritance; I heard indirectly that he then secured water rights on a High Sierra stream and was building a private power house.

Early in the spring of the subsequent year, I was startled to get a letter from him, inviting me to pay him a few weeks' visit at his mountain lodge near Huntington Lake, out from Bakersfield in the San Joaquin Valley. It was about time for my vacation; I liked the mountains, and along with the prospect of renewing a friendship, which had been close once and might be again—together with a goodly admixture of curiosity—I accepted quite eagerly. I found George seemingly in good health, considerably mellowed in manner and mannerisms by the years, and glad to see me. It was obvious, however, that the last of his college superficialities had gone; he was very evidently a man whose life had turned inward, ridden by some train of thought, whose intensity rendered ordinary interests only moving shadows to him.

I was much surprised at the magnitude of his power plant; he had made some arrangement with a power company to pass their supply through his turbines and on down-stream, and had a plant sufficient to supply a large city. He was quite alone in the place. After a typical mountain meal cooked by himself, he turned to other matters.

"I brought you here, Bill," said he, "not merely to renew friendship, but to see my 'trained atom!'"

So! Then he had either actually worked out something—or was worse in need of a friend than he knew. I did not feel easy; the expression of his face was too intense, too absorbed.

"Well! That's interesting! Shoot—but load with words of one syllable!"

"You need not be quite so solicitous," he smiled, eying me keenly. "Or, anyway, save some of it for yourself. I may as well go into the matter fully. It was your reminder of the 'wall of an atom' which started me on that line—which is one reason you are here. I began to think. The wall of an atom is capable of resisting any pressure short of that found in some of the giant stars. It is the kinetic force of the spinning electrons—together with their magnetic fields, perhaps—which keeps the nucleus isolated in a sort of vacuum—so far as matter is concerned. Now the idea which struck me was, suppose that one could create a sort of super-atom large

enough so that one could really 'sit on the nucleus.' One could then observe from inside as through a glass wall, untouched by either pressure or vibrations from outside; the whirling electron-shell would form a sort of diving-bell, in which you could descend into molten rock at any depth without harm.

"But very simple calculations showed that the formation of such a super-atom, even if the procedure were found, would require putting into the electrons more energy than is found in the whole solar system. Nor could any matter ever get into or out of it, once formed. Then it struck me—suppose one could keep an opening in it? And right along with that, came the idea that if an opening could be maintained, the thing would not have to be so large, because some very minute form of observing instrument could be inserted inside. This led logically to the conception of a cylindrical atom. The ordinary atom consists of a series of electrons whirling in orbits inclined in numerous directions to one another around a nucleus built of protons and some electrons for most elements. The electron-shell is thus spherical. But why not a cylindrical atom whose electrons would revolve around a bar nucleus? If one could find some way of disintegrating matter, the scattered protons and electrons would instantly seek their affinities, forming new atoms of various kinds. Supposing disintegration possible in the first place, why could not the reaggregation be controlled to form a new sort of atom? I conceived the idea then of applying disintegrative forces to any matter which was to be penetrated, meantime supplying a magnetic field of such nature as to cause each successive group of electrons and protons to add themselves on to a lengthening cylinder already established.

"FROM that point I began to get in earnest; it was then I decided to spend all my spare time on intra-atomic research. From the first the magnitude of the problem was manifest. First, disintegration of matter requires a tremendous input of energy, although the practicability of doing so within the limitation of available energy may be admitted. Second, the nature of the tremendously powerful field—magnetic, cohesive, gravitational, whichever you want to call it—between the nucleus and the electrons, was wholly unknown; is yet except right here. Its equations had to be discovered, worked out, and the means to control it found.

"The huge size of the necessary atom was another sticker. At first calculations it appeared that a half-inch between the bar nucleus and the electron cylinder would be the minimum possible in which power wires and perceptive instruments could be inserted. Whether such diameter would be practicable could only be determined by finding out the underlying laws of atom-formation and of the intra-atomic field. While I was accomplishing a certain amount of progress, there came along Hersinger's admixture, which, applied to quartz glass, would cause a rod of it to crystallize in such a manner that a definite image could be transmitted through the rod, the end crystal acting as the receptive lens. Thus one could see quite clearly around a corner with such a rod; you will remember that in the 'twenties' quite a bit of practical use began to be made of the light-transmitting qualities of quartz glass. So I figured out that if one could push a cylindrical atom into the earth, keeping inside of it beside the nucleus an image-transmitting quartz rod, and another plain rod to carry light down

from the top, one could magnify the image at the top and get any information he wanted as to the nature of the material passed—so far as sight goes. I was further helped by the contemporary discovery in the Universal Laboratories of the new alloy which was given the trade name of 'conductium'—a substance of such nature that a microscopic thread will carry electric currents which used to require heavy copper wires. As you know, it revolutionized electrical power transmission.

"Putting together a few of my own ideas with everything developed year by year by twenty or so of the great scientists, who were working along atomic problems, I finally discovered what appeared to be the key field-equation. I knew *how* to create an atom of any size—next thing was to do it! The observing apparatus, I found, could be carried down a tube not over an eighth-inch in diameter. The size of the power lines of conductium would of course depend on the size of the atom, as well as upon the rate at which one expected to disintegrate matter and add to the length of the cylindrical atom. I figured that about the minimum length of time I wanted to spend on reaching the center of the earth—4000 miles—was five years, or eight hundred miles per year. That figures to about two and a fifth miles per day, which would also be slow enough to make full observations of the material passed. Finally I worked out that the necessary rate of disintegration for a one-eighth inch cylinder, would allow of the transmitting wires to be put in the same size cylinder. Thus the final picture was a cylinder an eighth-inch across, revolving around a bar nucleus, with two conductium threads and two tiny quartz glass rods spaced around the nucleus. The glass would have to be drawn by special apparatus at the top and lowered as the end of the cylinder grew.

"Of course, I had no idea of putting into the electrons even a millionth of the kinetic energy, which they would contain; it was simply a matter of teasing them into leaving their original orbits and jumping into the new ones, retaining all their energy. That was a matter first of jolting them loose from their original locations and furnishing a field which would guide them into the new. The apparatus to supply that field, fed by the conductium wires, is quite microscopic, very complex, and along lines which I couldn't describe, because I couldn't understand it myself, if I hadn't lived with this problem for five years."

BUT how about the tremendous energy released by breaking up the atoms? I thought it had been calculated that it would be enough to blow the planet to powder."

"Bosh! Millikan showed as long ago as 1928 that atom-formation is a power-emitting process; though in spite of that a lot of misguided idiots persist in talking about using 'atomic energy.' If you want to get explosive power out of matter, you will have to do it by making atoms, not by breaking them—a very wise provision of nature against human foolishness; nature having likewise thoughtfully omitted to supply any atom-making materials. In fact, I have to use a God-awful amount of power at the end of my tube; that increases the kinetic energy of the atoms attacked, just enough to spring them out of their orbits to where they are caught and held by the end-protons of the bar nucleus. The big problem was to furnish a cylindrical field, the normal atomic field being spherical.

"So far so good; but when I got to practical applications I found I'd hardly started. In the first place, the huge diameter of my cylinder, almost astronomical in comparison with a normal atom, made about the same difference in the nature of the field as there is between the field of a kid's magnet and the gravitational field of the sun. Following some preliminary experiments, I had to figure out a new set of field equations, which were neither fish, flesh, nor fowl, so far as any previous ideas were concerned. My atom is really a pseudo-atom—a mechanical device rather than an atomic one. Then the effect of the transmitting wires and rods had to be taken into consideration.

"The ordinary atom has no such gadgets between its nucleus and shell; and I found that condition to be another monkey-wrench in the machinery. Then came the question: will an electron-shell, dense enough to stand such great pressures, also transmit the light necessary for observations? And if it transmitted the light, would it not also transmit enough heat to destroy the apparatus? Well, I found that the transmissive qualities could be modified by varying the handling of the field; and I arrived at a density which would keep out matter, transmit light, and keep out dangerous heat. But I also found that light transmitted through the inner field of an atom is something very different from light through space. That led to some chemical research and modifications of the quartz lens. I finally had to run some extra conductium thread through the quartz and introduce an apparatus to modify the light rays in order to get a correct picture. That was penultimate; the final step was to verify the accuracy of the work by pushing the cylinder down to known strata and examining the transmitted picture of the rock texture for comparison. After a long struggle I got a true image; and—the probe is ready for the patient. Want to see?"

I did—not unnaturally. We passed through an echoingly silent power-house to a small room, doored somewhat like a bank vault, with immensely thick walls. George explained that not only was this the case, but that some of his apparatus was mounted on special foundation materials to eliminate earth tremors and vibrations from the power-house. The center of the room was occupied by a large bakelite fitting, into which entered three very heavy insulated cables. The inside of the fitting was so thoroughly boxed off that I could guess nothing of the details.

"It isn't an ordinary current that I use—in any sense," explained George. "And it isn't used in an ordinary way. To expose any of the carrying fittings to the air would be dangerous; anyway, I've got uses ahead for this thing when I get done with the present job, and I don't wish to expose it to any unnecessary publicity. See those wires?"

Three tiny filaments of conductium dropped from the fitting through a minute hole in the concrete floor, accompanied by thin quartz glass rods; they did not occupy as much space as an ordinary copper power wire of medium size. I saw nothing peculiar about them, except that now and then I sensed an evanescent bluish haze which seemed to surround them.

"Take a swing at them with this," he said, handing me a heavy steel bar, "but watch your fingers!" I looked at him questioningly. It seemed like a rather pointless destruction of apparatus which, whether worth anything or not, must have taken time and money to produce.

"Go ahead!" said George. Moved by curiosity and the little imp of destruction which nests in every human breast, I did so, putting plenty of vinegar into the wallop, while I was at it. The bar clanged across the room, rebounding from something which gave me the impression of greater solidity than anything I'd ever encountered; I nursed my stinging fingers and swore with devotion, while George went off into heartier laughter than I had seen him exhibit since his tragedy.

"*That was my atom you hit,*" he elucidated. "My little, fragile, eighth-inch atom!" I looked at the faint bluish glint more in awe than in anger. Of course; a thing which figured to stand earth-core pressures would hardly be phased by the application of a mere steel bar, however vigorous. A queer feeling stole over me; it was incredibly before my eyes, that George had done the thing he had set for himself. I felt like one who has dreamed of seeing a foreign country all his life, his pictures thereof becoming so flavored with the dream-feeling, that he cannot immediately sense the reality of its first-seen shores. The odd, weird foreboding which I then began to sense, and subsequently never quite lost, was not very rational; but even so, it was but a puny prophetic measure of what later came to pass.

THE quartz glass rods extended through and above the fitting, into an apparatus fitted with a large lens, through which the light, after passing, was directed at a tall, thin ground glass screen about five feet high and six inches across. Back of the lens apparatus stood what looked like an electric furnace, mounted on a standard in such wise that it could be swung sideways. At one side of the glass stood a powerful microscope, likewise mounted, and on tables around the room, was an assortment of gadgets, with some of which I never did get particularly acquainted. They were added to from time to time during the odd months which followed.

"Gosh!" I remarked. "How far have you sent it down?"

"Only about three hundred feet so far. I just wanted to make sure it was all right before I got you to watch the actual tryout. It's like a show—you never can really enjoy one alone." The note in his voice on the word "alone" struck me rather sadly; a thought passed across my mind that there was a little morbidity here.

George threw a guarded switch, and the air began to hum faintly but pervasively. Upon the ground glass an image appeared. I stepped curiously around and inspected it. It was the perfect representation of the texture of granite, magnified about two hundred diameters. The rods glowed brightly.

"About a foot from the bottom," George explained, "the receiving lens of the quartz rod is turned toward the wall of the 'atom.' That gives me an image about a thirty-second of an inch in diameter, which is magnified on the screen as you see. The great clearness is due to the quality of the light, which I am able to transmit through the other rod. If I want a closer examination, I just swing the microscope into position to inspect the back of the screen, and can magnify the rock texture to nearly any size I please. So I not only have a unique scheme on the whole, but a system for mineralogical exploration which rather goes beyond anything yet, so far as the microscopic end is concerned. However, I've never been able to get a start on bringing actual samples to the top. Everything inside the 'atom' shell is de-

stroyed during the re-creation process, and I can't get anything through it afterward—you know that; you've just tried it!" he grinned.

"I think, though, that microscopic and spectroscopic examinations will give me everything worth knowing about anything I strike." Ah, how tragically inadequate did that idea turn out to be!

George hoisted the apparatus up until the image fell near the top of the screen; then pulled another switch. The lens traveled rapidly down along with its image until near the bottom; there was a click, the lens rose again to the top, minus the quartz glass rods; the furnace thing swung around, engaged with the lens machine, then clicked away again, leaving the rods restored; then the lens ran down again. The whole cycle took about thirty seconds for the five feet, or two inches per second, which gave time for a watch on the texture thrown on the screen. In case of anything unusual or interesting, the thing could be stopped for a detailed examination. Meantime the observer could sit quietly and watch the business go on automatically.

Enthralled, we spent the entire night watching the passing strata, the tip of the atom by morning being nearly eight thousand feet down, having been in monotonous igneous rock for the last two thousand or so, after passing through numerous interesting but not remarkable stratifications. George then sprung a new one. He set in place a compact little movie camera, mounted on another of those sliding standards, and electrically driven. It synchronized with the vertical motion of the lens, automatically recording the image thrown on the screen.

"Whenever I am away from the apparatus," he said, "I just set this going. Then, when I come back, I have the image automatically projected on another screen, keeping an eye on both at once. If it should turn out that I missed anything special while away, the lens at the end of the rod could be raised back to that level for closer examination. Otherwise I would have to hire two trained observers to help me, or miss about two-thirds of the scenery."

"And just what do you expect to find on this long range tour?"

"I expect to find more or less interesting minerals, and maybe some valuable geological information, for about two thousand miles down. After that I am carefully not expecting anything, because whatever I expect, it will be different." Well; his foresight was good, but his estimate of distance not so good.

On this occasion I stayed with him two weeks, during which time the probe went to about thirty-five miles without encountering much of great interest except two pockets of white-hot matter. The combination of great heat and pressure produced some spectroscopic modifications which no doubt were very interesting to professional physicists, but meant little to me. The material was ordinary molten magma.

BACK at my own business, pondering from time to time over what had been accomplished, it dawned upon me gradually that erratic old George had come to be one of the foremost, if not *the* foremost, in the land of science. To say nothing of the wonderful possibilities in practical application to subsurface exploration, he must have mastered not only everything hitherto known of atomic physics, but about twice as much more. Had

I been in his place, I would by this time have been lecturing to vast audiences and organizing mining companies on an entirely new scale, instead of soberly poking day by day further into the earth's monotonous innards.

So I went on about my business, determining more and more to make real use of George, when he got over his present experiment. I sounded him out gently on the subject once or twice, but got no rise, and decided to let the fever run its course, though keeping in fairly close touch. The atomic drill bit on and on until the second year and the eight hundredth mile were reached. Then things began to liven up. George had been busy most of his time digging into new applications of spectroscopic analysis, that and the microscope being the only means by which he could penetrate the wall of his "atom," which shut him off from contact with the rocks a hundredth of an inch away as effectually as the starry reaches of space withhold the astronomer from burning his fingers on Betelgeuse. In the course of time he found a means of measuring not only the heat of the rocks, but the pressure on them. Both heat and pressure had gone according to Hoyle for about five hundred miles, being almost incalculable at that depth. One thing he had wanted to find—whether the rock was liquid at such depths—he had not been able to determine. In fact, the word had no meaning under such pressures and temperatures. No doubt a fragment of solid suddenly transferred from that depth to the surface would have exploded instantly into incandescent vapor. But even the glowing materials occasionally found at first, ceased. Evidently the atoms of the material down there were held under such pressure that they could not radiate light.

But at five hundred miles the story began to change. The monotonous character of the rocks altered, giving way to metals more and more; the lighter metals, of course, came first, then heavier and heavier, without any definite demarcations. But also about this time both temperature and pressure ceased to follow the old rules of increase. They began to grow less rapidly. And when at nine hundred miles nearly everything had disappeared except such heavy stuff as platinum, lead, and gold, George began to get feverish; and for that matter, so did I. Being his only confidant, he called me in to check up his analyses, and particularly his calculations of the weight of the earth derived from the strata encountered. This last was positively disquieting. The weight of rock per cubic inch had increased measurably for a long time past, owing to the great compression. The same was true of these metals. *But even with the old weights, the mass of the earth figured out to be many times what any scientist had calculated it.* And it was a cinch that the gold and the rest were not floating on some lighter metal; if anything, the material would go on getting heavier. It even appeared reasonable to suppose that there would be just so much gold, and that then we might find some new element much heavier.

At this point the thing began to haunt me. It was evident that we were on the track of something which would upset the science of celestial mechanics in some direction or other—provided we could get someone to take stock enough in the stuff to check up on it. Pressure and temperature increase continued to slack off until the thousand mark was reached. At that point or thereabouts they were at their maximum but had been nearly there for some time previous.

A FEW weeks later I got a hurry call from George. "COME QUICK NEVER MIND JOB GOING NUTS I THINK," he wired. I don't know just what I expected to find, but anyway, what I did find was startling from one point of view and prosaic for another. He handed me the reproduction of a spectrum. "Mull over that while you eat," said he, "and see what you make of it." "Mull" was the word. The thing didn't resemble anything I had ever seen; and in the course of my mix-up with George, I had absorbed a lot of spectroscopic lore. George wouldn't elucidate. He said that he wanted to see whether I saw the same thing he did; so I found myself up against several hours of stiff study, during which he watched me eagerly, albeit wearily. Finally there drifted across my mind one of those feelings of something just beyond the grasp of comprehension. I groped after it painfully for quite a while, then I too saw. "But there ain't no such animal!" I said.

"Well," grinned George, relieved, "since we both see it, I guess there is; that is, if the calculus of probabilities still works! I'm beginning to doubt the accuracy of everything from mathematics on down!"

"But an atomic number of seven thousand, three hundred and forty-seven!" I gasped.

"Divide by ninety-three," he smiled, "then see if it looks easier!" I did.

"But that's the atomic number of gold!"

"Just so."

"I can't make any sense out of that!"

"Well, the last time I looked at the screen there was another on it; try that one."

Two more hours of labor elapsed, and there lay on the paper the mystic number, "7626."

"Do the same thing to that," he said.

"Lead!" I gasped.

"Yes! All right; now write your own answer to the conundrum! What material has an atomic number of 93?"

"Why, that's the beginning of the transuranium series, supposed to be found in the interior of the stars and to make up about 98 per cent of the matter of the universe!"

"In other words, we have before us the gold and lead correspondents in a series where the atomic number of the hydrogen correspondent would be 93, or just one beyond uranium, the highest known atomic number!"

George leaned back with a tired but relieved sigh.

"Well, it takes a load off my brain cell to know that there are two of us, anyway. Now just take your little pencil and figure the weight of the earth according to the new dope."

I didn't care to just then. The whole thing was getting a bit beyond me; I had a feeling of—well, almost of the supernatural, as though we were pushing beyond the boundaries of the allowable universe. I couldn't feel that I would ever walk on the face of the earth with a sense of familiarity again. What other weird mysteries did its tame countenance hide? As to the weight—in a dim way there crossed my mind the feeling that it would be more than the solar system had been believed to be. Suddenly I sat up in more alarm.

"Ah," said George contentedly; "I see it struck you too!"

"You mean—the drill is now going through a lighter element?"

"Yes—it passed out of gold into hyper-gold; now it is in hyper-lead, the lighter element."

"Just as though it has passed the core of the earth?"

A strange medley of half-baked conjectures flocked chaotically through my mind. What was that about Einstein . . . Einstein . . . the curvature of space . . . matter in space. . . Ah! Now I had it! The Einstein theory stated, first, that matter in space brought about a special curvature; second, that three-dimensional space itself was curved in a hyper-space. Was it not quite possible then, that the presence of such vastly heavy substance brought about a curvature, which shortened the earth's diameter to about half? The idea comforted me, because solid mathematics seemed able to get some grasp on it. God knows it was weird enough to think of a globe with a circumference six times instead of three times its diameter; but it was better than the formless ghosts which had begun to troop into my mind from outer space. If I'd really known Einstein practically, I would not have had even that temporary stabilization. Would to heaven the problem had been so simple!

I was rather glad to get away next day and bury myself in more mundane matters; though obviously what I had lost in complacency, George had gained in the comfort of knowing that someone else saw the same things, and that if the thing was a hallucination, it was a double one.

THE story of the next year was a continuance of the experience; element after element was penetrated exhibiting the same succession in reverse order, which had been encountered on the way down, but all showing that multiplication of the atomic numbers of surface elements. The incredible stupidity into which the strange experiences had bludgeoned my brain may be measured by the fact that I did not realize for a month that the drill *could not* be approaching the other surface; otherwise the world would be an entity lopsided to an incredible degree, because of the difference in weight!

Again the sense of a haunting ghost just beyond the grasp of the mind began to disturb me; again and again an explanation seemed to be at hand, but always mockingly retreated into the shadowy recesses of my cerebrum. Broaching this to George, I found that he had never for a moment felt that the explanation lay anywhere in the sane mathematics of Einstein or of anyone else. He had simply ceased to speculate upon any explanation, and concentrated for the sake of sanity on driving his machine onward with the utmost possible speed, and upon working out a chemistry and physics for this new world of matter. From time to time we discussed the possibility of calling in some scientific authorities; but for various reasons never came to the point. Principally, I think, because we felt an intense desire to have a completed job to present; also partly because, without a sensible explanation, we would never be able to get scientists to investigate far enough to convince themselves that it was not all a fake.

Finally the time arrived when premonitions of an approaching surface—by correspondential phenomena—began to show up. I took leave from my job and stayed with George, both of us practically living on tiptoe, hardly eating or sleeping enough to keep sane. We no longer left the recording of any part of the tale to the automatic movie, but stood watch and watch, four hours at a time.

It was in the middle of my watch off, on one of the those cloudy, lowering, mysterious nights when any-

thing seems possible, that I roused wildly out of a heavy lethargy to become conscious of George's frantic grasp.

"Bill, shake out of it! For God's sake make it snappy!" he yelled.

Yanking a bathrobe around my shoulders, I stumbled sleepily and somewhat terrified, to the little room. I think that I would have been prepared for anything except what I saw. Gigantic caverns populated with strange monsters; the very flames of Hades, I think, would not have been so disconcerting.

He had some time since rigged a screen covering a whole wall of the room, and introduced much improved magnifying apparatus, so that the lens could now be stopped down and an image ten feet square thrown. Such an image now rested on the screen; and if we had not known that it emanated from some source two thousand miles below our feet, it would really have seemed quite prosaic. As it was, its very seeming familiarity produced most of its terrifying weirdness. On the screen, then, lay a starlit nightscape. Under a glare of stars brighter than any familiar to us, lit as by moonlight on a moderately bright night, rolled a sweep of barren land, relieved by dim, gigantically high, mystically glamorous mountains in the far distance. With a great effort of will, we steadied ourselves, took seats and began to try to observe rationally.

The equality of the sky and the light struck us first. The stars were really of the quality of planets—myriads of them. They seemed to *swim* in some medium, rather than to be suspended in space. It was as though the whole of this strange space possessed a sort of crystalline viscosity; the stars and the air—if there was air—seemed *alive*. But the dim land itself, upon which nothing stirred, seemed to have such aloof, distant remoteness as is felt in those dreams where one seems to be traversing some infinite plain all alone in the Universe. It brought with it terror, the terror of utter loneliness, but mingled with it a strange, wild attraction; an attraction such as might be extended by the infinitudes of interstellar space to one miraculously made free of them. And as we grew calmer, and the image remained on the screen without alteration in any respect, there came a deep, seductive, insidiously pervasive sense of *peace*. Not the peace of temporarily satisfied desire, of ambition achieved, or of mental and physical comfort, but peace such as might be felt by one forever done with all mortal strivings, and attuned to changeless infinity and eternity.

It was not such a feeling as I had ever experienced and imagined; and I felt as though, were I to sit there much longer, I would be drawn out of all normal experience and character. Feeling a growing desire to yield and let that strange enticement take me whither it would, I jerked myself out of the spell with a strong effort and began to study details again, in an attempt to regain a scientific attitude of mind.

STUDYING the constellations, I saw about the fainter ones a queer familiarity, which puzzled me the more I tried to fathom it. Turning to George, I saw him sitting, rapt, with an expression which impressed me eerily. He was leaning forward, gazing at the picture as though his soul were about to climb out of his eyes. There was a look of mental and moral hunger about his face which shocked me, and I realized that the strange attraction which I had shaken off had gone much further with him. I shook him.

"George! Do you recognize the constellations?"

He turned to me half-dazed, half-angry, sat up and pulled himself out of it.

"Of course not—but wait! Yes; there *is* something . . . something or other . . . by Gosh!" His lethargy fell off like a cloak.

"Mirror-images!"

"Yes. But it's a mirror-image of the whole sky, the constellations are reversed in their relations to one another."

"It's more than that; what about the sizes?"

How shall I describe the effect upon our minds when we finally comprehended that it was as though we looked upon our entire galaxy from an infinite distance away—from outside it entirely? That in this lorn sky that galaxy, faint in comparison with the rest, occupied but a small space, and not formed as a globe which one sees from a side only, but as though the galaxy were spread out on a sort of Mercator's projection?

We even thought we could pick out and see our familiar sun—a distant star!

For long moments we sat motionless, looking at one another "with a wild surmise, silent upon a peak in Darien!"

Finally, "Let's get out of here and take a sedative!" said George. "My brain's going!"

We stalled around for an hour next morning, clinking our saucers, uselessly stirring our cold coffee, and doing a thousand and one foolish little familiar things to help anchor us to the humdrum, and postpone the stress and strain of a renewed grapple with the Unknown. Finally we had to come to it, however, and the last few feet could not be passed fast enough. What kind of dawn would have overspread that dim land in the interim? But there was no dawn. That mysterious landscape lay stretched without change above or below, in a starlit night which we now began to recognize was eternal. And with that thought came again that mysterious, terrifying seduction of peace, silence, and utter quiet. We busied ourselves with a bit of scientific analysis—I know of nothing which will take the glamor off anything quicker than that. We ran the drill on for a ways, which quickly determined that this landscape was reversed with respect to our own—that its mountains towered away from our feet. This was evident from the fact that the point of view rose in the air as the drill proceeded; without, however, vouchsafing any more information. We continued this until it became evident that all we would get would be more of the same, with a progressive dimming due to the growing height above the surface. Fearful of losing what we had, and apprehensive as to whether anything further could be encountered—certainly to all visual evidence we would be going on out into infinite space—we stopped the thing at about seven hundred feet, which turned out to be the final physical limit of the wild enterprise.

The day was spent largely in spectroscopic analyses. Investigations of this kind, carried out with feverish intensity, served to keep us from thinking and to stabilize our minds considerably. But every additional bit of information gained, but added another brick to the prison wall of incomprehension, against which we were battering our bruised brain-pans in vain.

At last, tired out, we faced one another across the table, too excited and nervous to go to sleep, too wearied for further experiment, and up against an *impasse* with

nothing to grasp even as the merest handhold upon some line of ratiocination.

"George," I said, "this is altogether out of our depth. We've got to have talent and lots of it—or we'll soon be having a brainsmith tinkering with our works. Millikan is hale and hearty; Einstein isn't in his dotage yet; Eddington and the rest of the Englishmen are holding forth as usual; how about it?"

"Uh!" he grunted. "Remember Galileo?"

"Bosh! They don't burn people any more for scientific heresy!"

"No, not people! Only their ears! How about Nodon, Cazzamali, and Clark; even Dr. Osborne? Bill, knowing the scientific men that you do, would you risk your reputation and livelihood in trying to get those men to look at this thing? Or having gotten them to do so, could you convince them that it was anything but a clever fake?"

I PONDERED deeply, running over in my mind the many scientific controversies with which I had been familiar. Comparing our present situation with that of any discoverers of the past, it came to me that almost never had a discovery been accepted, even by the most open-minded men, unless it in some way were confined to the status of an extension, a modification, or correction of an idea previously accepted. To present seriously that which would immediately toss into the discard every accepted basis of scientific thought, except possibly in chemistry, and would expose our whole conception of the Universe as being as arrant a dream as the Ptolemaic system—! I thought of the years of sweating days and studious nights which had now brought me within reaching distance of a real place in my profession; I thought of the children and wife, whose future hung so on my continued advance; I thought of the polite, half-hidden smiles of my colleagues and superiors, of the many courteous but effective ways in which opportunity is blocked for anyone suspected of being a bit erratic in the head, and consequently of doubtful reliability for sober and responsible enterprise. It was just a bit too much for my courage, and I told George so; beginning to wonder how many times, in such a tricky universe, other bold adventurers like him had encountered some hinder side of the mask of things; had so encountered, and, like me, had prudently kept silent; or had been foolish enough to speak and in behalf of accepted sanity had been browbeaten and kicked into silence, or charitably immured in institutions where their ravings could not flutter the veils of our comfortable illusions. And the more I thought, the more determined I became.

"But," said George, "so far as I am concerned, there is more than that in it. Somehow I just don't want that world discussed; I don't want it—profaned." And I could share with him at least a substantial part of the feeling.

It is strange how adaptable the mind is. Within two weeks, though certainly the mad enigma did not become prosaic, we were learning to live with it in some comfort; we at least ceased to let it dash off with our brains on mad chases which exhausted us and left us at the starting point. I left then, and a month later received by mail the semi-final glimmer of rational light which was ever thrown into that tenebrous universe.

"The only trace of a path out," wrote George, "is

furnished by Einstein's theory of the curvature of space due to the presence of matter in it. If space is capable of curvature, it must lie within a hyperspace; if so it must be dimensional. Its curvature guides the progress of heavenly bodies, therefore it must be capable of resistance—*inertia*. And it is not hard to imagine that in relation to hyperspace it has also mass of some kind. Mass, inertia, dimensionality—do not those words spell *matter*? But if space is material, then why not any number of spaces lying side by side in hyperspace, each with its own laws, its own matter, its own boundaries, which no vibration from within may cross? Is it not a corollary of Einstein that a straight line, the flight of a ray of light, for instance, following the curvature of space, returns to the point of its source, unable to pass the boundary of space? *Suppose then that by some incomprehensible means we have penetrated into another space than ours.* Our laws of radiation need not necessarily exist there, nor any of our measures of time or distance; the hidden universe we have on view might be contained within a speck of our matter; yet comprise, on its own scale of magnitude, distances far greater than any in the universe viewable from the surface of earth. Since the measure of magnitudes in any space are as real as those in any other, space enclosed within our earth might be *really* as well as theoretically vaster than any we have measured without. When the boundaries of a space are passed, such relations as 'the whole is greater than its parts' cease to have meaning."

This, thought I, is verily Einstein squared—or perhaps with the square root extracted.

BUT I still had some cerebral cells of my own functioning, and I replied:

"Well and good; but am I to suppose that this one globe has such a trans-spacial center, and none other has it? Or that every heavenly body has such a center? Where would be the sense or reason in such a mad, wild scheme? Causality has been traced in every working of the cosmos; but where is the systematic development of natural law to result in such an order of things? And above all, what is the meaning of that distant view of our galaxy, seen from inside the earth?"

"Did you ever stop to think," he wrote back, "that perhaps there are only two divisions of space, with a single boundary between them? That such a boundary would be *limitless* in Euclidean measurement, and that the only limitless area we know of is the surface of a sphere? That perhaps a thousand miles within our earth lies the boundary between an inner and outer space balanced against one another, archetype of the eternal opposing pairs of forces which keep the universe in being, and that on our side is an accumulation of *our* matter resting upon the boundary, upon the other side an accumulation of *that* matter? Can you imagine that the limited sphericity of our globe is merely the manner in which finite minds represent to themselves the limitless surface of our space, and that in reality that space is no more *enclosed* or *inner* than ours is?"

"If so, you can then perhaps take the next step—imagine that the objects of the one universe are *reflected* in the ether of the other. Since your visit, I have gone far in the spectroscopy of the stars in the other world, and I find them *constituted like the matter of earth*. That means that while our stars are transuranic principally, and our earth mundane, *those* stars are mundane,

and the earth over which they soar, transuranic! Further than that, I have located in a far-distant point of the Milky Way, the miniature constellations of the 'inner' universe!"

Verily, I began to appreciate the feelings of those who threatened Galileo! Nothing on earth could ever be the same to me, or quite sane again, in face of such ghastly enigmas! It was in vain that I struggled for equilibrium. Why, if George were on the right track, centuries of devoted scientific labor had but landed us back in the midst of the old geocentric system, delineating us earth-dwellers as privileged inhabitants of the unique location in the universe—the boundary between its two halves! Once more the stars and the sun were hung in the heavens as lamps to light the crawling footsteps of man alone! There was at one and the same time a horrifying spaciousness about this conception, and a smothering constriction, which was most indescribable.

I came gradually, but firmly, to the resolve that, come what might, so far as I was concerned this secret would be guarded from mankind with my life. Meantime I felt the greatest eagerness for resolution of the questions as to the origin and destiny of the stars and their true relation to our earth; the place and magnitude of our planets, the rotations of the sun; why if the surface of our earth were really limitless, we had but measured upon it the area of the surface of a sphere eight thousand miles in diameter; and a thousand and one other thronging conundrums.

There were times when George and I together seemed almost on the track of solutions; but when I remembered that we were facing, alone and poorly equipped, the equivalent of all the problems which had busied astronomers since the days of Galileo, I despaired of any real progress in my lifetime; and ere long the last flicker of hope for further knowledge guttered out. For half a year after the discovery, George had been busy with investigation, calculation, and cogitation; but as time went on there crept into his communications a great mental weariness and apathy. That was natural enough; but I sensed by and by there was something in it more than a mere physical reaction.

His communications began to show a disquieting strain of mysticism; suggestions of a great longing to enter into the shadow region in a more literal way, and strange hints which did not easily connect up with the normal and natural. I began to feel a serious concern; and several times I planned to return to the Sierras to try to effect an influence upon him in which my letters seemed to fail. But I was frustrated by business demands which could not be denied, although tormented by a growing anxiety.

AT last one day I found my fingers trembling as I received from the carrier a thick envelope; a foreboding came over me, and it was with a great effort that I got the packet open.

"Bill," began the communication, "I may as well break it with the first words. When you get this, I will be gone. No, not suicide! I am not that sort of coward. But years ago I guess I lost the main anchor. The great discovery and the events connected with it put new life into me and let me forget—other things. Lately, however, it has become clear that I will never learn any more of the new world by scientific means—and, oh, you can never guess the irresistible, ungodly longing to enter into its shadowy, eternal peace, which has grown upon me

from the first! Of late, things have changed in strange ways, too. Hints of realities I could not get through physical means have begun to come to me in other ways as I watched the vision on the screen; faintly, at first, then clearer and clearer.

"There is life there, Bill! Not life as you and I have thought of it, but life which sees and feels through the stones and the stars; motionless, changeless life, of which, so help me, we mortals may become part. The ancients were right; that realm lies not merely the other side of a thousand miles each of earthly and transuranic matter, but the other side of death! I am fast passing thither, and it is only a matter of days; but I have made provision for the complete destruction of the plant and laboratory, burying the latter under hundreds of feet of earth blasted from the hillside. The 'atom' cannot be pulled out or driven down by any human power; but I know now that it is unlawful for any human eye to look down that rashly driven tube, nor is it well for others to guess what we have seen. Therefore—burial.

"So soon as I write this, I shall be moved to the hospital in Bakersfield, leaving a time mechanism to effect the destruction. I will make arrangements for this letter to reach you only after I have gone; for I do not want you to come to see me, and have to meet in your eyes the pitying accusation of madness. I have left to you the sizable remnant of my fortune, in trust for the purpose of helping to so educate humanity that when in the course of years—ages, perhaps—it dawns upon man that things are not what they seem, and that for reality he must look ever *within himself* and never outward, that realization will bring madness to as few as may be! Good-bye, Bill!"

Poor George! How utterly alone I felt, crushed by the weight of knowledge I must carry silently to the grave—to the *inner universe*! Now, what madness was this—was I also raving? The ancients—what were the ancients right about? Reminiscences of forgotten mythological studies floated into my mind, took shape, and stood before me stark. Why, of all religions, Christianity alone had taught the skies to be the abode of the fortunate dead! The Greeks had their afterworld below—in the realm of shadows! There also was the Egyptian Amenti. And did not the Hopi Indians sing in memory of those who had taken "The Trail of all Trails—the Trail to Those Below?"

I shook myself loose from this train of thought, and for sanity's sake began a rational consideration of the weird mélange. What a fool I was! George had studied mythology as well as I; he may have forgotten the old eschatologies consciously, but his subliminal self had not. Sapped by an enduring grief, normal earthly appetites weakened, worn by the battering disappointment presented by the new universe he had discovered, torn by the longing generated by a world of mystery into which he could never physically enter, he had weakened *pari passu* mind and body; had dreamed dreams and seen visions in that state where the inner vision becomes pliable to the wish; forgotten mythic lore had crept stealthily upon his weakness from the unguarded recesses of the older, the irrational mind, which is the heritage of man, be he ever so modern; and *facilis descensus*! And so, a mind which could have been of incalculable service to man, had been dragged into useless destruction by an overstrong imaginative genius harnessed to many unconscious weaknesses.

THE END

Synthetic

By Charles Cloukey

(Continued from page 138)

second to spare he put his throttle on and the gray and green comet crashed into the white destroyer. They fell together in a twisted mass of metal and flames. It was the only possible way he could have stopped the white plane from passing the third time over the ship that carried her whom the synthetic man loved. I looked at

my watch. Less than eight minutes had passed since I had taken off, yet it seemed an eternity.

The cabin plane landed safely.

Bob Nelson's life was short, and his death glorious. As I stood there it came to me clearly, beyond the shadow of a doubt, that the synthetic man had a soul.

THE END

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