

Answer

ALVAN WREN, POISED beside a transparent port in the side of the service rocket, gazed out with considerable interest. The object of his attention, hanging a few miles away and slowly drifting closer, was not too imposing at first glance; merely a metal globe gleaming in the sun-light, the reflection from its surface softened by a second, concentric, semitransparent envelope. At this distance it did not even look very large; there was no indication that more than seventy years of time and two hundred million dollars in effort had already been expended upon that inner globe, although it was still far from completion. It had absorbed in that time, on an average, almost a quarter of the yearly income from a gigantic research "sinking fund" set up by contributions from every institution of learning on Earth; and—unlike most research projects so early in their careers—had already shown a sizable profit.

More detail began to show on both spheres, as the rocket eased closer. The outer envelope lost its appearance of translucent haze and showed itself to be a silver lacework—a metallic mesh screen surrounding the more solid core. Wren knew its purpose was to shield the delicate circuits within from interference when Sol spouted forth his streams of electrons; it was all he did know about the structure, for Alvan Wren had a very poor grounding in the physical sciences. He was a psychologist, with enough letters after his name to shout down anyone who decried his intelligence, but the language of volts and amperes, ergs and dynes was strange to him.

The pilot of the rocket was not acquainted with his passenger, and his remarks were not particularly helpful.

"We ought to make contact in about fifteen minutes," he said. "We're not supposed to use rockets close to the machine, and we have to brake down to safe contact speed at least twenty miles away. That's why the final approach takes so long. They don't like anything they can't account for in the neighborhood—and that goes for stray electrons and molecules, as well as atomic converters."

"What is their objection to rocket blasts, provided they're not fired directly at the station?" asked Wren. "What influence could a jet of gas even one mile away possibly have on their machinery?"

"None, directly; but gases diffuse, and some of the elements in rocket fuel are easily ionized in sunlight. The boys in there claim that the firing of a rocket blast five miles from the outer sphere will disturb some of their circuits, when the molecules which happen to leak inside their screen are ionized there. It sounds a little farfetched to me, but that's not my line. I do know that that machine is inoperative nearly half the time from causes which are not precisely known, but which must be of the same order of magnitude as the one I mentioned. I'm careful of my jets around here, because they'd have my job if I caused them trouble more than once; and the board would slap a 'lack of proficiency' on my dismissal papers, so I'd have a nasty time finding a new one."

"If you make this trip regularly, I don't suppose you have much difficulty with this rather tricky glide."

"I'm used to it. I've been making this supply run every week for nearly three years, with special flights between times. This ship carries everything they need at the station, and also the bright boys from home who have special problems to work, and don't believe the machine can handle them without their personal presence." The pilot looked sideways at Wren. "Most of those fellows were able to tell me things I didn't know about the computer. You're the first sightseer I've ever carried. I didn't think the universities encouraged them. Are you a journalist?"

Wren smiled. "I don't blame you for getting some such idea. I'll admit I don't know the first thing about electronic computers; the station out here is only a name to me. But I have a problem. I don't know whether it can be stated in terms that can be treated here or now; I know very little math; but I decided to come out for a conference with the operators, to find out whether or not I could be helped." He nodded at the great expanse of silver mesh that now filled almost the entire view area of the port. "Aren't we getting pretty close?"

The pilot nodded silently and returned to his seat, curbing his curiosity for the time being. Actually, there was little he could do during the "landing" since he was forbidden to use power; but he felt safer at

the controls while the coppery hull of his ship drifted into the resilient metal network of the static shield and was seized by metal grapples—grapples operated by specially designed electric motors so matched and paired that the inevitable magnetic fields accompanying their operation were undetectable at more than a few feet. The grapple cables tightened, and the swaying of the ship ceased gradually as its kinetic energy was taken up by the resilient mesh. The pilot locked his controls, and rose with a grin.

"They tell me," he said, "that when the screen was first built, about forty years ago, some bright boy decided that the supply rocket would have to be very carefully insulated in order not to interfere with the potential equilibrium of the outer sphere; so they coated the hull of the ship that was being used then with aluminum hydroxide, I think—something very thin, anyway, but a good insulator; and they made an approach that way while a problem was being run." He grinned more broadly. "I don't know the exact capacity of the condenser thus formed, but there's an operator still out here whose favorite cuss word is the name of that board member. They had to replace several thousand tubes, I guess. Now they look on the supply ship as a necessary evil, and suspend operations while we come in and the accumulated charge on the screen drains into our hull."

"How do I get in to the main part?" interrupted Wren, whose interest in historical anecdotes was not of a high order.

"There's a hollow shaft opening outside the web not far from us. There will be men out in a few moments to unload the ship, and they'll show you the way. You'll have to wear a spacesuit; I'll show you how to get into it, if you'll come along." He led the way from the control room to a smaller chamber between it and the cargo compartments, and in a short time had the psychologist arrayed in one of the bulky but flexible garments which men must wear to venture outside the metal bubbles which bear them so far from their own element. The pilot donned one also, and then led the way through the main airlock.

Wren had become more or less used to weightlessness on the flight to the station, but its sudden conjunction with so much open space unnerved him for a moment, and he clutched at the arm of the figure drifting beside him. The pilot, understanding, steadied his companion, and after a moment they were able to push themselves from the lip of the airlock toward the end of the metal tube whose mouth was flush with the screen, and some thirty yards away from them. As they approached the opening, four spacesuited men appeared in it, saw them, and waited to catch their flying forms. Wren found himself set "down" within reach of a heavy strand of silver cable, which he grasped in response to the gesture of one of the men—their suit radios were not on the standard frequency, and as he learned later, were not even turned on—while the pilot promptly leaped back across the gap to his ship and disappeared inside.

A moment later a large door aft of the airlock which he and Wren had used slid open, and the four men of the station leaped for it. It was not an airlock; for convenience of this particular station, the supplies were packed in airtight containers and the storage holds were opened directly to the void for unloading. The psychologist watched with interest as one of the men came gliding back to the shaft with the end of a rope in his gauntleted hands. He braced himself beside Wren and began pulling; and a seemingly endless chain of sealed metal boxes began to trail from the open cargo door. The first of them was accompanied by another of the men, who took the rope's end from the hands of the first and disappeared down the shaft with it. After a brief pause, the procession of containers began to follow him down the metal tube.

The whole unloading took less than a quarter of an hour. Wren rode the end of the chain down the shaft with the rest of the men, and found himself eventually in a chamber large enough to accommodate the whole cargo; a chamber that was evidently usable as an airlock, for after sealing the door leading from the outside, one of the men pressed a green button beside it, and within a few seconds the gradual rise to audibility of a clanging bell betokened increased air pressure.

Wren removed his suit, with some assistance, as soon as he saw the others begin to do so; and as soon as he was rid of it approached one of the unloading crew.

"Can you tell me," he asked, "how to locate Dr. Vainser? He should be expecting me; we have been communicating for some time."

The man he had addressed looked down out of pale blue eyes from a height fully seven inches greater than the psychologist's five feet nine.

"You must be Dr. Wren. Vainser told me you were probably on this rocket; I'll take you to him shortly. My name is Rudd, by the way. Is any of this stuff yours?" He waved a hand toward the cases drifting around the great chamber—the other men were capturing them slowly and fastening them to the walls for more convenient opening. Wren gave an affirmative nod.

"I have several cubic yards of problem material somewhere in the lot. It's all marked plainly enough, so there will be no trouble in identifying it. I say, don't you spin this place to give centrifugal gravity? I'm still not quite sure of myself without weight." The taller man laughed at the question.

"I suppose we could, though it would be hard to keep the screen spherical with anything like one gravity at its rim. It was decided long ago that the conveniences derived from spin were far more than offset by the nuisances; you'll be weightless as long as you are here." He sobered momentarily. "As a matter of fact, I doubt that Vainser could stand much acceleration. You'll see why when you meet him." Wren had raised his eyebrows interrogatively at Rudd's first remark; but the blond giant refused to amplify it further. He turned abruptly away from the psychologist, and left him without apology to assist in the anchoring of the last of the cases. This job took rather longer than the original unloading, and Wren was forced to curb his impatience and curiosity until it was completed.

At last, however, Rudd turned back to his guest, and without bothering to speak beckoned him to follow. He led the way through a circular doorway opposite the original entrance, and Wren found himself in a brightly lighted, metal-walled corridor apparently extending toward the center of the globular structure. Down this the two men glided for some distance; then Rudd led the way into another and yet another passage, all brightly lighted as the first. At last, however, he checked his flight before a closed door, on which he knocked—such conveniences as electric annunciators were taboo within the walls of the station.

The voice that sounded from behind the panel, bidding them enter, was the first intimation to Wren of the meaning that lay behind Rudd's enigmatic remark of a few minutes before. It was a reedy, barely audible whisper, that reached their ears only because of the ventilating grill in the solid door. It suggested a speaker crushed under an unutterable load of illness, fatigue, old age; and hearing it, Wren was slightly prepared for the sight that greeted his eyes as Rudd swung the door open and the two men entered.

Vainser, indeed, could not have stood anything like the strain of Earth gravity. What must once have been strong, athletic body was shrunken until it could have weighed scarcely eighty pounds; skinny wrists and ankles, and a pipe-stem neck protruding from the man's clothing left little doubt of his physical condition. Wren could not even imagine his probable age; great as it must have been, the eyes that peered steadily from the brown, wrinkled old face were as alert as those of man in his prime. On Earth, that body would have given out long before; but in the gravity-free environment of the station almost the only work required of the feeble heart was to keep a reasonable supply of blood circulating to the still keen brain.

Wren concealed his astonishment as best he could, and gave his attention to the whispered greeting that came from the lips of the ancient.

"You are Dr. Wren, I suppose. I feel that I know you quite well from our former communication, but I am glad to meet you in person. Your problem has interested me greatly, and I shall be more than glad to help in all possible ways to prepare your data for machine solution. Judging by what you have written me so far, it will be a long task.

"I have not yet mentioned your work to the others here, but I am sure we shall need assistance; so perhaps you will explain the nature of your study to Rudd, here, while I listen and perhaps learn more than you have already told me. By the time you have finished, your data cases should be in the office I am assigning to you, and we can start serious work whenever you wish."

Wren expressed his agreement with this proposal, and relaxed where he was, as there were, of course, no chairs in the room. The others hung motionless as he began to speak, their silent attention displaying their interest in the psychologist's words.

"My problem stems from a very old question, to which I do not even yet expect to get a complete answer. You are aware, unless you are imbedded even more deeply in the rut of your own profession

than I am in mine, that many hypotheses have been advanced in the past few centuries on the nature of mind and thought. That is really the fundamental problem of my profession. The first scientific approaches to the problem were made in the late nineteenth century, by such men as Thorndike, Ebbinghaus, and Pavlov. Many theories were evolved; one of the earliest arose, I suppose, from Pavlov's work, for it tried to explain learning and thought by the development and strengthening of interneural connections between stimuli and responses. It was claimed that the number of cells in the cerebral cortex was sufficiently large to permit enough different combinations to account for the reactions and ideas of a man's life. I believe it was computed that the number of possible combinations of connection between and among those cells is something like ten to the three billionth power."

Rudd raised his eyebrows at this. "If that figure is correct, then all the reactions and ideas of every creature that has lived on Earth since the planet was made could easily be included. That number shocks even me, and I've been fooling around with problems involving the number of electrons in the universe—a mere ten to the fortieth or fiftieth, as I recall. What's wrong with the theory?"

"Mere forming of connections, and strengthening with use, doesn't seem to be enough. If I were to have you hold your left hand against an electrode, and give you small but annoying electric shocks by means of it, preceding each shock by the ringing of a bell, you would in a very short time react to the bell by withdrawing your hand—a conditioned reflex, not beyond your conscious control, but certainly not dependent on it. If, that reflex established, I place your right hand against the electrode and sound the bell, which hand do you withdraw? The right, of course. Yet any 'strengthened connection' must have been formed between the sensory nerves in the left hand and the motor nerves in the same arm. Evidently connectionism is not adequate, at least as first stated.

"Other theories have been developed—some express learning and knowledge in terms of behavior. These explain nothing until one redefines 'behavior' to mean everything from social activity to peristalsis and food-oxidation in the body cells, which leaves us right where we started. Possibly some extremely complex neuron connection and reaction will explain everything from nightmares to Handel's Messiah, but every time someone brings forth a new idea in that direction a lot of psychologists are tempted to become mystics. Nothing seems to be a complete answer. Maybe the brain or the whole nervous system or the whole physical body is not the person—maybe there is a spirit or something of that nature that our microscopes and other physical apparatus can't get hold of. I am willing to entertain that idea as a possibility, but I am not religious enough to treat the concept as a certainty; and it leaves nothing to work on. Therefore I would like to try, using your machine, to learn whether or not a purely mechanical and/or chemical set of reactions can possibly explain the observed phenomena of the human mind. I am not too familiar with electric circuit diagrams, but I know they frequently become too complex for human minds to unravel, and that this machine of yours has been used in that connection. I suppose I was thinking in terms of an imperfect analogy, but I thought the similarity in problems might be great enough to give us a foothold for at least making a start on the problem. What is your opinion?"

"I take it," whispered Vainser in his reedy tones, "that if we fail to set up such a circuit, nothing will have been proved; but if we succeed, your science will be able to avoid for a few generations at least the sad fate of metaphysics. Your analogy of an electric circuit is probably the best possible, by the way, and we might as well continue to use it in thinking about this matter—provided we are careful to remember that it is only an analogy. It occurs to me also that, even if we do not succeed completely with Dr. Wren's problem, we are almost certain to gain many helpful ideas in the matter of the computer itself. It works, Doctor, on a principle rather similar to the 'connectionism' you mentioned first, though the 'nerves' are electron streams rather than material connections."

"I agree," stated Rudd. "The study appears to be both intrinsically worthwhile, and promising in the way of by-products. I hope you won't mind my giving what help I can, at such times as my regular job spares me."

"Not at all. The more people present who understand the computer, the better. I freely admit that I have no idea of the steps that must be taken to prepare my data for use. Perhaps if we went to examine it now—" Wren's voice trailed off into an interrogative silence. Vainser took up the conversation.

"I imagine your materials will not yet be in the office; the men have a good deal to do after a supply

rocket arrives. I suggest we eat now—I do eat, in spite of appearances, Dr. Wren—and I am sure that all will be ready by the time we have finished."

This suggestion met with approval, and after Wren's first weightless meal, the three scientists betook them-selves to the "office" in which the psychologist's data had been placed. Vainser's word was somewhat mis-leading; the place was more like a cross between a drafting room, a physical laboratory, and a photographic darkroom. The cases in which Wren's material had been packed were moored to one wall and their airtight seals broken, though the lids were still latched to keep the contents from drifting too wildly. Wren, who had by now acquired considerable proficiency in weightless maneuvering, propelled himself over to the containers and began extracting numerous notebooks, sheafs of photographs, and not a few detached pieces of paper bearing what appeared to be hastily scribbled thoughts. These he transferred to the numerous tables, anchoring them with the spring clips which here re-placed the magnetic paperweights to be found in most gravity-free desks. The other two made no attempt to assist, realizing that the material was being arranged in some order with which they were unfamiliar; but when the cases were empty, they accompanied Wren to one of the tables, where they were promptly delivered a surpris-ingly clear and well-illustrated lecture on general psy-chology. The illustrative material consisted partly of tabulated experimental data, partly of the schematic "circuit diagrams" with which psychologists like to illus-trate things like conditioned and unconditioned reflexes, and very largely of some excellent drawings and micro-photographs of nerve and brain structure. The initial explanatory lecture finished, Vainser took the initiative, and all three plunged into the task of so redesigning all these items that they could be presented to the "sense organs" of the giant computer.

These were varied in nature. Strictly numerical prob-lems could be presented on punched tape or cards, as in many of the mid-twentieth-century machines—though a shell-trajectory problem such as had taken those devices several hours could have been solved and the same answer-data tabulated in seconds by perhaps a dozen of the enormously complicated tubes of this installation.

In addition, the machine possessed eyes—lenses which focused on precisely divided sensitive grids, to which such items as graphs and wiring diagrams could be presented directly—if they were first drawn most care-fully to the proper scale. Last, and least in the eyes of Vainser and his assistants in spite of its uniqueness, was the "ear" which permitted the actual dictation of data. The machine had a vocabulary of some six thousand words, which was constantly being increased by the spare-time labor of the technician who had developed the attachment. Ten tubes were able to integrate these words into the sentences of the English language; the machine could both hear and answer. Since this method did not permit the precision results of the others, the crew of the station considered it more an amusement than anything else; the work had been done quite unof-ficially, and on his own time, by a junior member of the staff. Whether or not it had practical value, it reflected on the entire device an aura of uncanniness that af-fected even Wren, when the attachment was demon-strated to him.

It was possible, he felt, that some use might later be made of this faculty, but Vainser and Rudd stated posi-tively that the photoelectric analyzers were definitely needed for most of his data. This would entail the re-drawing of all diagrams to an exact scale, in variously colored inks. Vainser promptly withdrew Rudd from his regular duties, in order to perform this task. Rudd shivered at the prospect, but set manfully to work. He com-forted himself by remarking that the present diagrams were nothing to the ones they would get in the solutions, and they would be Wren's headache. Vainser agreed, his toneless whisper suggesting amusement, as they worked.

The initial problem was more of a test than anything else. The data from an early conditioning experiment were diagrammed and fed to one of the eyes. The an-swer film bore a standard conditioned-reflex diagram. Wren was vastly pleased; Vainser and Rudd were satisfied, and promptly went to work on the records of a more complicated experiment. Only two of the thirty thousand-odd tubes in the computer had contributed to the first solution, and one of those acted solely in a "memory" capacity; so it looked as though a great deal more could be done before any mechanical limits were reached.

The sun of success continued to shine throughout the first week. The three men worked, ate, slept, and peri-odically presented an accumulation of data to the eyes of the electronic entity that lay hidden in

the walls about them. Conditioned reflexes and everything about them—inhibition, extinction, reconditioning; all that Wren considered important in that most elementary form of learning was fed to the machine, which in every case effortlessly designed a "circuit" capable of displaying the desired characteristics; and while some of the circuits were complicated enough, none approached in complexity even a minor ganglion of the human nervous system—not even the monstrosity that resulted when all the earlier answers were given to ten "eyes" simultaneously, for integration into a master "conditioning" diagram.

"I've given a good many courses in psychology," re-marked Wren at one point, "but I've never before had a machine for a pupil. I must admit that it's the best one I ever had—maybe it's because I'm preparing my lectures more carefully than ever before!"

"Who's preparing them?" queried Rudd, with marked accent on the interrogative.

"Well, I have a couple of very good lab assistants. If they will kindly resume assisting, we will now consider the problem of memorization, beginning with the experiments of Ebbinghaus."

Work was continued. Most of the actual drafting of diagrams was done by Rudd, since Wren lacked the skill and Vainser the strength to handle the necessary tools. Ebbinghaus' data were finished; with his work and that of his successors the field of memorization was gradually covered; and by bringing chemical as well as electromechanical reactions into consideration, a system was developed which, according to the computer, would account for the observed phenomena of human memory. Wren was tempted to try immediate integration of this solution with that from the conditioning data, but was persuaded to wait until other fields had been covered; so they went on to the phenomena of foresight, imagination, and problem-solving thinking.

And here they met difficulties—heartbreaking ones. Some investigators might have stopped right there, and published the work so far completed, for as it stood it represented an enormous contribution to physiological psychology; but that simply never occurred to the three. The experimental data, while copious, were for the most part in forms which did not lend themselves to tabular or graphic representation. Even Vainser, most of whose long life had been spent reducing problems to just such form, made only the slowest of headway.

Two weeks were spent slogging through these difficulties, and in that time only three problems were run on the machine. None of these was set up as completely as Wren had hoped, and while solutions for all were forthcoming, he was rather doubtful of the value of these answers. However, at the end of the second week, the three men felt ready to attempt an integration of the experimental material dealing with problem-solving thinking. And it was here that an even more serious misfortune befell the work.

The preliminary hookups had been made. A dozen graphs had been placed under the single eye that was in use at the moment; the sensitized answer sheet had been placed in its receptacle, and a green light indicated that no part of the huge system was being used for other problems—a frequent cause of delay, since while only a very few tubes might actually deal with the matter in hand, special steps had to be taken to prevent two simultaneously run problems from influencing each other. Rudd had covered the room lights, leaving only the fluorescent spiral that illuminated the problem sheet in operation. Vainser touched the button that sensitized the eye.

For fully a second—longer than any previous solution had taken—nothing happened. Vainser actually had time to look in surprise at the fluorescent faces of some of the machine's status indicators, before the light went out.

Went out. No light was ever extinguished at the station. If darkness was required, the tubes were shuttered; covered with ingenious baffles which blocked the light, but permitted the generating tube to cool sufficiently. Turning off a light meant breaking an electronic circuit, and hurling into the surrounding ether electro-magnetic waves carrying energy enough to alter sharply the electronic paths in computer tubes hundreds of feet from the wires actually involved. There were no electric call bells, telephones or televisions; an efficient but amazingly archaic system of mechanical bells and speaking tubes formed the only system of room-to-room communication. The radios in the spacesuits were used only in the gravest emergencies; at other times a system of hand signals was made to suffice. The designers of the great computer had gone to too much trouble leaving behind the electrostatic and electromagnetic

disturbances of the Earth, to feel any desire to bring such troubles along with them.

Yet the lights had gone out—even the problem light and the status indicators. Rudd, at the lever controlling the room light shutters, opened them; and found the tubes black. All three were wearing watches with luminous dials; and those dials were the only visible objects in the neighborhood. They served only to make the surrounding darkness even blacker, if that were possible.

Before any of the men could speak, the call bell sounded from the corridor beyond the door. It emitted three double clangs in an apologetic, halfhearted manner, paused, and then repeated the call again and again.

"My call," Vainser's whisper cut eerily through the blackness. "This business must have affected the whole station. Come along; even if the call isn't coming from the center, everyone will head for there in an emergency. Rudd, you can travel faster than I; go on ahead and I'll bring Wren with me. I suppose there might be a flashlight or a match or something in the place, but I couldn't say where it might be. Find anything you can—preferably a remedy for all this."

One of the three vague green glows moved, and vanished abruptly as the edge of the doorway occulted it. The other two drifted together, and followed the path of the first more slowly into the corridor and along it. Wren knew the way to the center; he had been there several times, and by himself might have kept up with Rudd; but Vainser's feebleness slowed them even in gravity-free travel, since the old man could not have stood the impacts with walls and ceiling that the others accepted as a matter of course.

Wren, with one arm linked with one of Vainser's, pushed off gently from the door edge in what he knew to be the proper direction. He made no attempt to retain contact with a wall; and that, he knew immediately, was a mistake.

He was spinning. He didn't know which way. Neither his sight, his semicircular canals nor his kinesthetic sense could help him. He was spinning . . . no, he was falling . . . no, he was

He was drifting down the corridor, as he should have been, his arm linked in Vainser's. He was panting as though he had just undergone the limit of physical exertion, and his face was dewed with sweat; but the lights were on, and he was sane again. They had been off for less than a minute; looking back, he realized that he must have kicked off from the door jamb only two or three seconds ago.

He looked at the old man beside him. Vainser's expression resembled his own; but the fellow managed a weak grin, and spoke.

"My heart must be in better shape than I had been assuming; but I hope it never has to take another jolt like that."

Wren nodded. "I've been hearing about claustrophobia and space sickness and acrophobia, and I don't know how many phobias ever since my formal education began, and I thought I knew a lot about them; but from now on I'll really sympathize with their victims. Total darkness, weightlessness, and no contact with a fixed object make a horrible combination. I realize now that those phobias were simply verbalisms to me before."

"That's your department. I'll have to find out what went wrong in this place. Let's go on to the center." They went, slowly recovering their composure on the way.

The entire complement of the station seemed to be there, and a buzz of voices indicated that speculation was rife. No one seemed to know exactly what had happened; and there was good reason for the general ignorance, for after an hour's careful investigation, neither Vainser nor Rudd nor any of the other members of the maintenance and operation staffs could find a single clue to the source of the recent trouble. For all the information that the various indicators could give, the station had been in normal operation for the last seventy years.

The group broke up slowly. Rudd, Vainser, and Wren returned to the room they had been using, wrapped in silent thought. Here, a careful examination was made of the apparatus that had been in use at the time of the breakdown; and here, too, all seemed to be in order—until Vainser remembered something.

"The eye—it's off!" he exclaimed. "I'm sure we sensitized it just before all this happened—didn't we?"

"We did," replied Rudd, "but I turned it off before leaving. I was at the shutters, and I automatically de-sensitized it before I opened them."

"I see." Vainser nodded in understanding, and drifted over to the controls. He extended a hand to the sensitizer contact, as though to start the uncompleted problem; but before he touched it, another thought appeared to strike him. He removed the sheets from the problem table, instead, and peered at them closely for some time. Finally he spoke again.

"I'm beginning to get an idea about all this, but it will take a while to work it out. You gentlemen may as well go and relax; you can't help me, and it will certainly take some time. I'll call you if and when I get what I think is the answer."

Rudd and Wren looked at each other, and then at the old technician; and being able to think of nothing better, they followed his suggestion. There were recreation facilities in the station, of course, and they made use of them for some hours. They ate, and slept—or at least retired, though neither got much sleep—ate again, and finally settled down to a routine of three-dimensional billiards alternated with periods of unrestrained speculation on the nature of Vainser's inspiration. Beyond the obvious fact that it had to do with the problem which he had taken from the table, they got nowhere.

It was fully twenty hours before Rudd's personal call came clanging on the corridor bells. The two wasted no time in transferring themselves to the presence of Vainser. He greeted them rather absently, and for several moments did not speak in response to the inquiring expression on their faces. At last, however, frowning at the papers before him, he began his explanation.

"I am far from sure that this is correct," were his opening words, "for I cannot be absolutely certain that the computer would behave this way under the circumstances I have outlined here; but it seems at least reasonable." He looked up. "Rudd, have you ever considered the problem of building a machine that could repair itself? How would you go about it?" The big technician frowned.

"It would be—complicated. Aside from your primary-purpose machine—let's say that's an electric motor, for purposes of illustration—you'd need an attachment which could weld, and wind wire on cores, replace brushes, and do all a repairman can. It would also need some sort of guide, such as sets of blueprints and photoelectric scanners, of templates, so that it could do the right thing when something in the motor went wrong. As I say, it would be complicated."

"And what would it do when one of its scanners, or welders, or some other part of the repair mechanism broke down?"

"You'd need a second similar attachment—"

"With templates for the first. And in order to take care of matters if the second went out, the first would have to have templates for the second. And that would solve matters perfectly, except that each set of templates would have to include everything in the other repair gadget—including its templates. I imagine you see the slight practical difficulty."

Rudd pulled an earlobe in meditative fashion, and nodded slowly. "I see your point. It is the old picture--within-a-picture problem, worked backward. But what has that to do with the present situation?" Vainser smiled wryly, and indicated the problem-graphs on which he had been working.

"I spent quite a while on these, trying to work out an answer without the aid of the machine. I already had an inkling of what had happened, so I was quicker than I might otherwise have been. Really, I don't know why it didn't occur to us sooner. The trouble is, the 'circuit' having the characteristics demanded by this set of data—a problem-solving circuit, in other words—is identical with the electronic setup in one of the tubes of this machine. Obviously! After all, that's what the machine's for, and whether the human brain really works that way or not, it's certainly a possible solution. The thing is really a vicious circle; if the machine is capable of solving that problem at all, it will get that answer—one identical with its own setup. If it isn't, we simply get nothing.

"You remember, once a given tube is in full use, it acts as a 'memory,' a set of templates, if you like, from our previous illustration, while one of its neighbors integrates. This time, each integration simply puts each tube in total equilibrium—and the next one took over. That's why it took several seconds for anything to happen. Thirty thousand tubes charged to the limit, and trying to find more—naturally, as soon as the last tube had completed its integration, it tried to pass the load on to another, as usual, and

the whole system began to over-load. It's a thing that never happened before, but there are safety devices, put in when the station was first started, which cut off all electronic currents in the place when such an event occurs. I had forgotten about them, and they don't record; so there was no indication of their having operated—except the obvious fact that they had! When you desensitized the eye that was causing the trouble, you put a point of resistance in an other-wise superconducting circuit; and within a few seconds the load petered out, and the lights came back on. Sim-ple?"

"Simple," agreed Rudd. "But where does it leave us? Can we get any further with Wren's business?"

"I'm sure we can," said Vainser after a moment's thought. "It's just a matter of avoiding problems whose solutions are too similar to individual tube circuits; and we certainly ought to be able to do that. I think, Wren, that we had better skip the present problem—or take it as solved, if you prefer—and get on with whatever comes next."

"I guess you're right," replied the psychologist. "Al-though I am unfamiliar with the interior of the com-puter, your analogies have given me what is probably an adequate picture of the situation. We will go on to imagination. There are a number of interesting experi-ments on record, dealing with eidetic imagery, lightning calculators, and similar phenomena, which should prove of value."

The work progressed once more, but even more slowly. To the ever-mounting problem of graphic pres-entation of data was added that of avoiding particular solutions. They worked out what was in theory a simple method for this; they integrated each new method with all that had gone before, instead of treating it sepa-rately. The diagrams which resulted on the answer films were horrific in their complexity, as might be expected; and Wren had to spend a large amount of the time in studying these, trying to make sense out of them. Still, progress was made.

Emotions were dealt with, and, to Rudd's unfeigned astonishment, handled on a combined chemical and me-chanical basis. Habits had fallen under the same assault as conditioning; attitudes and ideals, slightly more re-sistant, had been added to the list; the ability of the hu-man mind to generalize from particular incidents had proved easy to add to the running integration, though Wren suspected it might have been more troublesome by itself.

The stock of data which the psychologist had brought with him was growing low; the study was nearing the end of its planned course. There were a few of the hu-man mind's highest capabilities to be included—constructive imagination, artistic appreciation and abil-ity, and similar characteristics; and these were making more trouble than all the earlier problems together. Without the practice furnished by those earlier jobs, Vainser and Rudd would probably never have suc-ceeded in preparing this last material for use. Wren himself was little help; he was spending most of his time with the most recent of the answer sheets. They wres-tled with the business for an entire week, Vainser letting subordinates handle the routine administrative work of the station instead of taking time out to do it himself; and in the end they were only half satisfied with the result.

They pried the psychologist forcibly away from the sheet which had been absorbing his entire attention, and put him to work with them; and only after three more days did the men feel that the thing could be given to the machine. Surprisingly enough, the material had boiled down sufficiently to make possible its presenta-tion to a single eye. The previous total sheet alone was placed beneath another.

In consequence, the arrangement was practically identical with that which had caused the disturbance a fortnight earlier; and Wren felt slightly uneasy as Rudd shuttered the room lights and pressed the button acti-vating the eye. Each run of the past half-dozen had taken slightly longer than its predecessor, since each represented all the previous work plus the new subject material: so no one was surprised at the two or three seconds of silence which followed the activation of the computer. Then the wavering green hairline on the screens of the status indicators steadied and straight-ened, and Rudd, at Vainser's nod, desensitized the eye, opened the shutters, and removed the answer sheet from its frame. With a slight bow, which looked rather ridiculous from a man who was hanging in midair rather than standing on his feet, he handed the month's work to Wren and remarked, "There, my friend, is your brain. If you can make that machine, we'd be interested in a model. It would probably be a distinct improvement on this thing." He waved a hand at the walls around them as he spoke.

"Brain?" queried Wren in some surprise. "I thought I had made the matter clearer than that. I have no

reason to suppose that this diagram represents what goes on in the human mind. The study was to determine whether the mental processes we know of can be duplicated mechanically. It would seem that they can, and there is consequently no need to assume the existence of any-thing supernatural in the human personality. Of course, the existence of such a thing as the soul is by no means disproved; but it is now possible for psychology and spiritualism to avoid stepping on each other's toes—and the spiritualists will have to find something besides the 'Toute de mieux' argument to defend their opinions. As for making such a machine as is here indicated, I should hate to undertake the task. You may try it, if you wish; but some of the symbols in this diagram have evolved during the course of our work here to the meaning of rather complex chemical and mechanical operations, as I recall, and at a guess I should say you have several lifetimes of work ahead of you in such a task. Still, try it if you like. I must now attempt to understand this mass of lines and squiggles, in order to turn the whole study into publishable words. I thank you gentlemen more than I can say for the work you have done here. I trust you have found it of sufficient interest to provide at least a partial recompense for your efforts. I must go now to look this thing over." With a farewell nod that already bore something of the abstraction in which the man would shortly be sunk, he left the room.

Vainser chuckled hoarsely as the psychologist disappeared. "They're all that way," he remarked. "Get the work done for them, and they can think of nothing but what comes next. Well, it's the right attitude, I guess. His work certainly gave us a lot of worthwhile hints." He cast a sideways glance at his companion. "Do you plan to build that machine, Rudd?"

The other reactivated the eye, producing another copy of Wren's solution from the data which still lay on the tables, and examined it closely. "Might," he said at last. "It would certainly be worthwhile doing it; but I'm afraid our friend was right about the time required. Any of several dozen of these symbols would have to be expanded to represent a lot of research." He tossed the sheet toward a nearby table, which it did not reach. "Let's relax for a while. I'll admit that was interesting work, but there are other things in life." Vainser nodded agreement, and the technicians left the room together.

They saw almost nothing of Wren for the next several days. Once Rudd met him in the dining hall, where he replied absently to the big man's greeting; once Vainser sent a messenger to the psychologist to ask if he planned to leave on the next supply rocket. The messenger reported that the answer had consisted of a single vague nod, which he had taken for assent; Wren had not lifted his eyes from the paper. Vainser had the data packed away in the original cases, ordered and packed the sheets which resulted from their investigations, and forbore to disturb Wren further. He knew better.

And then the rocket came. It glided gently up to the great sphere, nuzzled the outer screen softly, and came to rest as the grapples seized it. Vainser, notified of its arrival, sent a man to inform the psychologist, and forgot the matter. For perhaps three minutes.

The messenger must have returned in about that time, though his voice preceded him by some seconds. He was calling Vainser's name, and there was no mistaking the alarm in his tones even before he burst through the doorway into the chief technician's room.

"Sir," he panted, "something's wrong with Dr. Wren. He won't pay any attention to me at all, and ... I don't know what it is!"

"I'll go," replied Vainser. "You bring the doctor to him. It might be some form of gravity sickness; he was a ground-gripper before he came here."

"I don't think so," replied the man as he turned to carry out the order. "You look for yourself!"

Vainser lost no time in proceeding to Wren's room; and once there, he felt himself compelled to agree that something other than gravity sickness was wrong. The doctor, entering a minute or two later, agreed, but he could offer no suggestion as to what might actually be the trouble.

Wren was hanging in midair, relaxed, with the answer sheet that had cost so much work held before his face as though he were reading. There was nothing wrong with his attitude; anyone passing the open door and giving a casual glance within would have assumed him to be engaged in ordinary study.

But he made no answer when his name was called; not a motion of the eyeballs betrayed awareness of any-thing around him but that piece of paper. The doctor worked it gently from his grasp; the fingers resisted slightly, and remained in the position in which they were left. The eyes never moved; the paper

might still have been there before them.

The doctor turned him so that he was facing one of the lights directly, waved his hands in front of Wren's face, snapped his fingers in front of the staring eyes, all without making the least impression on the psycholo-gists's trancelike state. At last, after administering a number of stimulants intravenously without effect, the medical man admitted defeat.

"You'd better wrap him in a suit and get him to Earth, the quicker the better," he said. "There's nothing more I can do for him here. I can't even imagine what's wrong with him."

Vainser nodded slowly, and beckoned to the messen-ger and Rudd, who had come in during the exami-nation. They took Wren's arms and towed him out of the room toward the great airlock, Vainser and the doc-tor following. With some effort, his body was worked into a spacesuit; and the old technician watched with a slowly gathering frown on his forehead as the helpless figure disappeared toward the outside. The frown was still there when Rudd came back to meet him in his office.

For several minutes the two looked at each other si-lently. Each knew what the other was thinking, but nei-ther wanted to give voice to his opinion. At last, however, Rudd broke the silence.

"It was a better job than we realized." The other nodded.

"Trying to understand perfectly the workings of a brain—with a brain. We should have realized, espe-cially after what happened a couple of weeks ago. Each thought image is a mechanical record in the brain tis-sue. How could a brain make a complete record of itself and its own operation? Even breaking the picture down into parts wouldn't save a man like Wren; for, with the picture as nearly complete as he could make it, he'd think, What change is this very thought making in the pattern? and he'd try to include that in his mental pic-ture; and then try to include the change due to that, and so on, thinking in smaller and smaller circles. He was conscious enough, I guess, so naturally the stimulants made no difference; and every usable cell of his brain was concentrated on that image, so none of the senses could possibly intrude. Well, he knows now how a brain works."

"Then all his work was wasted," remarked Rudd, "if everyone who understands it promptly loses the use of his mind. Maybe I'd better not build that machine after all. I wonder if there's any possible way of snapping the poor fellow out of it?"

"I should think so. Simply breaking the line of thought enough for him to forget a little of it should do the trick. It can't be done through his senses, as we learned, and stimulants are obviously the wrong thing from that point of view. I should simply deprive him of consciousness. Morphine should do it. I am enclosing a recommendation to that effect in his material, which will go back with him. I didn't want to suggest it to our own doctor; even if he didn't decide I was crazy, I wouldn't want to saddle him with that responsibility. I might, of course, be very wrong. The boys on Earth will have to make up their own minds.

"But I'm afraid you're right about the uselessness of his results. It was a doomed line of endeavor from the start, no matter what method of approach was used. As soon as you understand completely the working of the brain, your own is of no further use. Evidently all psy-chologists since the year dot have been chasing their tails, but were too far behind to realize it. Wren was brighter or luckier than the others—or perhaps, simply had better tools—and caught up with his!"