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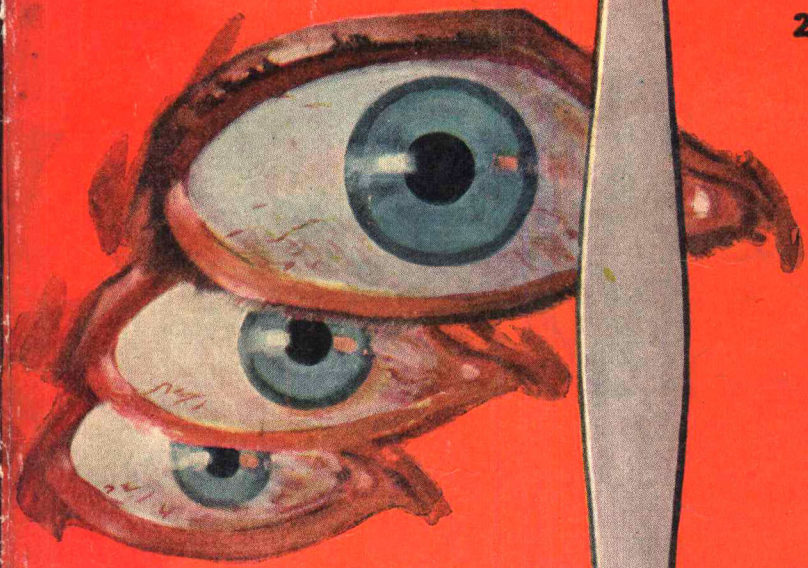

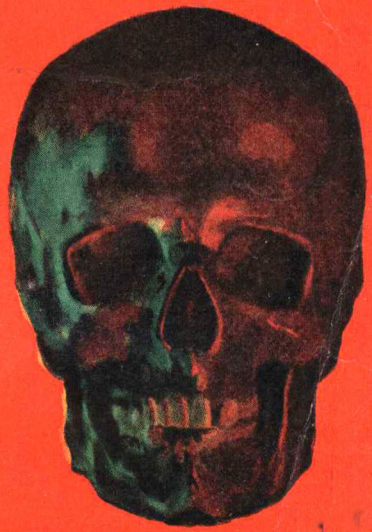

PRIVATE EYE

BY LEWIS PADGETT

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GLEEP AND BEPO

That the United States is very actively engaged in atomic energy research is probably unknown to a considerable number of African tribes, and some of the more remote Tibetan inhabitants. But for some reason relatively few Americans seem to realize that the British and Canadians are doing very nicely, thank you, in the same line of research.

Canada's establishment at Chalk River, so far as generally released data goes, is a very low-energy pile, using heavy water as the moderator rather than graphite. From the very low-energy level attributed to it—three watts—my guess is that it is simply operated without much shielding. The power level is limited by what human observers can safely encounter, rather than by the atomic nature of the pile.

"Gleep" and "Bepo" however, are Britain's efforts—and very sound efforts they are. The principal atomic research station in Britain is at Harwell, a location chosen as being reasonably convenient to both London, and Oxford University. Harwell was, during the War, one of the RAF's major bases; its buildings are now being used by the British Atomic Energy Research Establishment—AERE corresponding to our AEC. At Harwell is the Gleep—Graphite Low-Energy Experimental Pile—and a variety of nuclear research facilities, both chemical and physical. The British have the world's second largest cyclotron, a 110-inch, two hundred million volt machine, and a five million volt van de Graff electrostatic generator at Harwell for other experimental work.

"Bepo" is the British Experimental Pile—with an "o" added, presumably, for euphony. The Gleep has been active since August, 1947. It's turning out a supply of radio-isotopes for experimental work. Its rate of production is considerably smaller than that of our Oak Ridge pile; Oak Ridge operates at over four thousand kilowatts, while the Gleep is rated at about one hundred kilowatts. Bepo, however, is just starting its operations, and is rated at six thousand kilowatts. The exact level of operation of our piles at Hanford, where the plutonium for bombs is made, has not been revealed, but is presumably on the order of five hundred thousand kilowatts apiece for each of the three piles. Nevertheless, the Bepo will produce more radio-isotopes than any present American facility, since the Hanford piles are designed

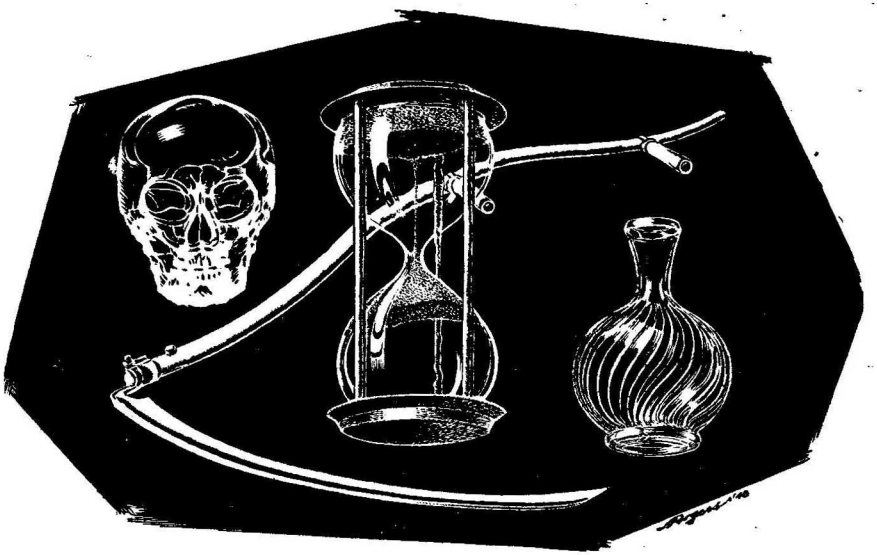
exclusively for plutonium production, and have no access openings for research and isotope-treatment work. Bepo is designed primarily as a high-level research tool, and is far more complex in mechanical design than even our Oak Ridge pile. It is an admirable and extremely valuable research tool, having all the advantages inherent in a design worked up after five years of practical experience with operating atomic piles. Oak Ridge was the first high-energy pile ever built; naturally, its design is obsolete, for any new technology advances with enormous strides in the first few years. But no atomic pile in history has yielded more important data than that obtained from Oak Ridge.

This fall, the United States will have another important high-level experimental pile in operation on Long Island, at the Brookhaven National Laboratories. We have, in addition to Oak Ridge, several other pile set-ups, but those are either non-research—Hanford—or relatively low-level—Los Alamos has several and the Argonne Laboratories outside of Chicago has several. These, while capable of yielding immensely valuable direct data on nuclear fission, are not so useful in isotope production for biological and industrial research because of their relatively low-energy levels.

The British research program, having the advantage of a five-year background of atomic experience, is going ahead rapidly, and with what is, evidently, excellent planning. Temporarily, their facilities for producing the useful research tools, synthetic radio-isotopes, somewhat exceeds the United States facilities. They do not have facilities, as yet, for the production of atomic weapons—on the other hand, an unspoken but very real understanding exists that, in case of any military emergency, the British can fairly well rely on the Hanford facilities. In any presently probable politico-military situation, Britain and the United States would be allies. A military situation in which the United States was on the opposite side appears, now, as an exceedingly remote possibility; if it did occur, it would be more likely the result of Britain being overwhelmed by an invader—in which case any military atomic facilities would be destroyed anyway.

In the field of peacetime atomic energy, therefore, the British are doing a first-rate job, and have every reason to do so. They are, in fact, quite apt to establish commercial atomic power plants before we do. Be it remembered that the United States has unlimited coal reserves, and completely adequate coal production; we don't need atomic fuel. Britain, on the other hand, is severely pinched by lack of fuel power; they want and need a new source of energy for energy's sake. The United States wants and needs atomic energy for special purposes, special situations, but not for the sake of simple bulk energy.

The Editor.



PRIVATE EYE

BY LEWIS PADGETT

***The** problem of getting away with murder is an old one. But with the Eye to watch your every move for fifty years back, it was a new and apparently insolvable one! But there was, actually, an infinitely tougher problem—*

Illustrated by Rogers

The forensic sociologist looked closely at the image on the wall screen. Two figures were frozen there, one in the act of stabbing the other through the heart with an antique letter cutter, once used at Johns Hopkins for surgery. That was before the ultra-microtome, of course.

"As tricky a case as I've ever seen," the sociologist remarked. "If we can make a homicide charge stick on Sam Clay, I'll be a little surprised."

The tracer engineer twirled a dial and watched the figures on the screen repeat their actions. One—Sam Clay—snatched the letter cutter from a desk and plunged it into the other man's heart. The victim fell down dead. Clay started back in apparent horror. Then he dropped to his knees beside the twitching body and said wildly that he didn't mean it. The body drummed its heels upon the rug and was still.

"That last touch was nice," the engineer said.

"Well, I've got to make the preliminary survey," the sociologist sighed, settling in his dictachair and placing his fingers on the keyboard. "I doubt if I'll find any evidence. However, the analysis can come later. Where's Clay now?"

"His mouthpiece put in a *habeas mens.*"

"I didn't think we'd be able to hold him. But it was worth trying. Imagine, just one shot of scop and he'd have told the truth. Ah, well. We'll do it the hard way, as usual. Start the tracer, will you? It won't make sense till we run it chronologically, but one must start somewhere. Good old Blackstone," the sociologist said, as, on the screen, Clay stood up, watching the corpse revive and arise, and then pulled the miraculously clean paper cutter out of its heart, all in reverse.

"Good old Blackstone," he repeated. "On the other hand, sometimes I wish I'd lived in Jeffreys' time. In those days, homicide was homicide."

Telepathy never came to much. Perhaps the developing faculty went underground in response to a familiar natural law after the new science appeared—omniscience. It wasn't really that, of course. It was a device for looking into the past. And it was limited to a fifty-year span; no chance of seeing the arrows at Agincourt or the homunculi of Bacon. It was sensitive enough to pick up the "fingerprints" of light and sound waves imprinted on matter, descramble and screen them, and reproduce the image of what had happened. After all, a man's shadow can be photographed on concrete, if he's unlucky enough to be caught in an atomic blast. Which is something. The shadow's about all there is left.

However, opening the past like a book didn't solve all problems. It took generations for the maze of complexities to iron itself out, though finally a tentative check-and-balance was reached. The right to kill has been sturdily defended by mankind since Cain rose up against Abel. A good many idealists quoted, "The voice of thy brother's blood crieth unto me from the ground," But that didn't stop the lobbyists and the pressure groups. Magna Carta was quoted in reply. The right to privacy was defended desperately.

And the curious upshot of this imbalance came when the act of homicide was declared nonpunish-

able, unless intent and forethought could be proved. Of course, it was considered at least naughty to fly in a rage and murder someone on impulse, and there was a nominal punishment—imprisonment, for example—but in practice this never worked, because so many defenses were possible. Temporary insanity. Undue provocation. Self-defense. Manslaughter, second-degree homicide, third degree, fourth degree—it went on like that. It was up to the State to prove that the killer had planned his killing in advance; only then would a jury convict. And the jury, of course, had to waive immunity and take a scop test, to prove the box hadn't been packed. But no defendant ever waived immunity.

A man's home wasn't his castle—not with the Eye able to enter it at will and scan his past. The device couldn't interpret, and it couldn't read his mind; it could only see and listen. Consequently the sole remaining fortress of privacy was the human mind. And that was defended to the last ditch. No truth-serum, no hypoanalysis, no third-degree, no leading questions.

If, by viewing the prisoner's past actions, the prosecution could prove forethought and intent, O.K.

Otherwise, Sam Clay would go scot-free. Superficially, it appeared as though Andrew Vanderman had, during a quarrel, struck Clay across the face with a stingaree whip. Anyone who has been stung by a Portuguese man-of-war can understand that, at this point, Clay could plead temporary insanity and self-defense, as well as undue provocation and possible justification. Only the curious cult of the Alaskan Flagellantes, who make the stingaree whips for their ceremonials, know how to endure the pain. The Flagellantes even like it, the pre-ritual drug they swallow transmutes pain into pleasure. Not having swallowed this drug, Sam Clay very naturally took steps to protect himself—irrational steps, perhaps, but quite logical and defensible ones.

Nobody but Clay knew that he had intended to kill Vanderman all along. That was the trouble. Clay couldn't understand why he felt so let down.

The screen flickered. It went dark. The engineer chuckled.

"My, my. Locked up in a dark closet at the age of four. What one of those old-time psychiatrists would have made of that. Or do I mean obimen? Shamans? I forget. They interpreted dreams, anyway."

"You're confused. It—"

"Astrologers! No, it wasn't either. The ones I mean went in for symbolism. They used to spin prayer wheels and say 'A rose is a rose is a rose', didn't they? To free the unconscious mind?"

"You've got the typical layman's attitude toward antique psychiatric treatments."

"Well, maybe they had something, at that. Look at quinine and digitalis. The United Amazon natives used those long before science discovered them. But why use eye of

newt and toe of frog? To impress the patient?"

"No, to convince themselves," the sociologist said. "In those days the study of mental aberrations drew potential psychotics, so naturally there was unnecessary mumbo-jumbo. Those medicos were trying to fix their own mental imbalance while they treated their patients. But it's a science today, not a religion. We've found out how to allow for individual psychotic deviation in the psychiatrist himself, so we've got a better chance of finding true north. However, let's get on with this. Try ultraviolet. Oh, never mind. Somebody's letting him out of that closet. The devil with it. I think we've cut back far enough. Even if he was frightened by a thunderstorm at the age of three months, that can be filed under Gestalt and ignored. Let's run through this chronologically. Give it the screening for . . . let's see. Incidents involving these persons: Vanderman, Mrs. Vanderman, Josephine Wells—and these places: the office, Vanderman's apartment, Clay's place—"

"Got it."

"Later we can recheck for complicating factors. Right now we'll run the superficial survey. Verdict first, evidence later," he added, with a grin. "All we need is a motive—"

"What about this?"

A girl was talking to Sam Clay. The background was an apartment, grade B-2.

"I'm sorry, Sam. It's just that . . . well, these things happen."

"Yeah. Vanderman's got something I haven't got, apparently."

"I'm in love with him."

"Funny. I thought all along you were in love with me."

"So did I . . . for awhile."

"Well, forget it. No, I'm not angry, Bea. I'll even wish you luck. But you must have been pretty certain how I'd react to this."

"I'm sorry—"

"Come to think of it, I've always let you call the shots. Always."

Secretly—and this the screen could not show—he thought: Let her? I wanted it that way. It was so much easier to leave the decisions up to her. Sure, she's dominant, but I guess I'm just the opposite. And now it's happened again.

It always happens. I was loaded with weight-cloths from the start. And I always felt I had to toe the line, or else. Vanderman—that cocky, arrogant air of his. Reminds me of somebody. I was locked up in a dark place, I couldn't breathe. I forget. What . . . who . . . my father. No, I don't remember. But my life's been like that. He always watched me, and I always thought some day I'd do what *I* wanted —but I never did. Too late now. He's been dead quite a while.

He was always so sure I'd knuckle under. If I'd only defied him once—

Somebody's always pushing me in and closing the door. So I can't use

my abilities. I can't prove I'm competent. Prove it to myself, to my father, to Bea, to the whole world. If only I could—I'd like to push Vanderman into a dark place and lock the door. A dark place, like a coffin. It would be satisfying to surprise him that way. It would be fine if I killed Andrew Vanderman.

"Well, that's the beginning of a motive," the sociologist said. "Still, lots of people get jilted and don't turn homicidal. Carry on."

"In my opinion, Bea attracted him because he wanted to be bossed," the engineer remarked. "He'd given up."

"Protective passivity."

The wire taps spun through the screening apparatus. A new scene showed on the oblong panel. It was the Paradise Bar.

Anywhere you sat in the Paradise Bar, a competent robot analyzer instantly studied your complexion and facial angles, and switched on lights, in varying tints and intensities, that showed you off to best advantage. The joint was popular for business deals. A swindler could look like an honest man there. It was also popular with women and slightly passé teleo talent. Sam Clay looked rather like an ascetic young saint. Andrew Vanderman looked noble, in a grim way, like Richard Coeur-de-Leon offering Saladin his freedom, though he knew it wasn't really a bright thing to do. *Noblesse oblige,* his firm jaw seemed to say, as he picked up the silver decanter and poured. In ordinary light, Vanderman looked slightly more like a handsome bulldog. Also, away from the Paradise Bar, he was redder around the chops, a choleric man.

"As to that deal we were discussing," Clay said, "you can go to—"

The censoring juke box blared out a covering bar or two.

Vanderman's reply was unheard as the music got briefly louder, and the lights shifted rapidly to keep pace with his sudden flush.

"It's perfectly easy to outwit these censors," Clay said. "They're keyed to familiar terms of profane abuse, not to circumlocutions. If I said that the arrangement of your chromosomes would have surprised your father . . . you see?" He was right. The music stayed soft.

Vanderman swallowed nothing. "Take it easy," he said. "I can see why you're upset. Let me say first of all—"

"Hijo—"

But the censor was proficient in Spanish dialects. Vanderman was spared hearing another insult.

"—that I offered you a job because I think you're a very capable man. You have potentialities. It's not a bribe. Our personal affairs should be kept out of this."

"All the same, Bea was engaged to me."

"Clay, are you drunk?"

"Yes," Clay said, and threw his

drink into Vanderman's face. The music began to play Wagner very, very loudly. A few minutes later, when the waiters interfered, Clay was supine and bloody, with a mashed nose and a bruised cheek. Vanderman had skinned his knuckles.

"That's a motive," the engineer said.

"Yes, it is, isn't it? But why did Clay wait a year and a half? And remember what happened later. I wonder if the murder itself was just a symbol? If Vanderman represented, say, what Clay considered the tyrannical and oppressive force of society in general—synthesized in the representative image . . . oh, nonsense. Obviously Clay was trying to prove something to himself, though. Suppose you cut forward now. I want to see this in normal chronology, not backward. What's the next selection?"

"Very suspicious. Clay got his nose fixed up and then went to a murder trial."

He thought: I can't breathe. Too crowded in here. Shut up in a box, a closet, a coffin, ignored by the spectators and the vested authority on the bench. What would I do if I were in the dock, like that chap? Suppose they convicted? That would spoil it all. Another dark place— If I'd inherited the right genes, I'd have been strong enough to beat up Vanderman. But I've been pushed around too long.

I keep remembering that song.

Stray in the herd and the boss said kill it,
So I shot him in the rump with the handle of a skillet.

A deadly weapon that's in normal usage wouldn't appear dangerous. But if it could be used homicidally —No, the Eye could check on that. All you can conceal these days is motive. But couldn't the trick be reversed? Suppose I got Vanderman to attack me with what he thought was the handle of a skillet, but which I knew was a deadly weapon—

The trial Sam Clay was watching was fairly routine. One man had killed another. Counsel for the defense contended that the homicide had been a matter of impulse, and that, as a matter of fact, only assault and battery plus culpable negligence at worst, could be proved, and the latter was canceled by an Act of God. The fact that the defendant inherited the decedent's fortune, in Martial oil, made no difference. Temporary insanity was the plea.

The prosecuting attorney showed films of what had happened before the fact. True, the victim hadn't been killed by the blow, merely stunned. But the affair had occurred on an isolated beach, and when the tide came in—

Act of God, the defense repeated hastily.

The screen showed the defendant, some days before his crime, looking

up the tide-table in a news tape. He also, it appeared, visited the site and asked a passing stranger if the beach was often crowded. "Nope," the stranger said, "it ain't crowded after sundown. Gits too cold. Won't do you no good, though. Too cold to swim then."

One side matched *Actus non facit reum, nisi mens sit rea*—"The act does not make a man guilty, unless the mind be also guilty"—against *Acta exteriora indicant interiora secreta*—"By the outward acts we are to judge of the inward thoughts". Latin legal basics were still valid, up to a point. A man's past remained sacrosanct, provided—and here was the joker—that he possessed the right of citizenship. And anyone accused of a capital crime was automatically suspended from citizenship until his innocence had been established.

Also, no past-tracing evidence could be introduced into a trial unless it could be proved that it had direct connection with the crime. The average citizen did have a right of privacy against tracing. Only if accused of a serious crime was that forfeit, and even then evidence uncovered could be used only in correlation with the immediate charge. There were various loopholes, of course, but theoretically a man was safe from espionage as long as he stayed within the law.

Now a defendant stood in the dock, his past opened. The prosecution showed recordings of a ginger blonde blackmailing him, and that clinched the motive and the verdict—guilty. The condemned man was led off in tears. Clay got up and walked out of the court. From his appearance, he seemed to be thinking.

He was. He had decided that there was only one possible way in which he could kill Vanderman and get away with it. He couldn't conceal the deed itself, nor the actions leading up to it, nor any written or spoken word. All he could hide were his own thoughts. And, without otherwise betraying himself, he'd have to kill Vanderman so that his act would appear justified. Which meant covering his tracks for yesterday as well as for tomorrow and tomorrow.

Now, thought Clay, this much can be assumed: If I stand to lose by Vanderman's death instead of gaining, that will help considerably. I must juggle that somehow. But I mustn't forget that at present I have an obvious motive. First, he stole Bea. Second, he beat me up.

So I must make it seem as though he's done me a favor—somehow.

I must have an opportunity to study Vanderman carefully, and it must be a normal, logical, waterproof opportunity. Private secretary. Something like that. The Eye's in the future now, after the fact, but it's watching me—

I must remember that. *It's watching me now!*

All right. Normally, I'd have thought of murder, at this point.

That can't and shouldn't be disguised. I must work out of the mood gradually, but meanwhile—

He smiled.

Going off to buy a gun, he felt uncomfortable, as though that prescient Eye, years in the future, could with a wink summon the police. But it was separated from him by a barrier of time that only the natural processes could shorten. And, in fact, it had been watching him since his birth. You could look at it that way—

He could defy it. The Eye couldn't read thoughts.

He bought the gun and lay in wait for Vanderman in a dark alley. But first he got thoroughly drunk. Drunk enough to satisfy the Eye.

After that—

"Feel better now?" Vanderman asked, pouring another coffee.

Clay buried his face in his hands.

"I was crazy," he said, his voice muffled. "I must have been. You'd better t-turn me over to the police."

"We can forget about that end of it, Clay. You were drunk, that's all. And I . . . well, I—"

"I pull a gun on you . . . try to kill you . . . and you bring me up to your place and—"

"You didn't use that gun, Clay. Remember that. You're no killer. All this has been my fault. I needn't have been so blasted tough with you," Vanderman said, looking like Coeur-de-Leon in spite of uncalculated amber fluorescence.

"I'm no good. I'm a failure.

Every time I try to do something, a man like you comes along and does it better. I'm a second-rater."

"Clay, stop talking like that. You're just upset, that's all. Listen to me. You're going to straighten up. I'm going to see that you do. Starting tomorrow, we'll work something out. Now drink your coffee."

"You know," Clay said, "you're quite a guy."

So the magnanimous idiot's fallen for it, Clay thought, as he was drifting happily off to sleep. Fine. That begins to take care of the Eye. Moreover, it starts the ball rolling with Vanderman. Let a man do you a favor and he's your pal. Well, Vanderman's going to do me a lot more favors. In fact, before I'm through, I'll have every motive for wanting to keep him alive.

Every motive visible to the naked Eye.

Probably Clay had not heretofore applied his talents in the right direction, for there was nothing second-rate about the way he executed his homicide plan. In that, he proved very capable. He needed a suitable channel for his ability, and perhaps he needed a patron. Vanderman fulfilled that function; probably it salved his conscience for stealing Bea. Being the man he was, Vanderman needed to avoid even the appearance of ignobility. Naturally strong and ruthless, he told himself he was sentimental. His sentimentality never reached the point of actually inconveniencing him, and Clay knew enough to stay within the limits.

Nevertheless it is nerve-racking to know you're living under the scrutiny of an extratemporal Eye. As he walked into the lobby of the V Building a month later, Clay realized that light-vibrations reflected from his own body were driving irretrievably into the polished onyx walls and floor, photographing themselves there, waiting for a machine to unlock them, some day, some time, for some man perhaps in this very city, who as yet didn't know even the name of Sam Clay. Then, sitting in his relaxer in the spiral lift moving swiftly up inside the walls, he knew that those walls were capturing his image, stealing it, like some superstition he remembered . . . ah?

Vanderman's private secretary greeted him. Clay let his gaze wander freely across that young person's neatly-dressed figure and mildly attractive face. She said that Mr. Vanderman was out, and the appointment was for three, not two, wasn't it? Clay referred to a notebook. He snapped his fingers.

"Three—you're right, Miss Wells. I was so sure it was two I didn't even bother to check up. Do you think he might be back sooner? I mean, is he out, or in conference?"

"He's out, all right, Mr. Clay," Miss Wells said. "I don't think he'll be back much sooner than three. I'm sorry."

"Well, may I wait in here?"

She smiled at him efficiently. "Of course. There's a stereo and the magazine spools are in that case."

She went back to her work, and Clay skimmed through an article about the care and handling of lunar filchards. It gave him an opportunity to start a conversation by asking Miss Wells if she liked filchards. It turned out that she had no opinion whatsoever of filchards but the ice had been broken.

This is the cocktail acquaintance, Clay thought. I may have a broken heart, but, naturally, I'm lonesome.

The trick wasn't to get engaged to Miss Wells so much as to fall in love with her convincingly. The Eye never slept. Clay was beginning to wake at night with a nervous start, and lie there looking up at the ceiling. But darkness was no shield.

"The question is," said the sociologist at this point, "whether or not Clay was acting for an audience."

"You mean us?"

"Exactly. It just occurred to me. Do you think he's been behaving perfectly naturally?"

The engineer pondered.

"I'd say yes. A man doesn't marry a girl only to carry out some other plan, does he? After all, he'd get himself involved in a whole new batch of responsibilities."

"Clay hasn't married Josephine Wells yet, however," the sociologist countered. "Besides, that responsibility angle might have applied a few hundred years ago, but not now. He went off at random. "Imagine a society where, after divorce, a man was forced to support a perfectly healthy, competent woman! It was vestigial, I know—a throwback to the days when only males could earn a living—but imagine the sort of women who were willing to accept such support. That was reversion to infancy if I ever—"

The engineer coughed.

"Oh," the sociologist said. "Oh . . . yes. The question is, would Clay have got himself engaged to a woman unless he really—"

"Engagements can be broken."

"This one hasn't been broken yet, as far as we know. And *we know.*"

"A normal man wouldn't plan on marrying a girl he didn't care anything about, unless he had some stronger motive—I'll go along that far."

"But how normal is Clay?" the sociologist wondered. "Did he know in advance we'd check back on his past? Did you notice that he cheated at solitaire?"

"Proving?"

"There are all kinds of trivial things you don't do if you think people are looking. Picking up a penny in the street, drinking soup out of the bowl, posing before a mirror—the sort of foolish or petty things everyone does when alone. Either Clay's innocent, or he's a very clever man—"

He was a very clever man. He never intended the engagement to

get as far as marriage, though he knew that in one respect marriage would be a precaution. If a man talks in his sleep, his wife will certainly mention the fact. Clay considered gagging himself at night if the necessity should arise. Then he realized that if he talked in his sleep at all, there was no insurance against talking too much the very first time he had an auditor. He couldn't risk such a break. But there was no necessity, after all. Clay's problem, when he thought it over, was simply: How can I be sure I don't talk in my sleep?

He solved that easily enough by renting a narcohypnotic supplementary course in common trade dialects. This involved studying while awake and getting the information repeated in his ear during slumber. As a necessary preparation for the course, he was instructed to set up a recorder and chart the depth of his sleep, so the narcohypnosis could be keyed to his individual rhythms. He did this several times, rechecked once a month thereafter, and was satisfied. There was no need to gag himself at night.

He was glad to sleep provided he didn't dream. He had to take sedatives after a while. At night, there was relief from the knowledge that an Eye watched him always, an Eye that could bring him to justice, an Eye whose omnipotence he could not challenge in the open. But he dreamed about the Eye.

Vanderman had given him a job in the organization, which was enormous. Clay was merely a cog, which suited him well enough, for the moment. He didn't want any more favors yet. Not till he had found out the extent of Miss Wells' duties —Josephine, her Christian name was. That took several months, but by that time friendship was ripening into affection. So Clay asked Vanderman for another job. He specified. It wasn't obvious, but he was asking for work that would, presently, fit him for Miss Wells' duties.

Vanderman probably still felt guilty about Bea; he'd married her and she was in Antartica now, at the Casino. Vanderman was due to join her, so he scribbled a memorandum, wished Clay good luck, and went to Antartica, bothered by no stray pangs of conscience. Clay improved the hour by courting Josephine ardently.

From what he had heard about the new Mrs. Vanderman, he felt secretly relieved. Not long ago, when he had been content to remain passive, the increasing dominance of Bea would have satisfied him, but no more. He was learning self-reliance, and liked it. These days, Bea was behaving rather badly. Given all the money and freedom she could use, she had too much time on her hands. Once in a while Clay heard rumors that made him smile secretly. Vanderman wasn't having an easy time of it. A dominant character, Bea—but Vanderman was no weakling himself.

After a while Clay told his employer he wanted to marry Joseph-

ine Wells. "I guess that makes us square," he said. "You took Bea away from me and I'm taking Josie away from you."

"Now wait a minute," Vanderman said. "I hope you don't—"

"My fiancée, your secretary. That's all. The thing is, Josie and I are in love." He poured it on, but carefully. It was easier to deceive Vanderman than the Eye, with its trained technicians and forensic sociologists looking through it. He thought, sometimes, of those medieval pictures of an immense eye, and that reminded him of something vague and distressing, though he couldn't isolate the memory.

After all, what could Vanderman do? He arranged to have Clay given a raise. Josephine, always conscientious, offered to keep on working for a while, till office routine was straightened out, but it never did get straightened out, somehow. Clay deftly saw to that by keeping Josephine busy. She didn't have to bring work home to her apartment, but she brought it, and Clay gradually began to help her when he dropped by. His job, plus the narcohypnotic courses, had already trained him for this sort of tricky organizational work. Vanderman's business was highly specialized—planet-wide exports and imports, and what with keeping track of specific groups, seasonal trends, sectarian holidays, and so forth, Josephine, as a sort of animated memorandum book for Vanderman, had a more than full-time job.

She and Clay postponed marriage for a time. Clay—naturally enough—began to appear mildly jealous of Josephine's work, and she said she'd quit soon. But one night she stayed on at the office, and he went out in a pet and got drunk. It just happened to be raining that night, Clay got tight enough to walk unprotected through the drizzle, and to fall asleep at home in his wet clothes. He came down with influenza. As he was recovering, Josephine got it.

Under the circumstances, Clay stepped in—purely a temporary job—and took over his fiancée's duties. Office routine was extremely complicated that week, and only Clay knew the ins and outs of it. The arrangement saved Vanderman a certain amount of inconvenience, and, when the situation resolved itself, Josephine had a subsidiary job and Clay was Vanderman's private secretary.

"I'd better know more about him," Clay said to Josephine. "After all, there must be a lot of habits and foibles he's got that need to be catered to. If he wants lunch ordered up, I don't want to get smoked tongue and find out he's allergic to it. What about his hobbies?"

But he was careful not to pump Josephine too hard, because of the Eye. He still needed sedatives to sleep.

The sociologist rubbed his forehead.

"Let's take a break," he suggested. "Why does a guy want to commit murder anyway?"

"For profit, one sort or another."

"Only partly, I'd say. The other part is an unconscious desire to be punished—usually for something else. That's why you get accident prones. Ever think about what happens to murderers who feel guilty and yet who aren't punished by the law? They must live a rotten sort of life—always accidentally stepping in front of speedsters, cutting themselves with an ax—accidentally; accidentally touching wires full of juice—"

"Conscience, eh?"

"A long time ago, people thought God sat in the sky with a telescope and watched everything they did. They really lived pretty carefully, in the Middle Ages—the first Middle Ages, I mean. Then there was the era of disbelief, where people had nothing to believe in very strongly—and finally we get this." He nodded toward the screen. "A universal memory. By extension, it's a universal social conscience, an externalized one. It's exactly the same as the medieval concept of God—omniscience."

"But not omnipotence."

"Mm."

All in all, Clay kept the Eye in mind for a year and a half. Before he said or did anything whatsoever, he reminded himself of the Eye, and made certain that he wasn't revealing his motive to the judging future. Of course, there was—would be—an Ear, too, but that was a little too absurd. One couldn't visualize a large, disembodied Ear decorating the wall like a plate in a plate holder. All the same, whatever he said would be as important evidence—some time—as what he did. So Sam Clay was very careful indeed, and behaved like Caesar's wife. He wasn't exactly defying authority, but he was certainly circumventing it.

Superficially Vanderman was more like Caesar, and his wife was not above reproach, these days. She had too much money to play with. And she was finding her husband too strong-willed a person to be completely satisfactory. There was enough of the matriarch in Bea to make her feel rebellion against Andrew Vanderman, and there was a certain lack of romance. Vanderman had little time for her. He was busy these days, involved with a whole string of deals which demanded much of his time. Clay, of course, had something to do with that. His interest in his new work was most laudable. He stayed up nights plotting and planning as though expecting Vanderman to make him a full partner. In fact, he even suggested this possibility to Josephine. He wanted it on the record. The marriage date had been set, and Clay wanted to move before then; he had no intention of being drawn into a marriage of convenience after the necessity had been removed.

One thing he did, which had to be

handled carefully, was to get the whip. Now Vanderman was a fingerer. He liked to have something in his hands while he talked. Usually it was a crystalline paper weight, with a miniature thunderstorm in it, complete with lightning, when it was shaken. Clay put this where Vanderman would be sure to knock it off and break it. Meanwhile, he had plugged one deal with Callisto Ranches for the sole purpose of getting a whip for Vanderman's desk. The natives were proud of their leatherwork and their silversmithing, and a nominal makeweight always went with every deal they closed. Thus, presently, a handsome miniature whip, with Vanderman's initials on it, lay on the desk, coiled into a loop, acting as a paper weight except when he picked it up and played with it while he talked.

The other weapon Clay wanted was already there—an antique paper knife, once called a surgical scalpel. He never let his gaze rest on it too long, because of the Eye.

The other whip came. He absentmindedly put it in his desk and pretended to forget it. It was a sample of the whips made by the Alaskan Flagellantes for use in their ceremonies, and was wanted because of some research being made into the pain-neutralizing drugs the Flagellantes used. Clay, of course, had engineered this deal, too. There was nothing suspicious about that; the firm stood to make a sound profit. In fact, Vanderman had promised him a percentage bonus at the end of the year on every deal he triggered. It would be quite a lot. It was December, a year and a half had passed since Clay first recognized that the Eye would seek him out.

He felt fine. He was careful about the sedatives, and his nerves, though jangled, were nowhere near the snapping point. It had been a strain, but he had trained himself so that he would make no slips. He visualized the Eye in the walls, in the ceiling, in the sky, everywhere he went. It was the only way to play completely safe. And very soon now it would pay off. But he would have to do it soon; such a nervous strain could not be continued indefinitely.

A few details remained. He carefully arranged matters—under the Eye's very nose, so to speak—so that he was offered a well-paying position with another firm. He turned it down.

And, one night, an emergency happened to arise so that Clay, very logically, had to go to Vanderman's apartment.

Vanderman wasn't there. Bea was. She had quarreled violently with her husband. Moreover, she had been drinking. (This, too, he had expected.) If the situation had not worked out exactly as he wanted, he would have tried again—and again—but there was no need.

Clay was a little politer than necessary. Perhaps too polite, certainly Bea, that incipient matriarch, was led down the garden path, a direc-

tion she was not unwilling to take. After all, she had married Vanderman for his money, found him as dominant as herself, and now saw Clay as an exaggerated symbol of both romance and masculine submissiveness.

The camera eye hidden in the wall, in a decorative bas-relief, was grinding away busily, spooling up its wire-tape, in a way that indicated Vanderman was a suspicious as well as a jealous husband. But Clay knew about this gadget, too. At the suitable moment he stumbled against the wall in such a fashion that the device broke. Then, with only that other eye spying on him, he suddenly became so virtuous that it was a pity Vanderman couldn't witness his *volte face*.

"Listen, Bea," he said, "I'm sorry, but I didn't understand. It's no good. I'm not in love with you any more. I was once, sure, but that was quite a while ago. There's somebody else, and you ought to know it by now."

"You still love me," Bea said with intoxicated firmness. "We belong together."

"Bea. Please. I hate to have to say this, but I'm grateful to Andrew Vanderman for marrying you. I . . . well, you got what you wanted, and I'm getting what I want. Let's leave it at that."

"I'm used to getting what *I* want, Sam. Opposition is something I don't like. Especially when I know you really—"

She said a good deal more, and

so did Clay—he was perhaps unnecessarily harsh. But he had to make the point, for the Eye, that he was no longer jealous of Vanderman.

He made the point.

The next morning he got to the office before Vanderman, cleaned up his desk, and discovered the stingaree whip still in its box. "Oops," he said, snapping his fingers—the Eye watched, and this was the crucial period. Perhaps it would all be over within the hour. Every move from now on would have to be specially calculated in advance, and there could be no slightest deviation. The Eye was everywhere—literally everywhere.

He opened the box, took out the whip, and went into the inner sanctum. He tossed the whip on Vanderman's desk, so carelessly that a stylus rack toppled. Clay rearranged everything, leaving the stingaree whip near the edge of the desk, and placing the Callistan silver-leather whip at the back, half concealed behind the interoffice visor-box. He didn't allow himself more than a casual sweeping glance to make sure the paper knife was still there.

Then he went out for coffee.

Half an hour later he got back, picked up a few letters for signature from the rack, and walked into Vanderman's office. Vanderman looked up from behind his desk. He had changed a little in a year and a half; he was looking older, less noble, more like an aging bulldog. Once, Clay thought coldly, this man stole my fiancée and beat me up.

Careful. Remember the Eye.

There was no need to do anything but follow the plan and let events take their course. Vanderman had seen the spy films, all right, up to the point where they had gone blank, when Clay fell against the wall. Obviously he hadn't really expected Clay to show up this morning. But to see the louse grinning hello, walking across the room, putting some letters down on his desk—!

Clay was counting on Vanderman's short temper, which had not improved over the months. Obviously the man had been simply sitting there, thinking unpleasant thoughts, and just as Clay had known would happen, he'd picked up the whip and begun to finger it. But it was the stingaree whip this time.

"Morning," Clay said cheerfully to his stunned employer. His smile became one-sided. "I've been waiting for you to check this letter to the Kirghiz kovar-breeders. Can we find a market for two thousand of those ornamental horns?"

It was at this point that Vanderman, bellowing, jumped to his feet, swung the whip, and sloshed Clay across the face. There is probably nothing more painful than the bite of a stingaree whip.

Clay staggered back. He had not known it would hurt so much. For an instant the shock of the blow knocked every other consideration

out of his head, and blind anger was all that remained.

Remember the Eye!

He remembered it. There were dozens of trained men watching everything he did just now. Literally he stood on an open stage surrounded by intent observers who made notes on every expression of his face, every muscular flection, every breath he drew.

In a moment Vanderman would be dead—but Sam Clay would not be alone. An invisible audience from the future was fixing him with cold, calculating eyes. He had one more thing to do and the job would be over. Do it—carefully, carefully!—while they watched.

Time stopped for him. *The job would be over.*

It was very curious. He had rehearsed this series of actions so often in the privacy of his mind that his body was going through with it now, without further instructions. His body staggered back from the blow, recovered balance, glared at Vanderman in shocked fury, poised for a dive at that paper knife in plain sight on the desk.

That was what the outward and visible Sam Clay was doing. But the inward and spiritual Sam Clay went through quite a different series of actions.

The job would be over.

And what was he going to do after that?

The inward and spiritual murderer stood fixed with dismay and surprise, staring at a perfectly empty future. He had never looked beyond this moment. He had made no plans for his life beyond the death of Vanderman. But now—he had no enemy but Vanderman. When Vanderman was dead, what would he fix upon to orient his life? What would he work at then? His job would be gone, too. And he liked his job.

Suddenly he knew how much he liked it. He was good at it. For the first time in his life, he had found a job he could do really well.

You can't live a year and a half in a new environment without acquirining new goals. The change had come imperceptively. He was a good operator; he'd discovered that he could be successful. He didn't have to kill Vanderman to prove that to himself. He'd proved it already without committing murder.

In that time-stasis which had brought everything to a full stop he looked at Vanderman's red face and he thought of Bea, and of Vanderman as he had come to know him—and he didn't want to be a murderer.

He didn't want Vanderman dead. He didn't want Bea. The thought of her made him feel a little sick. Perhaps that was because he himself had changed from passive to active. He no longer wanted or needed a dominant woman. He could make his own decisions. If he were choosing now, it would be someone more like Josephine—

Josephine. That image before his mind's stilled eye was suddenly very

pleasant. Josephine with her mild, calm prettiness, her admiration for Sam Clay the successful business man, the rising young importer in Vanderman, Inc. Josephine whom he was going to marry—Of course he was going to marry her. He loved Josephine. He loved his job. All he wanted was the status quo, exactly as he had achieved it. Everything was perfect right now—as of maybe thirty seconds ago.

But that was a long time ago—thirty seconds. A lot can happen in half a minute. A lot had happened. Vanderman was coming at him again, the whip raised. Clay's nerves crawled at the anticipation of its burning impact across his face a second time. If he could get hold of Vanderman's wrist before he struck again—if he could talk fast enough—

The crooked smile was still on his face. It was part of the pattern, in some dim way he did not quite understand. He was acting in response to conditioned reflexes set up over a period of many months of rigid self-training. His body was already in action. All that had taken place in his mind had happened so fast there was no physical hiatus at all. His body knew its job and it was doing the job. It was lunging forward toward the desk and the knife, and he could not stop it.

All this had happened before. It had happened in his mind, the only place where Sam Clay had known real freedom in the past year and a half. In all that time he had forced himself to realize that the Eye was watching every outward move he made. He had planned each action in advance and schooled himself to carry it through. Scarcely once had he let himself act purely on impulse. Only in following the plan exactly was there safety. He had indoctrinated himself too successfully.

Something was wrong. This wasn't what he'd wanted. He was still afraid, weak, failing—

He lurched against the desk, clawed at the paper knife, and, knowing failure, drove it into Vanderman's heart.

"It's a tricky case," the forensic sociologist said to the engineer. "Very tricky."

"Want me to run it again?"

"No, not right now. I'd like to think it over. Clay . . . that firm that offered him another job. The offer's withdrawn now, isn't it? Yes, I remember—they're fussy about the morals of their employees. It's insurance or something, I don't know. Motive. Motive, now."

The sociologist looked at the engineer.

The engineer said: "A year and a half ago he had a motive. But a week ago he had everything to lose and nothing to gain. He's lost his job and that bonus, he doesn't want Mrs. Vanderman any more, and as for that beating Vanderman once gave him . . . ah?"

"Well, he did try to shoot Vanderman once, and he couldn't, re-

member? Even though he was full of Dutch courage. But—something's wrong. Clay's been avoiding even the appearance of evil a little too carefully. Only I can't put my finger on anything, blast it."

"What about tracing back his life further? We only got to his fourth year."

"There couldn't be anything useful that long ago. It's obvious he was afraid of his father and hated him, too. Typical stuff, basic psych. The father symbolizes judgment to him. I'm very much afraid Sam Clay is going to get off scot-free."

"But if you think there's something haywire—"

"The burden of proof is up to us," the sociologist said.

The visor sang. A voice spoke softly.

"No, I haven't got the answer yet. Now? All right. I'll drop over."

He stood up.

"The D. A. wants a consultation. I'm not hopeful, though. I'm afraid the State's going to lose this case. That's the trouble with the externalized conscience—"

He didn't amplify. He went out, shaking his head, leaving the engineer staring speculatively at the screen. But within five minutes he was assigned to another job—the bureau was understaffed—and he didn't have a chance to investigate on his own until a week later. Then it didn't matter any more.

For, a week later, Sam Clay was walking out of the court an acquitted man. Bea Vanderman was waiting for him at the foot of the ramp. She wore black, but obviously her heart wasn't in it.

"Sam," she said.

He looked at her.

He felt a little dazed. It was all over. Everything had worked out exactly according to plan. And nobody was watching him now. The Eye had closed. The invisible audience had put on its hats and coats and left the theater of Sam Clay's private life. From now on he could do and say precisely what he liked, with no censoring watcher's omnipresence to check him. He could act on impulse again.

He had outwitted society. He had outwitted the Eye and all its minions in all their technological glory. He, Sam Clay, private citizen. It was a wonderful thing, and he could not understand why it left him feeling so flat.

That had been a nonsensical moment, just before the murder. The moment of relenting. They say you get the same instant's frantic rejection on the verge of a good many important decisions—just before you marry, for instance. Or—what was it? Some other common instance he'd often heard of. For a second it eluded him. Then he had it. The hour before marriage—and the instant after suicide. After you've pulled the trigger, or jumped off the bridge. The instant of wild revulsion when you'd give anything to undo the irrevocable. Only, you

can't. It's too late. The thing is done.

Well, he'd been a fool. Luckily, it *had* been too late. His body took over and forced him to success he'd trained it for. About the job—it didn't matter. He'd get another. He'd proved himself capable. If he could outwit the Eye itself, what job existed he couldn't lick if he tried? Except—nobody knew exactly how good he was. How could he prove his capabilities? It was infuriating to achieve such phenomenal success after a lifetime of failures, and never to get the credit for it. How many men must have tried and failed where he had tried and succeeded? Rich men, successful men, brilliant men who had yet failed in the final test of all—the contest with the Eye, their own lives at stake. Only Sam Clay had passed that most important test in the world—and he could never claim credit for it.

". . . knew they wouldn't convict," Bea's complacent voice was saying.

Clay blinked at her. "What?"

"I said I'm so glad you're free, darling. I knew they wouldn't convict you. I knew that from the very beginning." She smiled at him, and for the first time it occurred to him that Bea looked a little like a bulldog. It was something about her lower jaw. He thought that when her teeth were closed together the lower set probably rested just outside the upper. He had an instant's impulse to ask her about it. Then he decided he had better not.

"You knew, did you?" he said.

She squeezed his arm. What an ugly lower jaw that was. How odd he'd never noticed it before. And behind the heavy lashes, how small her eyes were. How mean.

"Let's go where we can be alone," Bea said, clinging to him. "There's such a lot to talk about."

"We *are* alone," Clay said, diverted for an instant to his original thoughts. "Nobody's watching." He glanced up at the sky and down at the mosaic pavement. He drew a long breath and let it out slowly. "Nobody," he said.

"My speeder's parked right over here. We can—"

"Sorry Bea."

"What do you mean?"

"I've got business to attend to."

"Forget business. Don't you understand that we're free now, both of us?"

He had a horrible feeling he knew what she meant.

"Wait a minute," he said, because this seemed the quickest way to end it. "I killed your husband, Bea. Don't forget that."

"You were acquitted. It was self-defense. The court said so."

"It—" He paused, glanced up quickly at the high wall of the Justice Building, and began a one-sided, mirthless smile. It was all right; there was no Eye now. There never would be, again. He was unwatched.

"You mustn't feel guilty, even within yourself," Bea said firmly. "It wasn't your fault. It simply

wasn't. You've got to remember that. You *couldn't* have killed Andrew except by accident, Sam, so—"

"What? What do you mean by that?"

"Well, after all. I know the prosecution kept trying to prove you'd planned to kill Andrew all along, but you mustn't let what they said put any ideas in your head. I know you, Sam. I knew Andrew. You couldn't have planned a thing like that, and even if you had, it wouldn't have worked."

The half-smile died.

"It wouldn't?"

She looked at him steadily.

"Why, you couldn't have managed it," she said. "Andrew was the better man, and we both know it. He'd have been too clever to fall for anything—"

"Anything a second-rater like me could dream up?" Clay swallowed. His lips tightened. "Even you—What's the idea? What's your angle now—that we second-raters ought to get together?"

"Come on," she said, and slipped her arm through his. Clay hung back for a second. Then he scowled, looked back at the Justice Building, and followed Bea toward her speeder.

The engineer had a free period. He was finally able to investigate Sam Clay's early childhood. It was purely academic now, but he liked to indulge his curiosity. He traced Clay back to the dark closet, when the boy was four, and used ultra-violet. Sam was huddled in a corner, crying silently, staring up with frightened eyes at a top shelf.

What was on that shelf the engineer could not see.

He kept the beam focused on the closet and cast back rapidly through time. The closet often opened and closed, and sometimes Sam Clay was locked in it as punishment, but the upper shelf held its mystery until—

It was in reverse. A woman reached to that shelf, took down an object, walked backward out of the closet to Sam Clay's bedroom, and went to the wall by the door. This was unusual, for generally it was Sam's father who was warden of the closet.

She hung up a framed picture of a single huge staring eye floating in space. There was a legend under it. The letters spelled out: THOU GOD SEEST ME.

The engineer kept on tracing. After awhile it was night. The child was in bed, sitting up wide-eyed, afraid. A man's footsteps sounded on the stair. The scanner told all secrets but those of the inner mind. The man was Sam's father, coming up to punish him for some childish crime committed earlier. Moonlight fell upon the wall beyond which the footsteps approached showing how the wall quivered a little to the vibrations of the feet, and the Eye in its frame quivered, too. The boy seemed to brace himself. A defiant half-smile showed on his mouth, crooked, unsteady.

This time he'd keep that smile, no

matter what happened. When it was over he'd still have it, so his father could see it, and the Eye could see it and they'd know he hadn't given in. He hadn't . . . he—

The door opened.

He couldn't help it. The smile faded and was gone.

"Well, what was eating him?" the engineer demanded.

The sociologist shrugged. "You could say he never did really grow up. It's axiomatic that boys go through a phase of rivalry with their fathers. Usually that's sublimated; the child grows up and wins, in one way or another. But Sam Clay didn't. I suspect he developed an externalized conscience very early. Symbolizing partly his father, partly God, an Eye and society—which fulfills the role of protective, punishing parent, you know."

"It still isn't evidence."

"We aren't going to get any evidence on Sam Clay. But that doesn't mean he's got away with anything, you know. He's always been afraid to assume the responsibilities of maturity. He never took on an optimum challenge. He was afraid to succeed at anything because that symbolic Eye of his might smack him down. When he was a kid, he might have solved his entire problem by kicking his old man in the shins. Sure, he'd have got a harder whaling, but he'd have made some move to assert his individuality. As it is, he waited too long. And then he defied the wrong thing, and it wasn't really defiance, basically. Too late now. His formative years are past. The thing that might really solve Clay's problem would be his conviction for murder—but he's been acquitted. If he'd been convicted, then he could prove to the world that he'd hit back. He'd kicked his father in the shins, kept that defiant smile on his face, killed Andrew Vanderman. I think that's what he actually has wanted all along—recognition. Proof of his own ability to assert himself. He had to work hard to cover his tracks—if he made any—but that was part of the game. By winning it he's lost. The normal ways of escape are closed to him. He always had an Eye looking down at him."

"Then the acquittal stands?"

"There's still no evidence. The State's lost its case. But I . . . I don't think Sam Clay has won his. Something will happen." He sighed. "It's inevitable, I'm afraid. Sentence first, you see. Verdict afterward. The sentence was passed on Clay a long time ago."

Sitting across from him in the Paradise Bar, behind a silver decanter of brandy in the center of the table, Bea looked lovely and hateful. It was the lights that made her lovely. They even managed to cast their shadows over that bulldog chin, and under her thick lashes the small, mean eyes acquired an illusion of beauty. But she still looked hateful. The lights could do nothing about that. They couldn't

cast shadows into Sam Clay's private mind or distort the images there.

He thought of Josephine. He hadn't made up his mind fully yet about that. But if he didn't quite know what he wanted, there was no shadow of doubt about what he *didn't* want—no possible doubt whatever.

"You need me, Sam," Bea told him over her brimming glass.

"I can stand on my own feet. I don't need anybody."

It was the indulgent way she looked at him. It was the smile that showed her teeth. He could see as clearly as if he had X-ray vision how the upper teeth would close down inside the lower when she shut her mouth. There would be a lot of strength in a jaw like that. He looked at her neck and saw the thickness of it, and thought how firmly she was getting her grip upon him, how she maneuvered for position and waited to lock her bulldog clamp deep into the fabric of his life again.

"I'm going to marry Josephine, you know," he said.

"No, you're not. You aren't the man for Josephine. I know that girl, Sam. For a while you may have had her convinced you were a go-getter. But she's bound to find out the truth. You'd be miserable together. You need me, Sam darling. You don't know what you want. Look at the mess you got into when you tried to act on your own. Oh, Sam, why don't you stop pretending? You know you never

were a planner. You . . . what's the matter, Sam?"

His sudden burst of laughter had startled both of them. He tried to answer her, but the laughter wouldn't let him. He lay back in his chair and shook with it until he almost strangled. He had come so close, so desperately close to bursting out with a boast that would have been confession. Just to convince the woman. Just to shut her up. He must care more about her good opinion than he had realized until now. But that last absurdity was too much. It was only ridiculous now. Sam Clay, not a planner!

How good it was to let himself laugh, now. To let himself go, without having to think ahead. Acting on impulse again, after those long months of rigid repression. No audience from the future was clustering around this table, analyzing the quality of his laughter, observing that it verged on hysteria, measuring it against all possible occasions in the past that could not explain its exact depth and duration.

All right, so it was hysteria. Who cared? He deserved a little blow-off like this, after all he'd been through. He'd risked so much, and achieved so much—and in the end gained nothing, not even glory except in his own mind. He'd gained nothing, really, except the freedom to be hysterical if he felt like it. He laughed and laughed and laughed, hearing the shrill note of lost control in his own voice and not caring.

People were turning to stare. The bartender looked over at him uneasily, getting ready to move if this went on. Bea stood up, leaned across the table, shook him by the shoulder.

"Sam, what's the matter! Sam, do get hold of yourself! You're making a spectacle of me, Sam! What *are* you laughing at?"

With a tremendous effort he forced the laughter back in his throat. His breath still came heavily and little bursts of merriment kept bubbling up so that he could hardly speak, but he got the words out somehow. They were probably the first words he had spoken without rigid censorship since he first put his plan into operation. And the words were these.

"I'm laughing at the way I fooled you. I fooled everybody! You think I didn't know what I was doing every minute of the time? You think I wasn't planning, every step of the way? It took me eighteen months to do it, but I killed Andrew Vanderman with malice aforethought, and nobody can ever prove I did it." He giggled foolishly. "I just wanted you to know," he added in a mild voice.

And it wasn't until he got his breath back and began to experience that feeling of incredible, delightful, incomparable relief that he knew what he had done.

She was looking at him without a flicker of expression on her face. Total blank was all that showed. There was a dead silence for a quarter of a minute. Clay had the

feeling that his words must have rung from the roof, that in a moment the police would come in to hale him away. But the words had been quietly spoken. No one had heard but Bea.

And now, at last, Bea moved. She answered him, but not in words. The bulldog face convulsed, suddenly and overflowed with laughter.

As he listened, Clay felt all that flood of glorious relief ebbing away. For he saw that she did not believe him. And there was no way he could prove the truth.

"Oh, you silly little man," Bea gasped when words came back to her. "You had me almost convinced for a minute. I almost believed you. I—" Laughter silenced her again, consciously silvery laughter made heads turn. That conscious note in it warned him that she was up to something. Bea had had an idea. His own thoughts outran hers and he knew in an instant before she spoke exactly what the idea was and how she would apply it. He said:

"I *am* going to marry Josephine," in the very instant that Bea spoke.

"You're going to marry me," she said flatly. "You've got to. You don't know your own mind, Sam. I know what's best for you and I'll see you do it. Do you understand me, Sam?"

"The police won't realize that was only a silly boast," she told him. "They'll believe you. You wouldn't want me to tell them what you just said, would you, Sam?"

He looked at her in silence, seeing no way out. This dilemma had sharper horns than anything he could have imagined. For Bea did not and would not believe him, no matter how he yearned to convince her, while the police undoubtedly would believe him, to the undoing of his whole investment in time, effort, and murder. He had said it. It was engraved upon the walls and in the echoing air, waiting for that invisible audience in the future to observe. No one was listening now, but a word from Bea could make them reopen the case.

A word from Bea.

He looked at her, still in silence, but with a certain cool calculation beginning to dawn in the back of his mind.

For a moment Sam Clay felt very tired indeed. In that moment he encompassed a good deal of tentative future time. In his mind he said yes to Bea, married her, lived an indefinite period as her husband. And he saw what that life would be like. He saw the mean small eyes watching him, the relentlessly gripping jaw set, the tyranny that would emerge slowly or not slowly, depending on the degree of his subservience, until he was utterly at the mercy of the woman who had been Andrew Vanderman's widow.

Sooner or later, he thought clearly to himself, *I'd kill her.*

He'd have to kill. That sort of life, with that sort of woman, wasn't a life Sam Clay could live, indefinitely. And he'd proved his ability

to kill and go free.

But what about Andrew Vanderman's death?

Because they'd have another case against him then. This time it had been qualitative; the next time, the balance would shift toward quantitative. If Sam Clay's wife died, Sam Clay would be investigated no matter how she died. Once a suspect, always a suspect in the eyes of the law. The Eye of the law. They'd check back. They'd return to this moment, while he sat here revolving thoughts of death in his mind. And they'd return to five minutes ago, and listen to him boast that he had killed Vanderman.

A good lawyer might get him off. He could claim it wasn't the truth. He could say he had been goaded to an idle boast by the things Bea said. He might get away with that, and he might not. Scop would be the only proof, and he couldn't be compelled to take scop.

But—no. That wasn't the answer. That wasn't the way out. He could tell by the sick, sinking feeling inside him. There had been just one glorious moment of release, after he'd made his confession to Bea, and from then on everything seemed to run downhill again.

But that moment had been the goal he'd worked toward all this time. He didn't know what it was, or why he wanted it. But he recognized the feeling when it came. He wanted it back.

This helpless feeling, this impotence—was this the total sum of what he had achieved? Then he'd failed, after all. Somehow, in some strange way he could only partly understand, he had failed; killing Vanderman hadn't been the answer at all. He wasn't a success. He was a second-rater, a passive, helpless worm whom Bea would manage and control and drive, eventually, to—

"What's the matter, Sam?" Bea asked solicitously.

"You think I'm a second-rater, don't you?" he said. "You'll never believe I'm not. You think I couldn't have killed Vanderman except by accident. You'll never believe I could possibly have defied—"

"What?" she asked, when he did not go on.

There was a new note of surprise in his voice.

"But it wasn't defiance," he said slowly. "I just hid and dodged. Circumvented. I hung dark glasses on an Eye, because I was afraid of it. But—that wasn't defiance. So —what I really was trying to prove—"

She gave him a startled, incredulous stare as he stood up.

"Sam! What are you doing?" Her voice cracked a little.

"Proving something," Clay said, smiling crookedly, and glancing up from Bea to the ceiling. "Take a good look," he said to the Eye as he smashed her skull with the decanter.

THE END

EXPEDITION POLYCHROME

BY J. A. WINTER, M.D.

***The** doctor had said, dogmatically and absolutely, that no disease could make a man turn aquamarine blue. But his patient was (1) bright aquamarine and (2) obviously dying!*

Illustrated by Cartier

"No, Tom, you're making the mistake so many others do." Dr. Edwards smiled; he was very happy to have the chance to launch a discourse on his favorite theme. "There *can't* be any new diseases. You see, the human organism is capable of acting in only certain ways. For example, the blood pressure can go up, it can come down or it can remain the same. The temperature can be elevated, it can be subnormal or it can be normal. And so it goes for every function of the

body—it can change only within the limits of its own capacity to function."

No doubt about it—Edwards was feeling quite pleased with himself. And it was well-deserved. The medical expedition under his direction to the planet Minotaur had just solved a most unusual problem involving the death of all members of Expedition I.

He tilted back in his chair in the control room and continued. "When we study exotic diseases the difficulty, therefore, is to find the causative agent. The disease itself is probably greatly similar to one with which we have been familiar on Earth for hundreds of years."

"Oh, I see," said Tom. "The roads it may travel on might be new, but it's still the same old model that's doing the traveling."

"Exactly," replied Bob. "To give you another example: the body is capable of only certain color changes. The skin might turn brown, due to the presence of melanin, one of the normally found pigments. Or it might turn any one of the colors seen in the degradation of hemoglobin. You know, those fascinating hues which change from dark blue to green to yellow, which we all saw adorning your left eye last year.

"No," he continued, without giving Tom a chance to explain how he got that shiner, "we could never expect to see a man turn, say, an aquamarine blue. There just isn't a precursor for that color in the body. So we'll never see an exotic disease where the skin is aquamarine or we'll never see a disease where a man reacts outside of the normal limitations of response."

"So that's it," mused Tom. "Yes, what is it?" He turned around as a knock came at the door.

It was one of the crew members. "Sorry to interrupt, sir, but I'd like to have Dr. Edwards take a look at me. My skin is kind of a funny color."

Edwards turned around. Like the Bay of Naples on a sunny day, or Lake Superior in July, the man's skin was a beautiful vivid aquamarine blue.

Bob's jaw dropped. He had just said that such a color couldn't possibly occur, yet here it was! Tom couldn't help smiling at Bob's obvious discomfiture. "Dr. Edwards," he asked archly, "wouldn't you say that Slawson's skin is aquamarine blue?"

"Yes," answered Bob—and you could see he hated to admit it,—"I guess you could call it that."

"My, my," said Tom, "I didn't realize that 'never' was such a short time!"

Bob wasn't annoyed by Tom's sly digs—he deserved them; but he was immediately preoccupied with the medical problem which had just slapped him in his distinguished face. He pondered for a few minutes, meanwhile making little smacking sounds with his lips. Finally he reached over and flipped on the

switch of the intraship communication system.

"Schultz—come up to the radio room as fast as you can get here."

"Yes, sire," replied Schultz, with his usual exaggerated psuedodeference.

While waiting for Schultz, Bob turned to the crewman, standing there patiently. "How do you feel, Slawson?"

"Not too bad, sir," he replied; you could see that he wasn't going to dramatize his illness. "I noticed that I was a little short of breath when I walked up, but outside of that I'm O.K."

Dr. Wilhelm Schultz then dashed in. He checked any questions he might have had at a signal from Edwards, who continued his questioning.

"When did you first notice that your skin was this color?"

"Just a few minutes ago. Just after I got back in the ship."

Three pairs of eyebrows were immediately elevated; could Minotaur be dangerous, in spite of the negative laboratory tests?

"Oh, you were outside?" asked Bob, mildly. He wasn't going to let his anxiety to get the facts influence the judicious manner of getting a history.

"Yes, sir," answered Slawson. "When we got the word that we could go outside, that it was all clear, I just went out and walked around the ship. I . . . I hope that was all right, sir," he added apologetically.

"That was all right, Slawson," Bob replied. "But it looks as if we doctors were all wrong. What do you think about this, Schultzie?"

"It looks pretty obvious that he got his bee-ootiful pigmentation from outside, all right. Going to take precautions?"

"You're right, Dutchman. Kelly, please order that the ship be sealed, immediately." Bob waited a moment until Tom had finished snapping his brisk, crisp orders into the intercom mike. "Then you'd better have all the circulating air in the ship triple-filtered; use the emergency bank of precipitrons, too."

"All right, Bob," assented Tom, as he stood up. "But what was that you were saying about it being impossible for a man to turn blue? Boy, are you going to have some explaining to do!"

"Get out of here," grinned Bob. "Go take care of your tin can."

When Tom left, Bob immediately got back to business. "Sit down, Slawson, and let's go into this a little further. What did you do when you left the ship? Try to remember *everything*—no matter how trivial."

Slawson sat down; he leaned forward, with his elbows on his knees, knitting his brows in concentration. "Let's see, now. I was all by myself—I was the only one off duty at the time. I went out through the air lock, closing the inner door after me and leaving the outer door open. I took a few steps so I was out of the shadow of the ship and just

looked around. I remember thinking how good it was to see the sun . . . the suns, I mean . . . after that storm we had." He broke off his narrative momentarily, to ask, "Is that the sort of stuff you want to hear, sir?"

"Go ahead, boy; you're doing fine," Bob assured him.

"Then I just sort of wandered around the ship, looking at the plants and stuff. My hobby is botany, sir," he added, shyly. "I squatted down on the ground to see if there were any insects like ants or earthworms. But a worm isn't an insect, is it?" he asked confusedly.

"The earthworm, *Lumbricus terrestris,* is a member of the phylum Annelida. Get on with your story," snapped Schultz.

"Yes, sir," answered Slawson meekly; he was, strangely, apparently consoled by this fact of taxonomy. "Well, I didn't see anything on the ground, so I walked around a little more. I wasn't more than twenty or twenty-five meters from the ship at any time. Then I saw some flowers that were just budding out and went over to look at them. They weren't as pretty as our own flowers . . . no odor, either—"

This remark was immediately seized upon by Edwards. "No odor, eh? So you smelled them? What did these flowers look like?"

"Yes, sir—I just took a little bitty sniff. And I didn't look at them very closely, so I can't tell you much about them. There were seven petals with dentate edges, of a sort of chartreuse color. There were seven stamens with large lobulated anthers. The leaves were lanceolate, with stipules."

Schultz looked at Edwards. "So he didn't look at them closely, says he. What kind of a botanical lecture would he have given us if he *had* looked at them?"

"Let him alone, Schultz," said Bob. "He's interested, so he can't help being observant. What else did you do, Slawson?"

"That's all, sir. I was sort of cold, so I thought I'd come back to the ship and get a jacket and see if one of the boys wanted to go out for a walk. When I opened my locker I noticed the color of my skin, so I reported to you immediately."

Bob looked at Schultz, inquiringly. "Looks like we have our clue, doesn't it? Let's go down to the lab and go to work. Come on, Slawson."

The three men made their way to the laboratory, where they found Thomas, the pathologist. This was to be expected—he was never far or long away from his beloved, immaculate laboratory. As the three entered he was looking through a microscope.

"Gentlemen," he greeted them in his precise way. When I heard the order to seal ship I thought you might be suspicious of the air, so I began to do another check. What do you suspect?"

Instead of answering, Bob merely stepped from in front of Slawson,

made that casual gesture which means, "Look what we have here!"

Thomas' face was a study in pleasure—the pleasure of being presented with a new, interesting problem. "Well!" he said. "Most unusual. And you think that this coloration comes from the air?"

Bob shrugged. "All we know is that he apparently got it outside. It might be from a flower—but we can't afford to take any chances." He smiled wryly. "Seems as how Minotaur is not the safe, peaceful planet we thought."

"What did you find in the air, Dave?" Schultz asked the pathologist.

"I found a few granules of what might be pollen, but very few, not over three per cubic meter. It seems rather doubtful that we could get a reaction like this from airborne pollen," he answered. "But let's see what we can find out about Slawson. Any particular tests that you have in mind?"

Bob pursed his lips thoughtfully. "We'd better have the usual blood count, and urinalysis. And . . . let's see . . . you have a spectroscope, as I recall—we'd better see what that shows. And I'd better get Livingston here to do a skin biopsy so we can tell where the color is." He stepped to the intercom and called the surgeon.

By the time Livingston arrived Thomas and his efficient assistants had the specimens and were beginning the analysis. Slawson meekly obeyed the order to get undressed and lay down on the operating table, prepared to submit himself to the tender mercies of the surgeon.

"Do you want this skin specimen from any particular site?" Jack asked.

Bob looked at the recumbent Slawson again. "Roll over, please," he asked. From scalp to toes, front and back the crewman was blue, definitely and unequivocally blue. His hair and nails weren't colored; his pupils looked black, but all the rest was blue, blue, blue.

"Guess it doesn't make any difference, Jack. Snatch a piece of hide from wherever your little fiendish heart desires."

"O.K.—we'll take it off the abdomen, then." Moving with the rapid dexterity which comes from long practice, Livingston soon had an area of the skin anaesthetized, a section of the skin snipped out, the wound closed and the specimen handed to a technician. He turned from the table and bumped into Mandel, who had quietly wandered in to see what was going on.

"What have we here?" he asked.

"You figure it out, chum," the surgeon replied. "Let's see what a hot-shot diagnostician you can be."

"Hm-m-m, the differential diagnosis of a blue skin. Let me think." As he looked at Slawson, who was enjoying all this attention, he whistled softly between his teeth.

Bob pricked up his ears at the tune. "What's that you're whistling, Irv?"

The psychiatrist smiled. "That's

an old, old song—one popular in the twentieth century. It was called 'Am I Blue.'" He looked at Slawson again and said, "Well, there are several things we'd have to consider here. There's the possibility of methemoglobinemia or sulfhemoglobinemia. It might be just a cyanosis, but he wouldn't be as comfortable as he is, if that were the case. And outside of that, the pixies might have given him some Trypan blue intravenously."

By this time Kelly had completed his duties with the ship and was lounging in the doorway of the lab. He shook his head. "That jargon you grave-robbers talk beats me. And what, if my ignorance isn't hanging out, could Trypan blue be?"

"Trypan blue? That's one of the so-called vital dyes which used to be used in research. You could inject it intravenously or intraperitoneally into a rat and he'd turn a beautiful blue. It's not effective by mouth, though, so Slawson couldn't have drunk it. You're sure, Slawson, that you didn't turn blue just to annoy us doctors?"

Slawson grinned back at the little psychiatrist. "No, sir!"

Thomas had been listening to this little by-play. "We don't have any Trypan blue aboard, anyway. The closest thing we have to it is methylene blue—and that stains only one of the fluids."

Schultz sighed. "How well I know that. I took some once in my first year in medical school; the guy that gave it to me told me it was a sure sign of . . . shall we say . . . impurity. Boy, was I impure!"

His confessions were interrupted by a thump and crash. They turned around to see Slawson lying on the floor. He had apparently tried to sit up on the edge of the table and had fallen over in a dead faint.

Bob reached him first. His practiced fingers found the radial pulse. "Wow! His heart is going better than one forty! We'd better get some oxygen into him immediately."

In less time than it takes to tell it, Slawson was in bed in the sick bay, being given oxygen through a mask.

Bob checked the patient's pulse again. "It's coming down a little now. He must have had a terrific anoxemia; we couldn't see it because of his color. I wish that he had complained a little more—but all he said was that he was a little short of breath." He turned from the bed to speak to the man on duty. "Keep a close eye on him and if there's any change, call me immediately. If you can't reach me, call Dr. Schultz."

Bob made his way back to the laboratory, deeply immersed in his thoughts. What to do about Slawson? Was it necessary to return to all the precautions taken when they first landed? Was he going to get the same disease? Why hadn't the others turned blue? And what would the outcome be? His disciplined mind abruptly cut off these

unproductive thoughts. He had a job to do; he didn't know what his results would be, but he could at least do something.

He entered the lab; Thomas and his assistants were still busy with the various specimens.

"Has he been cross-matched for transfusion?" Bob asked.

The pathologist pointed to a 500cc. flask of blood standing in a pan of warm water. "That's compatible, if you want to use it," he answered.

"Guess we'd better," Edwards mused. "His blood certainly isn't carrying enough oxygen; maybe this will help. Give it to him as soon as you can, will you? Mr. Kelly," he said—the navy man had entered silently, carrying a sheet of paper—"what's this?"

"We got our answer from Earth. You'll love it."

Tom took the message.

BUIPSH. 0820451735. MERCY MINOTAUR CONGRATS SOLVING PROBLEM EXPONE. FRING EXPTHREE. BLASTF 0820451700 DUE MINOTAUR 11XX45XXXX WELDONE STARK COMBUIPSH

Edwards gave an exaggerated shudder and handed the message back to Kelly. "The way you navy boys can louse up the language. Translate it, please—I'm afraid I understand what it means."

"O.K. stupe. 'Bureau of Interplanetary Ships; August 20, 2245; message sent at 1735 to Ship *Mercy* on Planet Minotaur. Congratulations on solving the problem of Expedition I. For your information and guidance Expedition III blasted off today at 1700 and is due on Minotaur the latter part of November—no specified time. Well done, our good and faithful servants.' Signed by Bottle Beak Stark, Commander of the Bureau of Interplanetary Ships."

"That dumb jerk!" said Schultz. "Does he think that this planet is safe just because we've solved one problem? Can't he realize what an unnecessary risk those guys are taking?" He ignored the fact that he was in much greater danger than those he was worrying about; after all, exposure to exotic disease was in line of duty for him. "Bob, shouldn't we radio Stark. to call them back?"

Bob turned to Kelly. "We can't do that, can we?"

"You're right," he answered. "They'd be way outside the Heaviside layer by now and they couldn't either receive or transmit unless the rockets were shut off. Too much ionization from the blast. We'll just have to wait until they hit atmosphere here and warn them off."

"No, by God," said Bob grimly, "we'll just have to get this mess cleaned up before they get here—and hope that we don't run into any more in the meantime. How're we doing, Davey? Have you found out what causes blue boys?"

"I think we're on the track," replied Thomas. "The oxygen-combining power is way down, though not totally absent. There are def-

inite changes in the absorption spectrum of the hemoglobin. There is the typical pattern of methemoglobin plus a band near line F. I'd say . . . now, mind you, this is only a guess . . . that Slawson had absorbed a blue chromogen with an unstable radical which splits off to cause methemoglobinemia."

"Wow," said Tom. "And you docs were giving the Navy hell for talking technicalese. How about you translating now?"

"Dr. Schultz—will you teach the kindergarten while I look through the spectroscope?" requested Bob, in his most formal manner.

"Gladly, my dear Dr. Edwards," replied Schultz, equally formally. "Now pay attention, you nauseating lump of ignorance. Hemoglobin is a complex combination of iron and protein which acts as the oxygen carrier of the blood. In the presence of oxygen it absorbs it to form oxyhemoglobin; in the absence of oxygen it gives up the oxygen to form reduced hemoglobin. The oxygen attaches or detaches itself easily. Is that clear so far?"

Kelly inclined his head, reverently. "Your words of wisdom are a blessing to my ears."

"I'm glad you appreciate me. To continue: certain chemicals, including the nitrites, acetanilid and nitrobenzene, cause the formation of a stable hemoglobin compound called methemoglobin. When this happens, the blood no longer can carry oxygen."

"So that's it," said Tom. "In other words, the guy is actually smothering, even though he can still breathe."

"A most astute observation, my dear Kelly," said Schultz, condescendingly. "To continue; methemoglobin makes the blood turn a brownish-red. The patient himself gets a dusky blue look, due to the lack of oxygen. And then when you get the further addition of another color, which Death-House Davey has not yet identified, then you get a lovely color like Slawson did."

Tom shook his head. "Thank you, no. I'll stick to the same old flesh color—it sort of runs in the Kelly family. Seriously, Schultzie, what about Slawson's chances? Is this going to be—serious?" You could see that Kelly meant, but didn't have the nerve to say, 'fatal.'

Schultz shrugged. "No one can say, Tommy. We're going to do our

best to see that it isn't, of course. But we'll just have to wait and see."

Edwards interrupted. "Tom, would you send one of the crewmen out to get some of those flowers that Slawson was sniffing on?"

"O.K., Bob. Should he wear a spacesuit or can he go out raw?"

"I imagine if he just wore a respirator and put the flowers in a tightly closed container he'd be all right. Isn't that what you'd say, Thomas?" he appealed to the pathologist, who nodded his assent.

While Kelly left on this errand, Tom turned again to Livingston. "Jack, would you see that he gets that blood? And observe him closely to see how he responds. Better get another blood specimen before you pull the needle out. And now, Davey, let's see what we can do to identify this color."

Schultz and Mandel struck up one of those desultory medical conversations—a mixture of anecdotes about interesting cases, statements of opinion and defense of those opinions. Thomas and Edwards worked diligently, goldberging a filtration apparatus for separation of the color from the blood. They were interrupted, after a while, by the return of the crew member who had been sent out for the flowers.

"Well, did you get them?" asked Bob.

"Sir, I went out, but I didn't think I ought to try to get them just then. I wasn't sure about those animals."

"Animals!" The four doctors uttered the word simultaneously. They looked at each other, momentarily baffled and indecisive about this new and unexpected exigency.

Edwards made his mind up first. "Davey, hold the fort; we won't be gone long. The rest of us will go up to the dome and get a look at these beasties."

They hurriedly made their way to the observation dome at the top of the ship, adding Kelly to their number as they passed down the corridors. They entered the observation room, with Tom closing the airtight door carefully. The hull plates were open, and the sunlight streamed in, warmly. It took but a moment to raise the air pressure in the room and to inflate the elastic, transparent bubblelike dome. There were enough observation chairs for all of them, so the four of them were quickly elevated to the top of the dome. They each had a pair of binoculars and eagerly scanned the surrounding terrain.

"Do you see anything?"

"No, that vegetation is too dense."

And it was dense. When they first landed on this little plateau, it was quite barren; but now, since the terriffic storm of a few days ago, the vegetation had sprung up unbelievably fast. The ground as far as they could see was a lush green. The leaves of the various plants danced adagio in the gentle breeze. It was almost as if they could see them grow, they seemed so full of fresh, new life. Some of the plants, which had leaves like a giant dande-

lion and a shoot like a huge asparagus stalk, were now shoulder high. It was from a clump of these that the first-seen Minotauran emerged.

"Look!! Look!! There's one . . . no, two . . . of them now!" The navy man's keen eyes had spotted them first. "Holy dying Dinah! Aren't they a couple of beauties?"

Picture a four-legged animal with a body the same size as a St. Bernard dog, with disproportionately short, bowed legs like a dachshund. Give him a hairless, wrinkled gray-green skin, and a long, graceful neck like a camel, emerging from powerful shoulders. Put a head with long jaws on that neck; large yellow eyes, no external ears and a placid expression, for features. And finally, on the anterior surface of the long neck, imagine a rugose, lobulated mass of flesh reminiscent of the wattles of a turkey. There you will have, at first glance, the dominant inhabitant of the planet Minotaur.

"Wow—I wonder if they're as peaceful as they look. Look at those jaws! Mandel, you're our biologist—d'you think they're carnivorous?"

"No, Bob, I wouldn't say so," Irv answered, judiciously. "On Earth most of the carnivores, with the exception of the dog family, tend to be short jawed. Your long-jaws, like the horse and cow, are usually vegetarians."

As if to confirm this observation, one of the Minotaurans sat down on his haunches, reached up with his forelimbs and began pulling leaves off the plant and stuffing them in his capacious mouth. He sat there, quietly and contemplatively, giving himself over to the joys of mastication.

"Look at the color changes in that gadget on his neck! What do you suppose that's for?" asked Schultz.

And the colors were changing; various shades of red were playing over the surface. A broad, horizontal band of scarlet, followed by a light pink, would travel down the length of the colored area. This would be replaced by a vermilion, which would seem to pulsate, gently, alternately deepening and lightening in shade.

"Hm-m-m," said Mandel, slowly. "That's a puzzler. In most animals a colored organ is usually a sex character. The comb and wattles of the rooster, and the crest of those Venusian marsupials are examples. But those are pretty static—they change with the season, and don't flicker like a sign-painter's nightmare. Look . . . look there!!"

The seated animal had turned to face the other one, who had come up on it from behind. And now the colors did start to appear. Bands of purple, splotches of green, tremulous irregular areas of yellow, tumbled across and up and down the necks of those weird beasts for several seconds. Then, with one accord, the two animals faced the ship and began walking slowly toward it.

"It looks like they've just realized there's something strange here and are coming over to investigate us,"

remarked Kelly. "They don't seem to be particularly afraid."

"That's right," retorted Edwards, "and they don't seem to be awfully curious either. Placid sort of brutes, aren't they?"

"Do you think we ought to go out and meet them?" asked Schultz. "Should we roll out the red plush carpet and invite them in for tea?"

"That might not be a bad idea," answered Bob. "We might at least try to find out if they're intelligent or not. Just because they look like the result of miscegenation in the zoo doesn't mean that they can't be smart people. After all, you don't have to be anthropomorphic to be intelligent."

Bob thought for a few seconds. "Schultz, would you and Mandel be willing to go out and see what you can do to find out something about them? We can have a couple of the boys with rocket guns all ready to let them have it, if they make any hostile moves."

The internist and the psychiatrist looked at each other, as if trying to read the other's mind. There was no thought of criticizing Edwards for not offering to go out with them; it was tacitly understood that in most cases, his job as synthesist involved letting others collect data for him. Bob was always ready to run any risk necessary in the line of duty. He wasn't shirking in this case; he was functioning as he should.

Schultz was the first to speak. "My mother told me never to volunteer for anything, but the way you put it—might just as well. O.K. with you, Irv?"

The little psychiatrist gave the typical gesture—shoulders raised, hands with palms up moved outwards. "Why not? They can't be any worse than navy officers or surgeons."

Zip—down went the observation chairs and the men dashed out as soon as pressure could be equalized and the door opened. Their precipitous dash toward the air lock was halted by Livingston, whom they met in the corridor.

"Bob," he asked, "could you take a look at Slawson? The blood has just about all run in and he doesn't seem to be getting any results at all. His color hasn't improved and he's still pretty dyspneic in spite of the oxygen."

Edwards hesitated. He didn't want to forego the interesting experience of observing the inhabitants of Minotaur in their first contact with humans. On the other hand, he'd probably never see a blue man again—and if Slawson didn't soon make a change for the better, he wouldn't be seeing *this* blue man for long.

"O.K., Jack, I'll be right with you. Tom, will you make arrangements to have the boys covered? And you'd better carry a respirator around your neck; I don't think it'll be necessary to wear them unless you have the irresistible urge to sniff a posy."

"O.K., Bobbie," said Schultz.

If we make out all right with these critters, we'll try to line up a date for you, too. It wouldn't be any worse than some of those dogs I've seen you out with." And he fled down the corridor before Bob could think of a retort.

When Edwards entered the sick bay with the surgeon at his heels, he was greatly perturbed. Livingston had understated the seriousness of the patient's condition. A glance at the gauge on the oxygen tank showed that the gas was flowing as fast as possible—as yet Slawson was breathing in deep, shuddering, laboring gasps. His skin was still blue, of course—but underlying that color was the dusky bluish-purple that means insufficient oxygenation of the blood.

Bob picked up the stethoscope which lay on the nearby table and set the tips in his ears. He placed the bell on Slawson's chest, glanced down at his watch and counted for fifteen seconds. "About 140," he reported. "I can barely count it; heart sounds are rather muffled, too."

He slipped the stethoscope around to the bases of the lungs and listened intently for a few seconds. "He's getting some moist rales in the bases, too. Did you give him any atropine?"

"No," answered Jack, "I thought I'd wait until you saw him. Oh my—if only he had something simple like a rupture of the middle meningeal artery, I'd know what to do. But this beats me."

"You're not the only one," retorted Bob, absently. "Well, it looks as if we'll just have to fall back on the old-fashioned approach. It's funny, but when we get stuck on a baffler like this, we have to use the methods of five or six hundred years ago."

Bob sat down on a bunk and stroked his chin. "Eliminate, sedate and put the part at rest," he mused. "He doesn't need sedation—he's practically knocked out now. And how can we put the blood at rest—that's just foolish. And so, to eliminate—Jack, how did he act when the blood started to run in?"

"It seemed to do him some good for about the first five minutes. His respiration slowed down and I thought his color lightened up a little. But then he went right back to where he is now."

"Hm-m-m." A few moments of silence supervened, while Edwards pulled at his lower lip. "Jack, how does this sound as a working hypothesis? Slawson inhaled pollen from a flower. The pollen is a complex protein which is partially broken down in the body. It breaks down into two parts, one of which causes the blue coloration, the other which causes the methemoglobinemia."

"D'you think it's a true methemoglobinemia?" interrupted the surgeon.

"It doesn't make too much difference," answered Edwards. "We

know that there's a stable hemoglobin compound formed, and the red blood cells aren't carrying oxygen. Soooo—we take out the blood that isn't working and replace it with some that will. How does that sound to you?"

Livingston considered the matter for a few moments. "What can we lose? He can't last this way much longer. How much blood do you think we ought to give him?"

"Let's make it five liters, to start with. I'm sure we have that much in the blood bank. You get set up to cut down on a vein and we'll bleed him while the transfusion is running in the other arm."

Just then the intercom in the hallway outside the sick bay piped up. "Testing—Mandel testing."

Bob cocked an ear at the sound. "Tom must have turned the intercom on so we could all hear what the greeting committee has to say. Good idea. Well, I'll go up and get the blood while you get going on the phlebotomy."

As Bob walked into the lab he found Thomas and his assistants still working on their analysis of the mysterious blue blood. It wasn't with undivided attention, however; you could see that all of them were also extremely interested in the intercom.

"We're approaching the animals," said Mandel's voice. "They apparently have no fear of us. They're both sitting on their haunches looking at us and occasionally at each other. The color changes in that organ on the neck are phenomenal, and that's just happened since they caught sight of us. I wonder if that couldn't be their means of communication?"

That's a nice conjecture, thought Edwards. *We communicate by vibrations of one frequency and wavelength range—why can't the Minotaurans communicate on a different band of vibrations? A little inconvenient on a dark night perhaps—but so is talking and hearing in a boiler factory.*

Mandel's voice broke into his thoughts again. "One of the animals is wearing a sort of rope sling over his shoulders and has a stone ax or hammer hanging from it. They're intelligent, I guess, at least to the stage where they have artifacts."

The voice of the irrepressible Schultz interrupted. "Irv, I feel silly. What is the proper procedure in greeting these characters? Don't tell me I'm supposed to start sniffing like the dogs do."

Bob grinned. That clown Schultz—what a man! Well, this wasn't taking care of Slawson.

"We're going to try to replace five liters of blood," he told Thomas, as he took the blood from the refrigerator. "This is all the same batch, isn't it?"

"That's right—that'll be compatible," answered the pathologist. "We have nothing new to report here. It will probably take hours

before we can get this worked out. How is the patient?"

"Not so good," answered Bob, as he loaded the flasks of blood on a tray. "I don't even know if this idea will work, but there's nothing else that I can see to do. Give me a call if you have anything to report."

As Bob walked back toward the sick bay he heard the intercom again. "One of the animals has just plucked some leaves off a bush and is holding them out to us. Is that meant to be a gesture of friendship?"

Why does everything have to happen at once? thought Bob. *Here was an experience which could happen to few men, that of meeting and greeting the strange inhabitants of a new planet—and at the same time to be caught with one of the screwiest medical conditions ever seen.* But the doctor's conditioning asserted itself—the patient always comes first. So without further thought about what was going on outside the ship he and Livingston set about their sanguinary tasks of replacing Slawson's useless blood.

Withdraw 100 cc., replace 100 cc.; observe; repeat. Repeat again and again. They worked rapidly; they didn't attempt to adhere to the usual rate of two or three drops a second. But it took time. More than an hour had elapsed by the time the flask had been emptied of good blood and replaced with the bluish liquid that had been in Slawson's veins.

This business of transferring blood was not too difficult, of course. The task was sufficiently mechanical so they could keep one ear open for the reports of the men outside the ship. They heard Mandel describe the peculiar hands of the Minotaurans—ten pairs of opposable thumbs on each forelimb. The medial pair was the largest, the next pair slightly smaller; each succeeding pair of digits diminished in size, the most lateral being tiny. The animals walked on the knuckles of the first three or four pair of digits, the remainder being kept clear of the ground. They had, as far as could be determined, no sense of hearing, although it was possible that they might be conscious of vibrations in objects which they touched.

They seemed peculiarly unpugnacious. They were not fearful, either; they seemed curious about the humans, but in a rather placid sort of way. Mandel inferred that these animals—or were they people?—had no natural enemies and hence had little use for the emotion of fear.

The two doctors who were caring for Slawson knew fear; they were very much afraid that one of the members was going to meet Death on Minotaur. It wouldn't be the same sort of death that the members of Expedition I had met. It was going to be quicker, more merciful—but just as inevitable unless something could be done.

Edwards, who had been listening to the stricken man's heart action stood up with a sigh. "It's just no go. I thought for a while that those

transfusions would do the trick, but he's just as bad as he was before we started. I wonder—could it be that he got so much pollen into him that he couldn't absorb it all? Then, maybe, when we gave him the blood we got rid of some of the pollen but he absorbed some more again."

"It sort of acts like that," Livingston confirmed. "If that's the case we might have to give him transfusions until hell freezes over—and I don't think we have that much blood available."

"We don't," said Bob. "That was the last of his type. Of course we might get some donors from the crew, but type B, Rh negative is quite rare. And besides, if this anoxemia persists for much longer he's going to have some permanent brain damage. In that case, it might be kinder if he didn't survive."

"If we only had more time," muttered Jack. "I'll bet that we could find some substance which would have a greater affinity for the pollen than the pollen does for hemoglobin."

"You mean like the preference that bacteria have for the sulphonimides instead of para-amino-benzoic acid?" asked Bob.

"That's the idea; but those things can't be found out in an hour, even with the equipment we have aboard. I guess that it means that we just keep pouring the oxygen into him and hope for the best. Hey, did you hear that?"

It was Mandel's voice. "We have established some sort of communication with the pictures we've drawn on the sand. It's hard for them to see directly below them and Schultz and I are both getting tired squatting. I believe it would be perfectly safe for us to bring them aboard ship, where we can show them some photographs and maybe movies. Tom, Bob, what do you think?"

It was Bob who made the decision and spoke first. "You're in a better position to decide that than I am. If you think it's O.K., and if they'll follow you, come ahead. O.K. with you, Kelly?"

"If you say so, Bob. But just to be on the safe side, I'm going to keep them covered while they're aboard —unobtrusively, of course."

"All right. But tell your men not to go trigger-happy on us. No shooting unless there's a direct order from either you or me. And Irv—"

"Yes, Bob."

"Better take 'em on a sort of orientation tour of the ship first. I don't know if they'll understand anything, but it should be impressive. We'll wait here in the sick bay for you; Slawson has to be watched."

Perhaps fifteen minutes elapsed before they heard the peculiar slow clicking noise that they would always associate with the walk of the Minotaurans. Bob and Jack had filled in that quarter-hour doing useless little things for their patient, all to no avail. He was getting progressively weaker, and would probably not even survive the visit of their strange guests. They looked up to see the Minotaurans entering the room.

The one who carried the stone ax entered first, followed by his compatriot, then by Schultz and Mandel.

Schultz, as would be expected, performed the introductions with a flourish. "Boys, meet Tom and Jack. Tom and Jack, meet the boys."

The Minotaurans were oblivious of this travesty of courtesy, of course. They gazed at the two doctors with their large limpid yellow eyes, while their neck-organs turned a pleasing shade of chartreuse.

Then their eyes fell on the unconscious blue body of Slawson. With one accord they moved slowly toward the bed and gazed at him for a long moment. Then the larger of the two Minotaurans faced the other and began to manifest all possible color combinations in the mass of tissue which adorned his neck. Reds, greens, yellows, violets, flashes of orange, bands and flecks, stripes and spots—it was a veritable pageant of color. It seemed to make sense to the other, for he swung about on his hind legs and left the room.

"Now, what?" asked Bob, "What do you suppose got into him?"

"Should I follow him?" asked Kelly, sticking his head around the edge of the door.

"If you don't mind, let's just wait and see what happens," counseled Mandel. "I have a sneaking suspicion that these boys know what's

going on here. They seem to have an instinct of intuition that far surpasses ours. That boy will be back shortly, I'll bet anything."

So they waited, impatiently. Stone-Ax sat on his haunches and gazed at them, placidly. It was rather embarrassing, like trying to be polite to a foreigner who doesn't speak your language. You couldn't make polite conversation; you couldn't ask how business conditions were in his country, or how many children he had.

Mandel had given an excellent description; one thing he hadn't mentioned, though, was that the Minotauran had a peculiar and pleasant body odor. Bob had to sniff and think for several minutes before he could identify the elusive scent. *Why, it's lilac, of course,* he thought. *Wouldn't you know it would be a color, too?*

His thoughts were interrupted by the clicking *pad, pad* of the other Minotauran, returning. He wasn't exactly hurrying, but you could tell that he wasn't loitering by the wayside, either. He entered the room and everyone was startled to see that he carried a half-dozen nondescript flowers in his mouth.

"Oh, oh—more flowers," said Jack, excitedly. "Shall we try to stop him?"

Bob had a sudden intuition. "No, let's not. He can't do anything to hurt poor Slawson—I'm afraid he's beyond that stage. Let's see what they're going to do."

Stone-Ax took the flowers in one of his polydactyl appendages, then with the other arm pointed to the oxygen mask strapped to Slawson's face. He then pointed to his own face and made a gesture which apparently signified removal.

"I guess he wants us to take the oxygen mask off," said Schultz. "Should I, Bob?"

"Go ahead; we can put it back in a few seconds, if necessary."

The mask was removed. The Minotauran extended his hind legs so his forelimbs were over the level of the bed, then unhesitatingly thrust the flowers in front of Slawson's nose and mouth. There was a breathless silence in the room. For a moment nothing happened; then Slawson's stertorous breathing suddenly halted—and he gave a mighty sneeze! The flowers were left there for a few seconds longer, then were thrown to the floor. Then both of these strange beings turned toward the men, gave a curious little inclination of their necks, and, with unaltered dignity, left the room.

The men were too thunderstruck by this strange performance to make any move to delay their departure. With open mouths they looked at each other, at the p.tient and back at each other again.

"That's the strangest thing I've ever seen." Schultz was the first to break the silence. "What do you suppose that signified—a religious gesture, or what?"

"I don't think so," retorted Bob. "Look at Slawson."

They looked at the still unconscious man. Slowly, almost imperceptibly, the blue color was fading from his skin. And as it faded the laboring gasping respiration slowed down. He seemed to relax, or sink into a more comfortable and relaxed state. He no longer had to fight for his oxygen and was now ready to rest and recuperate.

Tom felt the patient's pulse. "It's slower," he said simply. "One hundred twenty—no, one hundred eight." He put the stethoscope in his ears and listened to the heart, then the lungs. "Heart action is full and strong and the lungs are practically clear."

"What'll we do about those animals?" asked Livingston. "Shouldn't we try to thank them, or . . . or—" He broke off; how can you thank someone you can't talk to? How can you do a return favor for a person whose needs or likes are totally beyond your knowledge?

"Just skip it, for now," said Bob slowly. "I have a hunch that those boys will be back after a while. And we'll try to do something for them, some day." And he left the room.

It wasn't until time for the last meal of the day that Edwards rejoined the group. They were still talking about the Minotaurans and their miraculous cure of an apparently hopeless disease, when Bob entered the room.

"You know, Tom," he began, "I'm afraid that I'm going to have to retract some of my dogmatic statements. You remember I told you that there couldn't be any exotic diseases. Well, I was wrong; you all saw how wrong I was. Slawson wouldn't have lived, either, if it hadn't been for the help of . . . of . . . shall we say, the natives. We were helpless. But it still proves one of the oldest of medical beliefs—that for every disease there is, somewhere, a cure, if only we can find it."

He smiled. "And maybe this also goes to prove that old school of medical thought, homeopathy, was right when they said *'Similia similibus curantur.'* Like cures like; the disease caused by the pollen of one flower can be cured by the pollen of another flower.

"Well anyhow, Expedition III can now land here with the assurance that they won't run the risk of turning blue. Of course, something else might come up in the meantime—but let's hope not.

"We've got a lot of work lined up for ourselves on this planet. We have to find out more about the natives, how they live, what they die of—everything. And we have to help them in some way. We owe them a debt we'll be a long time paying off. Right?"

In the midst of the murmur of assent that followed, Schultz walked in. "Slawson is just fine," he reported. "He had a good meal and is apparently none the worse for his experience."

THE END.

HOW CAN YOU LOSE?

BY W. MACFARLANE

***Absolutely** an iron-bound, copper-riveted lead-pipe cinch. And with the men they had they didn't need the lead pipes!*

Illustrated by Cartier

Carter College

Office of the President

TOP SECRET MOST SECRET
HIGHLY CONFIDENTIAL
No. 69

Dear Sir:

You have complied with the suggestions in our preceding letter, to wit: notarized oath of secrecy; posting of ten thousand dollar bond; predated bill of sale of home and contents, automobile, wife and child, or children, as the case may be. We appreciate your confidence in your alma mater, and in this letter we will explain the necessity for such strict measures, and the method by which the use of our information will be controlled. Be assured that all the warranties will be held absolutely confidential, and that their place of storage is inviolable.

In brief, this is the information: The football team of Carter College will not lose a single game in the

coming season. It is a matter of record that the Carter Cougars have lost only two games in the past two years, each of those two carefully considered losses approved by our Psychology Department, so that we might find ourselves in the position indicated by the inclosed schedule.

You will notice that our reputation has been built to the point where the so-called "big teams" will give us a "breather" date, and that we have been careful to convince them that we will field nothing more than a good Class-B team.

By early November the golden opportunity will be over. Dr. Nott, of our Business Administration school, has advised us that we cannot expect the odds to continue so favorable to our enterprise, as by that time the gambling world will have become aware of the not inconsiderable sums of money with which we propose to back the team. You may be assured that every psychological possibility is being carefully studied, and that the Carter Cougars will generally win a defensive game, with only enough flukes to assure unusual scores.

With luck it is possible that our operations may go undetected this year, but it is certain, Dr. Nott assures us, that the investment opportunities will be considerably diminished in years to come. On the basis of his probability curve it seems advisable to field a losing team in the 1951 season, which of course, will offer equal possibilities on the other side of the books.

By that time, however, it may have become necessary to disclose our methods to the armed forces of the United States, which will in the course of events negate our advantages in the field of sports.

Before examining the details of this proposition it might be well to bring to your attention a few of the maxims of Collis P. Carter, the founder of our college. He was, as you know, without peer in the realm of financial manipulation during the period 1871-1901, and a man of far wider ability than is generally known. It has recently been said of him that he had an atomic mind in the age of steam, and we will quote a few of his precepts in anticipation of questions which will undoubtedly come to your mind:

"If it's worms you want, hire the early bird."

"The foundations of any enterprise must be of solid granite, rock-bound and copper-bottomed, but make sure that there is also a hiding-hole and a back door."

"Knowledge in itself is worthless, if you don't know where to sell it."

The above quotations will indicate the state of mind of the board of regents who have outlined the plans under which the unequivocal winning powers of the Carter Cougars will be exploited. Our Law school, under the direction of Dr. Loughless, has examined every contingency, including a thorough screening of those to whom this letter has been sent. Dr. Loughless has written "Elements of Malprac-

tice," as well as "Legal Loopholes" and "Fundamentals of Chicanery," and is well qualified for this task.

We are thoroughly aware of the high caliber of our graduates, and appreciate the keen minds that will examine this proposition. With an "A" grade mandatory in the Business Philosophy course, "The Facts of Life," as specified in Collis P. Carter's will, we have set up what we feel to be an unbeatable situation, to protect ourselves as well as your selected alumni.

Now, for the facts behind our big gold and red machine, the Carter Cougars.

In 1940 Carter College secured the services of Dr. George A. Wooten, and established him as the head of our Paleontology Department. While his wide interests were a factor in his selection for the post, it was not anticipated that basic research in such a field could possibly bring about so happy a state of affairs as we now enjoy.

While in China during the recent war, Dr. Wooten discovered an ice cave of considerable extent while examining a tungsten mine for the Chinese government. Within the ice, during a subsequent investigation, he found an Apatosaurus. The Apatosaurus is a "dinosaur" of tremendous bulk; a modern horse might reach to its knee. The specimen was in a state of perfect preservation, and in the limited time available to him Dr. Wooten made a number of interesting discoveries, which will be published at some future date.

We are concerned chiefly with a cross section of one of the bones of the giant lizard. It had long been Dr. Wooten's theory that bone, as we know it today, would be unable to support the massive body of such a creature, weighing more than the largest whale. He had written a monograph on the subject, titled "Stains of Triassic Times," being a study of the fossilized softer parts of prehistoric reptiles. These parts, under favorable conditions, are impressed on the surrounding rock, and an examination of even the microscopical structure of the tissue is sometimes possible.

Dr. Wooten's conclusions at the time were tentative, but they pointed to a somewhat different equilibrium between the hydrogen and hydroxyl ions in the bloodstream, and allowed him to offer a new solution to the relatively abrupt disappearance of the dinosaurs: a change in intensity of the radiations from the sun, presumably in the ultraviolet spectrum, made physiological changes necessary for the survival of the giant reptiles, and being unable to adapt themselves, they vanished.

But at their peak, their bone structure was comparable to mild steel, and the flesh itself was firm beyond that of any animal or reptile today.

Dr. Wooten was able to maintain his frozen section of the Apatosau-

rus in a solid state until he finished his mission with the Chinese government. The Pacific war ended two weeks later, and on his return to Carter College, he was able to push his research to some very remarkable conclusions, which are directly responsible for the invincibility of the Cougar team.

We shall only hint at those results, and speak only in general terms of those items which concern us here. A serum has been discovered, related to the amino acids, that will greatly strengthen any human being. The digestive tract is enabled to extract a far higher percentage of the energy value of foods for example, and when the body is treated with the proper radiations, an even more startling change takes place. Subject 34-B weighed one hundred fifty-two pounds at the beginning of the experiment, and stood five feet three inches high. He is the same height today, but he weighs two hundred seventy-eight pounds, although his other measurements are almost the same as before the injections. His flesh is the consistency of a redwood burl, and his strength, enormous.

Before he realized his increased strength, Dr. Wooten struck a hold-up man on the chin, and tore his head from his body.

An interesting sidelight on the experiments is the guinea pig that was the first warm-blooded animal treated with the serum. He escaped and mauled a laboratory assistant, and was finally killed with an elephant gun; .22 cartridges would not penetrate his flesh.

The Wooten serum will not be administered in full strength to the team. There was an unfortunate experience two years ago when players with the optimum treatment met ordinary men in a football game. The broken bones and mangled flesh of the opponents made it necessary to remove our "iron men" immediately, and even so, there were some highly undesirable press reports.

You may have noticed a small news item carried by papers across the country last spring. A sports writer happened to be passing Carter Memorial stadium, and his story of how he had seen footballs kicked five hundred feet into the air created a minor sensation in football circles, and nearly won him top place in the Burlington Liars contest. As a matter of fact, a regulation football will collapse when kicked with sufficient force to throw it five hundred feet into the air. It may have been a burst bootball he saw at this altitude, or perhaps one of the solid, experimental models developed by James (Huddle) MacKrack, our well-known football mentor.

This is the proposition after so long an introduction: make a check payable to Carter College for ten thousand dollars, and at the close of the season, we will send you your dividends, to amount to not more than a return of five to one. The

surplus will accrue to the college. This letter is your warranty, and must be presented to collect your dividends. Included in this offer is Dr. Loughless' newest book, "Income Tax Evasion."

Independent betting is forbidden, and when detected will result in foreclosing of the notes we hold against you. This letter must not fall into outside hands, but if it does, it will be declared a hoax, and your bond, house, wife—or wives—forfeit.

Let us remind you of two more of Collis P. Carter's maxims:

"Never try to beat a cold deck."

"Faint hearts win nothing but heartburn."

Yours for Carter

J. S. Bagsworthy
Secretary to the President

THE END

THE ANALYTICAL LABORATORY

Last month the inelasticity of typemetal kept the Lab out of the issue; therefore we have two issues this time. Again the space is not overwhelming, but I want to repeat, for those who wonder, how we calculate the scores. Readers list the stories in order of choice; a first-choice vote is scored on our sheets as 1 for that story; second place is scored 2, and so on. The total points are added up for each story, and divided by the number of votes. This gives the "point score," a sort of "average position of choice" figure. The absolute value of these point scores is compared; the story with the lowest score is, evidently, the reader's first choice—so it gets First Place position. Anyone having ideas for fairer ratings is invited to suggest 'em. And here are the scores for September and October:

September 1948:

Place	Story	Author	Points
1.	Dreams Are Sacred	Peter Phillips	2.10
2.	Dance of a New World	John D. MacDonald	2.21
3.	The Catspaw	George O. Smith	2.43
4.	The Great Air Monopoly	René Lafayette	2.82
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THE EDITOR.

DEATH IS THE PENALTY

BY JUDITH MERRIL

***As science** becomes the primary weapon of war—the scientist becomes the primary target of enemy intelligence—and is, therefore, apt to be the primary target of his own Military's stupidity!*

Illustrated by Cartier

You come a twisting path in the still shade of the giant trees, through random patches of green and brown coolness. A last sudden turn delivers you into the clearing, and waves of heat shimmer before you. The sun's rays are too white, the little stream impossibly b l u e. Squinting, your eyes seek relief and find it.

By the side of the stream, the two black figures have made an island of quiet for themselves. The area inside the unrepaired old fence is filled with the calm inwardness of their tender cold embrace.

The guide will stop here and wait, until everyone is in the clearing, until each face has turned questingly toward the dark mystery. And when he speaks, the guide's voice will be quiet. Under the great trees he shouts, but in the presence of the black lovers, a man does not speak too loudly.

"The permanents here," the guide will tell his crowd of sightseers, "are a memorial to the Boundaries." Over to the left, high above even the giant trees, a Boundary rises white in the sun. Nobody looks at it; all eyes are on the black figures in the clearing. But it is there, always there, a thing no one ever forgets completely.

"The incident," he says, still quietly, "was the last of many that resulted finally in the erection of the Boundaries. The permanents were left here, guarded by a fence for the visitor's safety, instead of being disposed of in the usual fashion. They are safe now, so you may examine them as closely as you like. The names of these two were David Carman and Janice Block."

David wandered down the path between the trees, his thoughts on the stream ahead, remembering its brilliant blueness; his body, hot and sticky, even in the shade, remember-


CARTIER

ing the tingle of the water. It was a long walk from the lodge—but worth it when you got here. He came out in the clearing, and immediately disappointment struck at him. On the bank there was a book and robe. From somewhere around the curve splashing sounded. He had wanted to be alone.

He walked over slowly, and stood over the swimmer's possessions on the shore. Then he saw the book, recognized it, and smiled a little.

He stripped off his own robe, and entered the water noisily, deliberately, to let the earlier swimmer know he was there. In a moment, a brown arm flashed around the bend, cleaving through the bright blue. And then they met, for the first time.

It was a girl. A girl with brown limbs glistening from the fresh water, and bright brown hair tumbling loose waves out of her bathing cap. A girl in a yellow bathing suit. A girl with a diffident, uneven-toothed smile and snapping brown eyes, lashes wet still from the water. They both stood up, facing each other in the water, and the magic must have hit them both at once, because neither one spoke a word.

They stood, a few feet apart, and then he laughed, aloud, in delight, and she began to laugh, too. They both turned and walked up to the shore. He treasured the seconds, the feel of water pulling against his legs, the shore waiting ahead, the girl walking near him, the water pulling at her the same way, the shore looking the same to her. They sat down where she had left her robe, and he pulled cigarettes out of the pocket of his own. He handed her the pack, took one himself, and they smoked quietly, companionably.

She leaned back resting on one elbow, watching the man's face as he dragged deep on the cigarette. He was thin, tall and too thin, and when he sucked in the smoke, the concavities of his cheeks became deep hollows. His hair was tousled, sandy-colored, and she wondered about his eyes, shadowed under the bony brow-ridge. He was altogether a bony man, his cheekbones standing out in sharp relief from the long planes of his face, his jaw a stubborn angular challenge to the world, his long lean hands thin enough to reveal the fine structure of tiny bones and veins. She watched him, quietly, not wanting to talk, to find out something that might spoil it, just thinking. *This is how it is. This is how it hits you, and some day, the man is the right one, and you stay hit.*

He took the cigarette out of his mouth, held it in front of him watching the blue smoke turn white in the hot air, and disappear, and she knew he would speak. Desperately, she willed him not to.

Let him not say anything wrong. Please, please, let him not spoil it. Let him sit quiet for me to look at and pretend with.

"What do you think of his theory on the correlations on mass and individual reactions?"

She had been so afraid for him to speak that she didn't really hear the words at first. "His?" she said, stupidly.

"Mercken's." His voice was impatient. He turned toward her slowly, and she saw a shadow of disappointment fall over his face. "I saw the book," he said, now politely. "I thought it was yours—'Psychology of The Mass—'"

Intelligence came into her eyes, and she saw the smile return in answer to his face. "It *is* mine," she said, breathless now. This was *too* much, too good. "You don't mean," she rushed on, not answering him, "It's your field, too? You—"

"Of course!" He was impatient again. "How far are you—"

She let herself breathe again. She stopped wondering and willing anything. She let go, and they were talking. She never remembered afterwards what they talked about that first half hour. Some of it was psychology, and some of it themselves. Some of it was the woods, the trees and the sun and the brook. But when she began to think clearly once more, she knew his name was David, and she was talking shop—again. She stopped, abashed.

"You have your own worries," she said. "I can handle my own job—I guess," then, because she wanted to tell him, she rushed on to explain. Maybe she'd been saying stupid things, and it was important to explain. She was telling him how she had worried about his talking, how she had been afraid whatever he said would spoil the wonderful minute. She could say that without worry; she knew he'd felt it, too. And then how impossibly perfect it was when he did begin to talk. He listened gravely. He didn't say anything; he nodded, but in the nod she saw he knew about all the years and all about the men who were just a little silly, a little juvenile, who came running when she smiled, but backed off in fright when she talked.

He listened, and nodded, and understood, and then as soon as she was done, he said: "I've been thinking about that problem of yours. We've been using inferentials on our work. Have you tried applying them to the quiz-reactions, to test—"

"Inferentials?" she broke in, puzzled.

He took a stick, sketched the math of it quickly in the sand, and she watched with delight, as the simplicity and beauty of it emerged.

He moved the stick rapidly, wiped out what he had started again. "You take the first four symbols—"

And then he stopped. "Janice," he said quickly, very low, and a deathly stillness fell, "Janice, where did you say you worked?"

"I didn't." She was sober. She didn't know, she didn't want to know, but she *did* know, even before she answered him. "California Open Labs," she said, letting each word fall flat to the ground, letting it ring with its leaden weight as it fell. There had had to be something; she'd known there would be something; so this was it. "You're

at the Restricted Lodge?" It was a question as she said it, but it needed no answer. She knew.

Without looking at him, she stood up. "I'll try to forget it," she said, watching the shadows of the tree-tops on the ground, "I'll try not to let it—" She stopped. "You better go now," she said. Then she pulled the bathing cap down hard over her ears, and dashed for the water.

She ran, but he was faster than she. He caught her by the shoulders, roughly, before she got to the bank, swung her around, and waited till she lifted her eyes to his. Then he started to speak. His mouth opened but there was no word in it. There was nothing he could say. So instead of speaking, he pulled her close, and she was floating away from facts up into a world he brought her with the pressure of his lips.

He let her go slowly, and they sat down again, both of them shaken, too much moved to look at each other, or touch each other. It could have been a minute or an hour, when, finally, he said: "Janice, I think I love you. It's crazy and it shouldn't have happened, but I love you."

Then she turned and met his eyes once more. "I love you, David." She heard the melody in her own voice, and wondered how it could sound that way when the world was crashing around her ears. "There's nothing we can do, is there?" she said facing it, putting it in words, the fact, for both of them.

"Nothing," he said.

The words were right. The words were true, but the music was wrong. Wrong because it was happy. Because all the truths in the world couldn't pull them apart now.

They tried.

They didn't ask any more questions, and they never made any plans. It was the last time they would see each other—only it wasn't. Each of them came back alone, again and again, to the brook in the woods, came and sat alone and thought of how it might have been. And the day came, as it had to, when, rounding the twisting path through the trees, they were face to face again.

They stood without moving, and took no step toward each other. Then from both of them came a curious sigh, an exhalation as if each had held his breath too long. He reached out an arm, slowly, as if to make certain that this time his mind was not playing tricks. The shining brown hair, the sparkling brown eyes—this time they were real. His hand touched her shoulder, lightly, seeking and then not so lightly, and they were wrapped in each other's arms, along in a pounding beating universe, a private world of safety and companionship.

They walked back to the brook, arms entwined like children, and sat on the edge of the bright blue water for the rest of the afternoon, savoring each other's presence, talking only a little.

Still they made no plans. Not even an agreement—but after that

they met each week on the rest day. They met and sat there close by the edge of the brook, almost afraid to talk for fear of the things that might pass from him to her, but still not able to stay away altogether.

But it went on, and after a while the first fear slipped away. They were still cautious. They talked about themselves, their hopes, their dreams, anything but work. Once they thought they had found a safe subject. Something he had worked on that had since been released for Open research, and was now a problem in her hands. But that led them dangerously close to the borderline —the things he knew, that she could not. So they shied away, and talked again about themselves.

For Janice it was the first time. She knew he had understood, from the beginning, so she poured out to him now all the lonely years. She told him how the exams in Secondary had just barely passed her by for Restricted work, how she was left among men who were pleasant, friendly, good at their work. But always, when she met someone, he stayed a little while, then went away. She was too good—too smart, too quick. A man doesn't want a woman who is greater than he is.

Janice had subjected them, one by one, to the hot inquiring searchlight of her intellect, probed at their minds, and, when she was not herself discarded, she had discarded them, each in turn. Because a woman doesn't want a man who is less than she is.

After a while, they all knew she was cold, that she somehow had missed the secret of soft womanliness—and then she was alone. Until David.

Now something had happened. The hot intensity of the searchlight had diffused as the sun did when you left the clearing for the woods. She had found a man, the man; she had stopped picking and judging and weighing, and she was learning to be still, to watch, to lean back. There was also, obscurely, a new vitality to her, and though she had never been beautiful, a kind of beauty. She worked well, too. The inquiring light played now sharply only on her work, and the job gained from it, as her personality gained from the gentle radiance it reflected. And it did not seem to impede her efficiency that she would stop sometimes for a moment to think of the warm spot in the clearing, of David, and of the sheltered loneliness of their love.

Clinically, she was curious about the happiness they had gathered from the total impossibility of their being together. Objectively, she knew it could not last. But resolutely, she shut her mind, as he was doing, to what the end must be.

Each week she went to the brook and sat, talking a little, close by David's side, telling him her secrets, listening to his. Each time she came back renewed in a daze of happiness. But each time, also, she came back troubled, aware in the consciousness

she had shut out, that things could not go on as they were, not forever. Some day there would have to be consummation—or an end.

The day came, of course, as it had to come, when they met, and suddenly let loose on each other the growing misery of the weeks, the unhappiness they had each hidden even from themselves. It was noon when they met. They talked, and she sobbed a little, on the bank of the stream, until the sun was halfway down in the sky. And by that time they knew what they had known at the start. There was no way, no possible way, that they could ever have more than what they had now—and even that much was too dangerous.

For Janice there was a new realization. "But I'm not risking a thing, David," she said. "It's all you. *You're* the only one who'll be punished. They won't do a thing to me, when they . . . if—"

"When was closer, Janny." He smiled, a very tired smile, that did nothing to relieve the drawn tension of his lean face. "You were right the first time. They *will* find out if we keep this up. Shall we stop?" The last was joking, but serious too, because they both knew the answer. To stop would be to stop living. To die. It was not enough, that they had, but it was the slender string on which living and happiness depended.

Abruptly, she stood up. "Yes," she said. "Yes, we will stop. This isn't worth it. Not worth what they'd do—"

Seated at her feet, he heard the words, and knew how completely right they were. It would be harder to stop, harder all the time. And as long as they continued, there were only two things that could happen. The best was a lifetime of this, years and years of secret meetings at the brook. His mind tricked him into a grin as he wondered what they'd do if it rained? He jumped to his feet, still grinning.

"I'll carry you off," he said. "I'll take you in my arms and run over the edge of the world and hide you there. I'll make a club and and bow to catch your food—and manufacture a movie machine to keep you amused. We'll have a huge arsenal of b-bombs, and never let any one near. We'll—"

She stopped him, a firm hand pressed over his mouth. The old joke was no good now. Tears stood still in her eyes, waiting to move, as she tried to match his smile.

"No, darling, no, you won't. We shouldn't even talk about it, because if we do, some day we might try it. And there's no hiding place. Not in this world. There's no hiding place at all."

He took the hand that was pressed over his mouth, held it in both his own, and let his kiss fall into the container of the cupped palm, let it linger there, and then let the hand drop, nerveless, to her side. His arms went about her swiftly, need-

ing her close for warmth, for support—and they never heard the footsteps.

"In the name of Security!"

Long habit sent them whirling apart. Life-long conditioning put them both alertly at attention. And only in full view of the Security officer and his three assistants did either of them realize that they were on the wrong side of the Law, that they could not this time prepare to aid an officer of the State in the adjustment of Security. They were themselves a menace to all that held the nation safe.

The officer drew a warrant from his pocket, while a deputy held the gun on them steadily. "In the name of Security," he read, now, "David Carman, and Janice Block are hereby accused of infringement of Special Rule #107 of the Regulations as amended in the year 2074 A.D. 'That under these covenants, and in view of the necessity for preventing any possible leakage of information, it shall be especially forbidden to Restricted officers in the service of the State to engage in social intercourse in any shape, or form, or manner, with scientists in the Open fields, who shall in any way be capable of understanding, or retaining, or utilizing, any part of the Restricted information held by such officers.'"

He stopped, dramatically: "You know the regulations, Mr. Carman?"

"Yes." What else could he say?

"Miss Block, you have been aware of the risk you were taking? You knew the occupation of this man?"

"Yes?"

"And you had informed him of your occupation?"

There *was* a way out. "No!" she shouted. "No, no, no!" She heard her own voice, thin and screaming. "No, I never told him. I wanted to see him, so I never—"

David's hands on her shoulders stopped her. "It's no use, Jan." His voice was absurdly quiet, relaxed. "I'd investigated you. I had to, you see. I put through a query, saying I read your paper, the one you did last fall. I thought you should be reconsidered for Restricted, on the basis of the work you had done. I thought . . . well, it doesn't matter now, does it?"

The Security Officer read on. They knew what was coming. ". . . paper by Miss Block contained mathematical equations suspiciously similar to work in progress in the California Restricted Laboratories." Jan glanced up sharply, taken by surprise. But she had never used—and then, of course, she knew, her mind had tricked her. David had never finished showing her, but the hint was enough. She found a different way to the same result—a result her own background would never have found for her. So she had betrayed them, betrayed them while she worked, while she was happy, while she thought about coming here to this brook to see David again.

Again he took her hand, and pressed it. Just a little, but the little was enough. He knew, too, how it had happened, and he didn't blame her.

". . . David Carman is hereby indicted for treason, and Janice Block is commended to the care of a Refreshment Home until such time as the memories of this incident may have passed from her."

Janice's breath caught, whistled in through her teeth. Amnesic shock, then!

"Are you prepared to accompany us, Mr. Carman?"

She heard him breathe in deeply, saw his mouth open to form the word of acceptance. She reached out, clutched his arm with her own hand.

"No!" she screamed. "David, no! If they want to kill you, they'll have to kill both of us! You can't . . . you can't—"

He had turned and his arms went around her, disregarding the officers. He held her against him, without passion or strain, held her like a child, and waited till she was calm.

"I love you, Jan. You're the only woman I ever loved." He turned to the officers, and it was *they* who had trouble meeting his eye. "I'm ready," he said, and he took his arms from the girl.

"No." She wasn't screaming now. She was quiet, too. His touch, his arms about her, had given her that. She had to be quiet, or he wouldn't understand.

"David," she pleaded, "don't leave me. Don't go away and send me back to my loneliness. Stay with me." She nodded toward the pistol the man held. "Stay with me forever. David, *I want it that way.*"

He turned from the men and faced her, searched her eyes, and went to the depths of her soul. He took one step closer to her. Then, as they had in the water, they smiled at each other, and he put his arms out to her again.

"Officer!" she cried giddily. "Officer, can't you see? This man is resisting arrest!"

"They never knew," the guard will tell you, "when the immobilizer hit them. At that time," he will go on, "atomics were not well enough developed to make blast-pistols safe. The transmutation pistol was always used when Security officers had to display force in public.

"Ordinarily the permanents so created were safely dumped, to prevent radioactive effects. But it was directly resultant on this case that the force-boundaries"—all eyes wandered a little to the left—"were erected, to divide the social territories of the Restricted officers. So these two were left as a memorial for visitors to the park."

There is much more to see, but you walk away thinking, and do not listen. You are wondering about the wild, romantic days, before the Boundaries, before Civilization, before even Security.

THE END.

THE RED QUEEN'S RACE

BY ISAAC ASIMOV

***If you** remember your "Alice," you'll remember the Red Queen had a fair understanding of the principle of relativity.*

Illustrated by Orban

Here's a puzzle for you, if you like. Is it a crime to translate a chemistry textbook into Greek?

Or let's put it another way. If one of the country's largest atomic power plants is completely ruined in an unauthorized experiment, is an admitted accessory to that act a criminal?

These problems only developed with time, of course. We started with the atomic power plant—drained. I really mean *drained*. I don't know exactly how large the fissionable power source was—but in two flashing microseconds, it had all fissioned.

No explosion. No undue gamma

ray density. It was merely that every moving part in the entire structure was fused. The entire main building was mildly hot. The atmosphere for two miles in every direction was gently warm. Just a dead, useless building which later on took a hundred million dollars to replace.

It happened about three in the morning, and they found Elmer Tywood alone in the central source chamber. The findings of twenty-four close-packed hours can be summarized quickly.

1. Elmer Tywood—Ph.D., Sc.D., Fellow of This and Honorary That, one-time youthful participant of the original Manhattan Project, and now full Professor of Nuclear Physics—was no interloper. He had a Class-A Pass—Unlimited. But no record could be found as to his purpose in being there just then. A table on casters contained equipment which had not been made on any recorded requisition. It, too, was a single fused mass—not quite too hot to touch.

2. Elmer Tywood was dead. He lay next to the table; his face congested, nearly black. No radiation effect. No external force of any sort. The doctor said apoplexy.

3. In Elmer Tywood's office safe were found two puzzling items: i.e. twenty foolscap sheets of apparent mathematics, and a bound folio in a foreign language which turned out to be Greek, the subject matter, on translation, turning out to be chemistry.

The secrecy which poured over the whole mess was something so terrific as to make everything that touched it, *dead*. It's the only word that can describe it. Twenty-seven men and women, all told, including the Secretary of Defense, the Secretary of Science, and two or three others so top-notch that they were completely unknown to the public, entered the power plant during the period of investigation. Any man who had been in the plant that night, the physicist who had identified Tywood, the doctor who had examined him, were retired into virtual home arrest.

No newspaper ever got the story. No inside dopster got it. A few members of Congress got part of it.

And naturally so! Anyone or any group or any country that could suck all the available energy out of the equivalent of perhaps fifty to a hundred pounds of plutonium without exploding it, had America's industry and America's defense so snugly in the palm of the hand that the light and life of one hundred sixty million people could be turned off between yawns.

Was it Tywood? Or Tywood and others? Or just others, through Tywood?

And my job? I was decoy; or front man, if you like. Someone had to hang around the university and ask questions about Tywood. After all, he was missing. It could be amnesia, a hold-up, a kidnaping, a killing, a runaway, insanity, accident— I could busy myself with

that for five years and collect black looks, and maybe divert attention. To be sure, it didn't work out that way.

But don't think I was in on the whole case at the start. I wasn't one of the twenty-seven men I mentioned a while back, though my boss was. But I knew a little—enough to get started.

Professor John Keyser was also in Physics. I didn't get to him right away. There was a good deal of routine to cover first in as conscientious a way as I could. Quite meaningless. Quite necessary. But I was in Keyser's office now.

Professors' offices are distinctive. Nobody dusts them except some tired cleaning woman who hobbles in and out at eight in the morning, and the professor never notices the dust anyway. Lots of books without much arrangement. The ones close to the desk are used a lot—lectures are copied out of them. The ones out of reach are wherever a student put them back after borrowing them. Then there are professional journals that look cheap and are darned expensive, which are waiting about and which may some day be read. And plenty of paper on the desk; some of it scribbled on.

Keyser was an elderly man—one of Tywood's generation. His nose was big and rather red, and he smoked a pipe. He had that easy-going and nonpredatory look in his eyes that goes with an academic job—either because that kind of job attracts that kind of man or because that kind of job makes that kind of man.

I said: "What kind of work is Professor Tywood doing?"

"Research physics."

Answers like that bounce off me. Some years ago they used to get me mad. Now, I just said: "We know that, professor. It's the details I'm after."

And he twinkled at me tolerantly: "Surely the details can't help much unless you're a research physicist yourself. Does it matter—under the circumstances?"

"Maybe not. But he's gone. If anything's happened to him in the way of"—I gestured, and deliberately cliched—"foul play, his work may have something to do with it—unless he's rich and the motive is money."

Keyser chuckled dryly: "College professors are never rich. The commodity we peddle is but lightly considered, seeing how large the supply is."

I ignored that, too, because I know my looks are against me. Actually, I finished college with a "very good" translated into Latin so that the college president could understand it, and never played in a football game in my life. But I look rather the reverse.

I said: "Then we're left with his work to consider."

"You mean spies? International intrigue?"

"Why not? It's happened before!

After all, he's a nuclear physicist, isn't he?"

"He is. But so are others. So am I."

"Ah, but perhaps he knows something you don't."

There was a stiffening to the jaw. When caught off-guard, professors can act just like people. He said, stiffly: "As I recall offhand, Tywood has published papers on the effect of liquid viscosity on the wings of the Rayleigh line, on higher-order field equations, and on spin-orbit coupling of two nucleons, but his main work is on quadrupole moments. I am quite competent in these matters."

"Is he working on quadrupole moments now?" I tried not to bat an eye, and I think I succeeded.

"Yes—in a way." He almost sneered, "He may be getting to the experimental stage finally. He's spent most of his life, it seems, working out the mathematical consequences of a special theory of his own."

"Like this," and I tossed a sheet of foolscap at him.

That sheet was one of those in the safe in Tywood's office. The chances, of course, were that the bundle meant nothing, if only because it was a professor's safe. That is, things are sometimes put in at the spur of the moment because the logical drawer was filled with unmarked exam papers. And, of course, nothing is ever taken out. We had found in that safe dusty little vials of yellowish crystals with scarcely legible labels, some mimeographed booklets dating back to World War II and marked "Restricted," a copy of an old college yearbook, and some correspondence concerning a possible position as Director of Research for American Electric, dated ten years back. And, of course, chemistry in Greek.

The foolscap was there, too. It was rolled up like a college diploma with a rubber band about it and had no label or descriptive title. Some twenty sheets were covered with ink marks, meticulous and small—

I had one sheet of that foolscap. I don't think any one man in the world had more than one sheet. And I'm sure that no man in the world but knew that the loss of his particular sheet and of his particular life would be as nearly simultaneous as the government could make it.

So I tossed the sheet at Keyser, as if it were something I'd found blowing about the campus.

He stared at it and then looked at the back side, which was blank. His eyes moved down from the top to the bottom, then jumped back to the top.

"I don't know what this is about," he said, and the words seemed sour to his own taste.

I didn't say anything. Just folded the paper and shoved it back into the inside jacket pocket.

Keyser added petulantly: "It's a fallacy you laymen have that scientists can look at an equation and say 'Ah, yes—' and go on to write a book about it. Mathematics has no

existence of its own. It is merely an arbitrary code devised to describe physical observations or philosophical concepts. Every man can adapt it to his own particular needs. For instance no one can look at a symbol and be sure of what it means. So far, science has used every letter in the alphabet, large, small and italic, each symbolizing many different things. They have used bold-faced letters, Gothic-type letters, Greek letters, both capital and small, subscripts, superscripts, asterisks, even Hebrew letters. Different scientists use different symbols for the same concept and the same symbol for different concepts. So if you show a disconnected page like this to any man, without information as to the subject being investigated or the particular symbology used, he could absolutely not make sense out of it."

I interrupted: "But you said he was working on quadrupole moments. Does that make this sensible?" and I tapped the spot on my chest where the foolscap had been slowly scorching a hole in my jacket for two days.

"I can't tell. I saw none of the standard relationships that I'd expect to be involved. At least I recognized none. But I obviously can't commit myself."

There was a short silence, then he said: "I'll tell you. Why don't you check with his students?"

I lifted my eyebrows: "You mean in his classes?"

He seemed annoyed: "No, for Heaven's sake. His research students! His doctoral candidates! They've been working with him. They'll know the details of that work better than I, or anyone in the faculty, could possibly know it."

"It's an idea," I said, casually. It was, too. I don't know why, but I wouldn't have thought of it myself. I guess it's because it's only natural to think that any professor knows more than any student.

Keyser latched on to a lapel as I rose to leave. "And, besides," he said, "I think you're on the wrong track. This is in confidence, you understand, and I wouldn't say it except for the unusual circumstances, but Tywood is not thought of too highly in the profession. Oh, he's an adequate teacher, I'll admit, but his research papers have never commanded respect. There has always been a tendency towards vague theorizing, unsupported by experimental evidence. That paper of yours is probably more of it. No one could possibly want to . . . er, kidnap him because of it."

"Is that so? I see. Any ideas, yourself, as to why he's gone, or where he's gone?"

"Nothing concrete," he said, pursing his lips, "but everyone knows he is a sick man. He had a stroke two years ago that kept him out of classes for a semester. He never did get well. His left side was paralyzed for a while and he still limps. Another stroke would kill him. It could come any time."

"You think he's dead, then?"

"It's not impossible."

"But where's the body, then?"

"Well, really— That is *your* job, I think."

It was, and I left.

I interviewed each one of Tywood's four research students in a volume of chaos called a research laboratory. These student research laboratories usually have two hopefuls working therein, said two constituting a floating population, since every year or so they are alternately replaced.

Consequently, the laboratory has its equipment stacked in tiers. On the laboratory benches is the equipment immediately being used, and in three or four of the handiest drawers are replacements or supplements which are likely to be used. In the farther drawers, in the shelves reaching up to the ceiling, in odd corners, are fading remnants of the past student generations—oddments never used and never discarded. It is claimed, in fact, that no research student ever knew all the contents of his laboratory.

All four of Tywood's students were worried. But three were worried mainly by their own status. That is, by the possible effect the absence of Tywood might have on the status of their "problem." I dismissed those three—who all have their degrees now, I hope—and called back the fourth.

He had the most haggard look of all, and had been least communicative—which I considered a hopeful sign.

He now sat stiffly in the straight-backed chair at the right of the desk, while I leaned back in a creaky old swivel-chair and pushed my hat off my forehead. His name was Edwin Howe and *he* did get his degree later on. I know that for sure, because he's a big wheel in the Department of Science now.

I said: "You do the same work the other boys do, I suppose?"

"It's all nuclear work in a way."

"But it's not all exactly the same?"

He shook his head slowly: "We take different angles. You have to have something clear-cut, you know, or you won't be able to publish. We've got to get our degrees."

He said it exactly the way you or I might say, "We've got to make a living." At that, maybe it's the same thing for them.

I said: "All right. What's *your* angle?"

He said: "I do the math. I mean, with Professor Tywood."

"What kind of math?"

And he smiled a little, getting the same sort of atmosphere about him that I had noticed in Professor Keyser's case that morning. A sort of, "Do-you-really-think-I-can-explain-all-my-profound-thoughts-to-stupid-little-you?" sort of atmosphere.

All he said aloud, however, was: "That would be rather complicated to explain."

"I'll help you," I said. "Is that anything like it?" And I tossed the foolscap sheet at him.

He didn't give it any once over. He just snatched it up and let out a thin wail: "Where'd you get this?"

"From Tywood's safe."

"Do you have the rest of it, too?"

"It's safe," I hedged.

He relaxed a little—just a little: "You didn't show it to anybody, did you?"

"I showed it to Professor Keyser."

Howe made an impolite sound with his lower lip and front teeth, "*That* jackass. What did he say?"

I turned the palms of my hands upward and Howe laughed. Then he said, in an offhand manner: "Well, that's the sort of stuff I do."

"And what's it all about? Put it so I can understand it."

There was distinct hesitation. He said: "Now look. This is confidential stuff. Even Pop's other students don't know anything about it. I don't even think *I* know *all* about it. This isn't just a degree I'm after, you know. It's Pop Tywood's Nobel Prize, and it's going to be an Assistant Professorship for me at Cal Tech. This has got to be published before it's talked about."

And I shook my head slowly and made my words very soft: "No, son. You have it twisted. You'll have to talk about it before it's published, because Tywood's gone and maybe he's dead and maybe he isn't. And if he's dead, maybe he's murdered. And when the department has a suspicion of murder, everybody talks. Now it will look bad for you, kid, if you try to keep secrets."

It worked. I knew it would, because everyone reads murder mysteries and knows all the cliches. He jumped out of his chair and rattled the words off as if he had a script in front of him.

"Surely," he said, "you can't suspect *me* of . . . of anything like that. Why . . . why, my career—"

I shoved him back into his chair with the beginnings of a sweat on his forehead. I went into the next line: "I don't suspect anybody of anything *yet*. And you won't be in any trouble, if you talk, chum."

He was ready to talk. "Now this is all in strict confidence."

Poor guy. He didn't know the meaning of the word "strict". He was never out of eyeshot of an operator from that moment till the government decided to bury the whole case with the one final comment of "?". Quote. Unquote. (I'm not kidding. To this day, the case is neither opened nor closed. It's just "?")

He said, dubiously: "You know what time travel is, I suppose?"

Sure I knew what time travel was. My oldest kid is twelve and he listens to the afternoon video programs till he swells up visibly with the junk he absorbs at the ears and eyes.

"What about time travel?" I said.

"In a sense, we can do it. Actually, it's only what you might call micro-temporal-translation—"

I almost lost my temper. In fact, I think I did. It seemed obvious that the squirt was trying to diddle me; and without subtlety. I'm used to having people think I look dumb; but not *that* dumb.

I said through the back of my throat: "Are you going to tell me that Tywood is out somewhere in time—like Ace Rogers, the Lone Time Ranger?" (That was Junior's favorite program—Ace Rogers was stopping Genghis Khan single-handed that week.)

But he looked as disgusted as I must have. "No," he yelled. "I don't know where Pop is. If you'd *listen* to me— I said micro-temporal-translation. Now this isn't a video show and it isn't magic; this happens to be science. For instance, you know about matter-energy equivalence, I suppose."

I nodded sourly. Everyone knows about that since Hiroshima in the last war but one.

"All right, then," he went on, "that's good for a start. Now if you take a known mass of matter and apply temporal translation to it, —you know, send it back in time— you are, in effect, creating matter at the point in time to which you are sending it. To do that, you must use an amount of energy equivalent to the amount of matter you have created. In other words, to send a gram—or, say, an ounce—of anything back in time, you have to disintegrate an ounce of matter

completely, to furnish the energy required."

"Hm-m-m," I said, "that's to create the ounce of matter in the past. But aren't you destroying an ounce of matter by removing it from the present? Doesn't that *create* the equivalent amount of energy?"

And he looked just about as annoyed as a fellow sitting on a bumblebee that wasn't quite dead. Apparently laymen are never supposed to question scientists.

He said: "I was trying to simplify it so you would understand it. Actually, it's more complicated. It would be very nice if we could use the energy of disappearance to cause it to disappear but that would be working in a circle, believe me. The requirements of entropy would forbid it. To put it more rigorously, the energy is required to overcome temporal inertia and it just works out so that the energy in ergs required to send back a mass, in grams, is equal to that mass times the square of the speed of light in centimeters per second. Which just happens to be the Einstein Mass-Energy Equivalence Equation. I can give you the mathematics, you know."

"I know." I waved some of that misplaced eagerness back. "But was all this worked out experimentally. Or is it just on paper?"

Obviously, the thing was to keep him talking.

He had that queer light in his eye that every research student gets, I am told, when he is asked to discuss his problem. He'll discuss it with anyone, even with a "dumb flatfoot" —which was convenient at the moment.

"You see," he said, like a man slipping you the inside dope on a shady business deal, "what started the whole thing was this neutrino business. They've been trying to find that neutrino since the late thirties and they haven't succeeded. It's a subatomic particle which has no charge and has a mass much less than even an electron. Naturally, it's next to impossible to spot, and hasn't been spotted yet. But they keep looking because without assuming that a neutrino exists, the energetics of some nuclear reactions can't be balanced. So Pop Tywood got the idea about twenty years ago that some energy was disappearing, in the form of matter, back into time. We got working on that— or he did—and I'm the first student he's ever had tackle it along with him.

"Obviously, we had to work with tiny amounts of material and . . . well, it was just a stroke of genius on Pop's part to think of using traces of artificial radioactive isotopes. You could work with just a few micrograms of it, you know, by following its activity with counters. The variation of activity with time should follow a very definite and simple law which has never been altered by any laboratory condition known.

"Well, we'd send a speck back

fifteen minutes, say, and fifteen minutes before we did that—everything was arranged automatically, you see—the count jumped to nearly double what it should be, fell off normally, and then dropped sharply at the moment it was sent back below where it would have been normally. The material overlapped itself in time, you see, and for fifteen minutes we counted the doubled material—"

I interrupted: "You mean you had the same atoms existing in two places at the same time."

"Yes," he said, with mild surprise, "why not. That's why we use so much energy—the equivalent of creating those atoms." And then he rushed on, "Now I'll tell you what my particular job is. If you send back the material fifteen minutes, it is apparently sent back to the same spot relative to the Earth despite the fact that in fifteen minutes, the Earth moved sixteen thousand miles around the Sun, and the Sun itself moves more thousand miles and so on. But there are certain tiny discrepancies which I've analyzed and which turn out to be due, possibly, to two causes.

"First, there *is* a frictional effect—if you can use such a term—so that matter does drift a little with respect to the Earth, depending on how far back in time it is sent, and on the nature of the material. Then, too, some of the discrepancy can only be explained by the assumption that passage through time itself takes time."

"How's that?" I said.

"What I mean is that some of the radioactivity is evenly spread throughout the time of translation as if the material tested had been reacting during backward passage through time by a constant amount. My figures show that—well, if you were to be moved backward in time, you would age one day for every hundred years. Or, to put it in another way, if you could watch a time dial which recorded the time outside a 'time-machine', your watch would move forward twenty-four hours while the time dial moved back a hundred years. That's a universal constant, I think, because the speed of light is a universal constant. Anyway, that's my work."

After a few minutes, in which I chewed all this, I asked: "Where did you get the energy needed for your experiments?"

"They ran out a special line from the power plant. Pop's a big shot there, and swung the deal."

"Hm-m-m. What was the heaviest amount of material you sent into the past."

"Oh"—he sent his eyes upwards—"I think we shot back one hundredth of a milligram once. That's ten micrograms."

"Ever try sending anything into the future."

"That won't work," he put in quickly. "Impossible. You can't change signs like that because the energy required becomes more than infinite. It's a one-way proposition."

I looked hard at my fingernails:

"How much material could you send back in time if you fissioned about . . . oh, say, one hundred pounds of plutonium." Things, I thought, were becoming, if anything, too obvious.

The answer came quickly: "In plutonium fission," he said, "not more than one or two percent of the mass is converted into energy. Therefore, one hundred pounds of plutonium when completely used up would send a pound or two back into time."

"Is that all? But could you handle all that energy? I mean a hundred pounds of plutonium can make quite an explosion."

"All relative," he said, a bit pompously. "If you took all that energy and let it loose a little at a time, you could handle it. If you released it all at once, but used it just as fast as you released it, you could still handle it. In sending back material through time, energy can be used much faster than it can possibly be released even through fission. Theoretically, anyway."

"But how do you get rid of it?"

"It's spread through time, naturally. Of course, the minimum time through which material could be transferred would, therefore, depend on the mass of the material. Otherwise, you're liable to have the energy density with time too high."

"All right, kid," I said. "I'm calling up headquarters, and they'll send a man here to take you home. You'll stay there a while."

"But— What for?"

"It won't be for long."

It wasn't—and it was made up to him afterwards.

I spent the evening at Headquarters. We had a library there —a very special kind of library. The very morning after the explosion two or three operators had drifted quietly into the chemistry and physics libraries of the University. Experts in their way. They located every article Tywood had ever published in any scientific journal and had snapped each page. Nothing was disturbed otherwise.

Other men went through magazine files and through book lists. It ended with a room at Headquarters that represented a complete Tywoodana. Nor was there a definite purpose in doing this. It merely represented part of the thoroughness with which a problem of this sort is met.

I went through that library. Not the scientific papers. I knew there'd be nothing there that *I* wanted. But he had written a series of articles for a magazine twenty years back, and I read those. And I grabbed at every piece of private correspondence they had available.

After that I just sat and thought —and got scared.

I got to bed about four in the morning and had nightmares.

But I was in the Boss' private office at nine in the morning just the same.

He's a big man, the Boss, with iron-gray hair slicked down tight.

He doesn't smoke, but he keeps a box of cigars on his desk and when he doesn't want to say anything for a few seconds, he picks one up, rolls it about a little, smells it, then sticks it right into the middle of his mouth and lights it in a very careful way. By that time, he either has something to say or doesn't have to say anything at all. Then he puts the cigar down and lets it burn to death.

He used up a box in about three weeks, and every Christmas, half his gift-wraps held boxes of cigars.

He wasn't reaching for any cigars now, though. He just folded his big fists together on the desk and looked up at me from under a creased forehead. "What's boiling?"

I told him. Slowly, because micro-temporal-translation doesn't sit well with anybody, especially when you call it time travel, which I did. It's a sign of how serious things were that he only asked me once if I were crazy.

Then I was finished and we stared at each other.

He said: "And you think he tried to send something back in time—something weighing a pound or two and blew an entire plant doing it?"

"It fits in," I said.

I let him go for a while. He was thinking and I wanted him to keep on thinking. I wanted him, if possible, to think of the same thing I was thinking, so that I wouldn't have to tell him—

Because I hated to *have* to tell him—

Because it was nuts, for one thing. And too horrible, for another.

So I kept quiet and he kept on thinking and every once in a while some of his thoughts came to the surface.

After a while, he said: "Assuming the student, Howe, to have told the truth—and you'd better check his notebooks, by the way, which I hope you've impounded—"

"The entire wing of that floor is out of bounds, sir. Edwards has the notebooks."

He went on: "All right. Assuming he told us all the truth he knows, why did Tywood jump from less than a milligram to a pound?"

His eyes came down and they were hard: "Now you're concentrating on the time-travel angle. To you, I gather, that is the crucial point, with the energy involved as incidental—purely incidental."

"Yes, sir," I said grimly. "I think exactly that."

"Have you considered that you might be wrong? That you might have matters inverted?"

"I don't quite get that."

"Well, look. You say you've read up on Tywood. All right. He was one of that bunch of scientists after World War II that fought the atom bomb; wanted a world state— You know about that, don't you?"

I nodded.

"He had a guilt complex," the Boss said with energy. "He'd helped work out the bomb, and he couldn't sleep nights thinking of what he'd done. He lived with that fear for

years. And even though the bomb wasn't used in World War III, can you imagine what every day of uncertainty must have meant to him? Can you imagine the shriveling horror in his soul as he waited for others to make the decision at every crucial moment till the final Compromise of Sixty-Five?

"We have a complete psychiatric analysis of Tywood and several others just like him, taken during the last war. Did you know that?"

"No, sir."

"It's true. We let up after Sixty-Five, of course, because with the establishment of world control of atomic power, the scrapping of the atomic bomb stockpile in all countries, and the establishment of research liaison among the various spheres of influence on the planet, most of the ethical conflict in the scientific mind was removed.

"But the findings at the time were serious. In 1964, Tywood had a morbid subconscious hatred for the very concept of atomic power. He began to make mistakes, serious ones. Eventually, we were forced to take him off research of any kind. And several others as well, even though things were pretty bad at the time. We had just lost India, if you remember."

Considering that I was in India at the time, I remembered. But I still wasn't seeing his point.

"Now what," he continued, "if dregs of that attitude remained buried in Tywood to the very end. Don't you see that this time-travel is a double-edged sword? Why throw a pound of anything into the past, anyway? For the sake of proving a point? He had proved his case just as much when he sent back a fraction of a milligram. That was good enough for the Nobel Prize, I suppose.

"But there was *one* thing he could do with a pound of matter that he couldn't do with a milligram, and that was *to drain a power plant.* So that was what he must have been after. He had discovered a way of consuming inconceivable quantities of energy. By sending back eighty pounds of dirt, he could remove all the existing plutonium in the world. End atomic power for an indefinite period."

I was completely unimpressed, but I tried not to make that too plain. I just said: "Do you think he could possibly have thought he could get away with it more than once?"

"This is all based on the fact that he wasn't normal, man. How do I know what he could imagine he could do? Besides, there may be men behind him—with less science and more brains—who are quite ready to continue onwards from this point."

"Have any of these men been found yet? Any evidence of such men?"

A little wait, and his hand reached for the cigar box. He stared at the cigar and turned it end for end. Just a little wait more. I was patient.

Then he put it down decisively without lighting it.

"No," he said.

He looked at me, and clear through me, and said: "Then you still don't go for that?"

I shrugged, "Well— It doesn't sound right."

"Do you have a notion of your own?"

"Yes. But I can't bring myself to talk about it. If I'm wrong, I'm the wrongest man that ever was; but if I'm right, I'm the rightest."

"I'll listen," he said, and he put his hand under the desk.

That was the pay-off. The room was armored, sound-proof, and radiation-proof to anything short of a nuclear explosion. And with that little signal showing on his secretary's desk, the President of the United States couldn't have interrupted us.

I leaned back and said: "Chief, do you happen to remember how you met your wife? Was it a little thing?"

He must have thought it a *non sequitur*. What else could he have thought? But he was giving me my head now; having his own reasons, I suppose.

He just smiled and said: "I sneezed and she turned around. It was at a street corner."

"What made you be on that street corner just then? What made her be? Do you remember just why you sneezed? Where you caught the cold? Or where the speck of dust came from? Imagine how many factors had to intersect in just the right place at just the right time for you to meet your wife."

"I suppose we would have met some other time, if not then?"

"But you can't *know* that. How do you know whom you *didn't* meet, because once when you might have turned around, you didn't; because once when you might have been late, you weren't. Your life forks at every instant, and you go down one of the forks, almost at random and so does everyone else. Start twenty years ago, and the forks diverge further and further with time.

"You sneezed, and met a girl, and not another. As a consequence, you made certain decisions, and so did the girl, and so did the girl you didn't meet, and the man who did meet her, and the people you all met thereafter. And your family, her family, their family—and your children.

"Because you sneezed twenty years ago, five people, or fifty, or five hundred, might be dead now who would have been alive, or might be alive who would have been dead. Move it two hundred years ago; two thousand years ago, and a sneeze—even by someone no history ever heard of—might have meant that no one now alive would have been alive."

The Boss rubbed the back of his head: "Widening ripples. I read a story once—"

"So did I. It's not a new idea—but I want you to think about it for

awhile, because I want to read to you from an article by Professor Elmer Tywood in a magazine twenty years old. It was just before the last war."

I had copies of the film in my pocket and the white wall made a beautiful screen which was what it was meant to do. The boss made a motion to turn about, but I waved him back.

"No, sir," I said. "I want to read this to you. And I want you to listen to it."

He leaned back.

"The article," I went on, "is entitled: 'Man's First Great Failure!' Remember, this was just before the war, when the bitter disappointment at the final failure of the United Nations was at its height. What I will read are some excerpts from the first part of the article. It goes like this:

" '. . . That Man, with his technical perfection has failed to solve the great sociological problems of today is only the second immense tragedy that has come to the race. The first, and perhaps the greater, was that once these same great sociological problems *were* solved; and yet these solutions were not permanent because the technical perfection we have today did not then exist.

" 'It was a case of having bread without butter, or butter without bread. Never both together . . .

" 'Consider the Hellenic world from which our philosophy, our mathematics, our ethics, our art, our literature—our entire culture, in fact—stem . . . In the days of Pericles, Greece, like our own world, in microcosm, was a surprisingly modern potpourri of conflicting ideologies and ways of life. But then Rome came, adopting the culture, but bestowing, and enforcing, peace. To be sure, the *Pax Romana* lasted only two hundred years, but no like period has existed since . . .

" 'War was abolished. Nationalism did not exist. The Roman citizen was Empire-wide. Paul of Tarsus and Flavius Josephus were Roman citizens. Spaniards, North Africans, Illyrians assumed the purple. Slavery existed, but it was an indiscriminate slavery, imposed as a punishment, incurred as the price of economic failure, brought on by the fortunes of war. No man was a *natural* slave, because of the color of his skin, or the place of his birth.

" 'Religious toleration was complete. If an exception was made early in the case of the Christians, it was because they refused to accept the principle of toleration; because they insisted that only they themselves knew truth—a principal abhorrent to the civilized Roman . . .

" 'With all of Western culture under a single *polis,* with the cancer of religious and national particularism and exclusivism absent; with a high civilization in existence—why could not Man hold his gains?

" 'It was because technologically, ancient Hellenism remained backward. It was because without a machine civilization, the price of

leisure—and hence civilization and culture—for the few, was slavery for the many. Because the civilization could not find the means to bring comfort and ease to *all* the population.

" 'Therefore, the depressed classes turned to the other world, and to religions which spurned the material benefits of this world—so that science was made impossible in any true sense for over a millennium. And further, as the initial impetus of Hellenism waned, the Empire lacked the technological powers to beat back the barbarians. In fact, it was not till after 1500 A.D. that war became sufficiently a function of the industrial resources of a nation to enable the settled people to defeat invading tribesmen and nomads with ease . . .

" 'Imagine then, if somehow the ancient Greeks had learned just a hint of modern chemistry and physics. Imagine if the growth of the Empire had been accompanied by the growth of science, technology and industry. Imagine an Empire, in which machinery replaced slaves; in which all men had a decent share of the world's goods; in which the legion became the armored column, against which no barbarians could stand. Imagine an Empire which would therefore spread all over the world, *without* religious or national prejudices.

" 'An Empire of all men—all brothers—eventually all free . . .

" 'If history could be changed. If that first great failure could have been prevented—' "

And I stopped at that point.

"Well?" said the Boss.

"Well," I said, "I think it isn't difficult to connect all that with the fact that Tywood blew an entire power plant in his anxiety to send something back to the past, while in his office safe we found sections of a chemistry textbook translated into Greek."

His face changed, while he considered.

Then, he said heavily: "But nothing's happened."

"I know. But then I've been told by Tywood's student that it takes a day to move back a century in time. Assuming that ancient Greece was the target area, we have twenty centuries, hence twenty days."

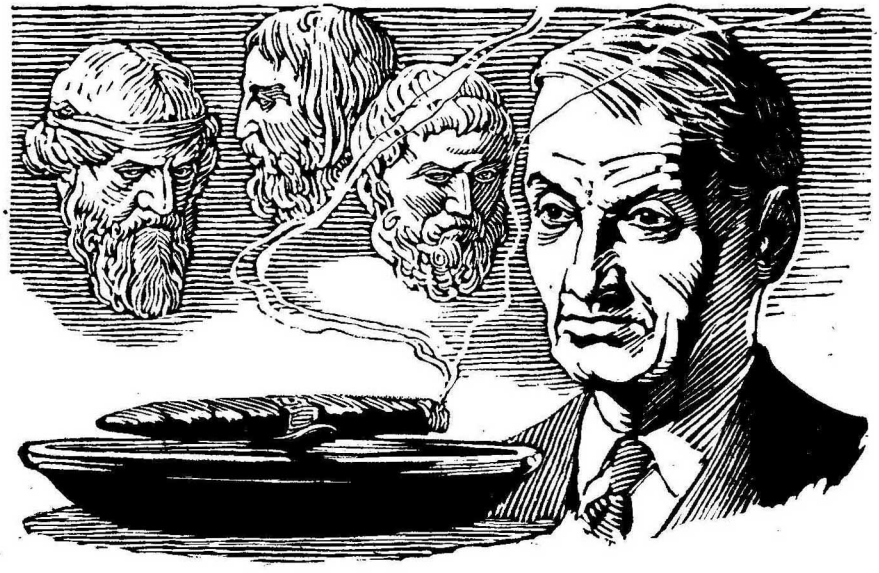
"But can it be stopped?"

"*I* wouldn't know. Tywood might, but he's dead."

The enormity of it all hit me at once, deeper than it had the night before—

All humanity was virtually under sentence of death. And while that was merely horrible abstraction, the fact that reduced it to a thoroughly unbearable reality, was that I was, too. And my wife, and my kid.

Further, it was a death without precedence. A ceasing to exist, and no more. The passing of a breath. The vanishing of a dream. The drift into eternal non-space and non-time of a shadow. I would not



be dead at all, in fact. I would merely never have been born.

Or would I? Would I exist—my individuality—my ego—my soul, if you like? Another life? Other circumstances?

I thought none of that in words, then. But if a cold knot in the stomach could ever speak under the circumstances it would sound like that I think.

The Boss moved in on my thoughts—hard.

"Then we have about two and a half weeks. No time to lose. Come on."

I grinned with one side of my mouth: "What do we do? Chase the book?"

"No," he replied coldly, "but there are two courses of action we must follow. First, you may be wrong—altogether! All of this circumstantial reasoning may still represent a false lead, perhaps deliberately thrown before us, to cover up the real truth. That must be checked.

"Secondly, you may be right—but there may be some way of stopping the book; other than chasing it in a time machine, I mean. If so, we must find out how."

"I would just like to say, sir, if this is a false lead, only a madman would consider it a believable one. So suppose I'm right, and suppose there's no way of stopping it?"

"Then, young fellow, I'm going to keep pretty busy for two and a half

weeks, and I'd advise you to do the same. The time will pass more quickly that way."

Of course he was right.

"Where do we start?" I asked.

"The first thing we need is a list of all men and women on the government payroll under Tywood."

"Why?"

"Reasoning. Your specialty, you know. Tywood doesn't know Greek, I think we can assume with fair safety, so someone else must have done the translating. It isn't likely that anyone would do a job like that for nothing, and it isn't likely that Tywood would pay out of his personal funds—not on a professor's salary."

"He might," I pointed out, "have been interested in more secrecy than a government payroll affords."

"Why? Where was the danger? Is it a crime to translate a chemistry textbook into Greek? Who would ever deduce from that a plot such as you've described."

It took us half an hour to turn up the name of Mycroft James Boulder, listed as "Consultant" and to find out that he was mentioned in the University Catalogue as Assistant Professor of Philosophy and to check by telephone that among his many accomplishments was a thorough knowledge of Attic Greek.

Which was a coincidence—because with the Boss reaching for his hat, the interoffice teletype clicked away and it turned out that Mycroft James Boulder was in the anteroom, at the end of a two-hour continuing insistence that he see the Boss.

The Boss put his hat back and opened his office door.

Professor Mycroft James Boulder was a gray man. His hair was gray and his eyes were gray. His suit was gray, too.

But most of all, his expression was gray; gray with a tension that seemed to twist at the lines in his thin face.

Boulder said, softly: "I've been trying for three days to get a hearing, sir, with a responsible man. I can get no higher than yourself."

"I may be high enough," said the Boss. "What's on your mind?"

"It is quite important that I be granted an interview with Professor Tywood."

"Do you know where he is?"

"I am quite certain that he is in government custody."

"Why?"

"Because I know that he was planning an experiment which would entail the breaking of security regulations. Events since, as nearly as I can make them out, flow naturally from the supposition that security regulations have indeed been broken. I can presume then that the experiment has at least been attempted. I must discover whether it has been successfully concluded."

"Professor Boulder," said the Boss, "I believe you can read Greek."

"Yes, I can,"—cooly.

"And have translated chemical

texts for Professor Tywood on government money."

"Yes—as a legally employed consultant."

"Yet such translation, under the circumstances, constitutes a crime, since it makes you an accessory to Tywood's crime."

"You can establish a connection?"

"Can't you? Or haven't you heard of Tywood's notions on time travel, or . . . what do you call it . . . micro-temporal-translation?"

"Ah?" and Boulder smiled a little. "He's told you, then."

"No, he hasn't," said the Boss, harshly. "Professor Tywood is is dead."

"What?" Then—"I don't believe you."

"He died of apoplexy. Look at this."

He had one of the photographs taken that first night in his wall safe. Tywood's face was distorted but recognizable—sprawled and dead.

Boulder's breath went in and out as if the gears were clogged. He stared at the picture for three full minutes by the electric clock on the wall. "Where is this place?" he asked.

"The Atomic Power Plant."

"Had he finished his experiment?"

The Boss shrugged: "There's no way of telling. He was dead when we found him."

Boulder's lips were pinched and colorless: "That must be determined somehow. A commission of scientists must be established, and, if necessary the experiment must be repeated—"

But the Boss just looked at him, and reached for a cigar. I've never seen him take longer—and when he put it down, curled in its unused smoke, he said: "Tywood wrote an article for a magazine, twenty years ago—"

"Oh," and the professor's lips twisted, "is *that* what gave you your clue. You may ignore that. The man is only a physical scientist and knows nothing of either history or sociology. A schoolboy's dreams and nothing more."

"Then you don't think sending your translation back will inaugurate a Golden Age, do you?"

"Of course not. Do you think you can graft the developments of two thousand years of slow labor on to a child society not ready for it? Do you think a great invention or a great scientific principle is born full-grown in the mind of a genius divorced from his cultural *milieu?* Newton's enunciation of the Law of Gravity was delayed for twenty years because the then-current figure for the Earth's diameter was wrong by ten percent. Archimedes almost discovered calculus, but failed because Arabic numerals, invented by some nameless Hindu or group of Hindus, were unknown to him.

"For that matter, the mere existence of a slave society in ancient Greece and Rome meant that machines could scarcely attract much attention—slaves being so much cheaper and more adaptable. And

men of true intellect could scarcely be expected to spend their energies on devices intended for manual labor. Even Archimedes, the greatest engineer of antiquity, refused to publish any of his practical inventions—only mathematical abstractions. And when a young man asked Plato of what use geometry was, he was forthwith expelled from the Academy as a man with a mean, unphilosophic soul.

"Science does not plunge forward—it inches along in the directions permitted by the greater forces that mold society and which are in turn molded by society. And no great man advances but on the shoulders of the society that surrounds him—"

The Boss interrupted him at that point: "Suppose you tell us what your part in Tywood's work was, then. We'll take your word for it that history cannot be changed."

"Oh, it can, but not purposefully — You see, when Tywood first requested my services in the matter of translating certain textbook passages into Greek, I agreed for the money involved. But he wanted the translation on parchment; he insisted on the use of ancient Greek terminology—the language of Plato, to use his words—regardless of how I had to twist the literal significance of passages, and he wanted it handwritten in rolls.

"I was curious. I, too, found his magazine article. It was difficult for me to jump to the obvious conclusion, since the achievements of modern science transcends the imaginings of philosophy in so many ways. But I learned the truth eventually, and it was at once obvious that Tywood's theory of changing history was infantile. There are twenty million variables for every instant of time, and no system of mathematics—no mathematical psychohistory, to coin a phrase—has yet been developed to handle that ocean of varying functions.

"In short, any variation of events two thousand years ago would change all subsequent history but in *no predictable way.*"

The Boss suggested, with a false quietness: "Like the pebble that starts the avalanche, right?"

"Exactly. You have some understanding of the situation, I see. I thought deeply for weeks before I proceeded, and then I realized how I must act—*must* act."

There was a low roar. The Boss stood up and his chair went over backward. He swung around his desk, and he had a hand on Boulder's throat. I was stepping out to stop him, but he waved me back—

He was only tightening the necktie a little. Boulder could still breathe. He had gone very white, and for all the time that the Boss talked, he restricted himself to just that—breathing.

And the Boss said: "Sure, I can see how you decided you must act. I know that some of you brain-sick philosophers think the world needs fixing. You want to throw the dice again and see what turns up. Maybe

you don't even care if you're alive in the new setup—or that no one can possibly know what you've done. But you're going to create just the same. You're going to give God another chance, so to speak.

"Maybe I just want to live—but the world could be worse. In twenty million different ways, it could be worse. A fellow named Wilder once wrote a play called 'The Skin of Our Teeth.' Maybe you've read it. Its thesis was that Mankind survived by just that skin of their teeth. No, I'm not going to give you a speech about the Ice Age nearly wiping us out. I don't know enough. I'm not even going to talk about the Greeks winning at Marathon; the Arabs being defeated at Tours; the Mongols turning back at the last minute without even being defeated—because I'm no historian.

"But take the Twentieth Century. The Germans were stopped at the Marne twice in World War I. Dunkirk happened in World War II, and somehow the Germans were stopped at Moscow and Stalingrad. We could have used the atom bomb in the last war and we didn't, and just when it looked as if both sides would have to, the Great Compromise happened—just because General Bruce was delayed in taking off from the Ceylon airfield long enough to receive the message directly. One after the other, just like that, all through history—lucky breaks. For every 'if' that didn't come true, that would have made wonder-men of all of us, if it had, there were twenty 'ifs' that didn't come true, that would have brought disaster to all of us, if they had.

"You're gambling on that one-in-twenty chance—gambling every life on Earth. And you've succeeded, too, because Tywood *did* send that text back."

He ground out that last sentence, and opened his fist, so that Boulder could fall out and back into his chair.

And Boulder laughed.

"You fool," he gasped, bitterly. "How close you can be and yet how widely you can miss the mark. Tywood *did* send his book back then? You are sure of that?"

"No chemical textbook in Greek was found on the scene," said the Boss, grimly, "and millions of calories of energy had disappeared. Which doesn't change the fact, however, that we have two and a half weeks in which to—make things interesting for you."

"Oh, nonsense. No foolish dramatics, please. Just listen to me, and try to understand. There were Greek philosophers once, named Leucippus and Democritus who evolved an atomic theory. All matter, they said was composed of atoms. Varieties of atoms were distinct and changeless and by their different combinations with each other formed the various substances found in nature. That theory was not the result of experiment or observation. It came into being, somehow, full-grown.

"The didactic Roman poet, Lu-

cretius, in his *'De Rerum Natura,'*—'On the Nature of Things'—elaborated on that theory and throughout manages to sound startlingly modern.

"In Hellenistic times, Hero built a steam engine and weapons of war became almost mechanized. The period has been referred to as an abortive mechanical age, which came to nothing because, somehow, it neither grew out of nor fitted into its social and economic *milieu*. Alexandrian science was a queer and rather inexplicable phenomenon.

"Then one might mention the old Roman legend about the books of the Sibyl that contained mysterious information direct from the gods—

"In other words, gentlemen, while you are right that any change in the course of past events, however trifling, would have incalculable consequences, and while I also believe that you are right in supposing that any random change is much more likely to be for the worse than for the better, I must point out that you are nevertheless wrong in your final conclusions.

"Because THIS is the world in which the Greek chemistry text WAS sent back.

"This has been a Red Queen's race, if you remember your 'Through the Looking Glass'. In the Red Queen's country, one had to run as fast as one could merely to stay in the same place. And so it was in this case! Tywood may have thought he was creating a new world, but it was *I* who prepared the translations, and I took care that only such passages as would account for the queer scraps of knowledge the ancients apparently got from nowhere would be included.

"And my only intention, for all my racing, was to stay in the same place."

*

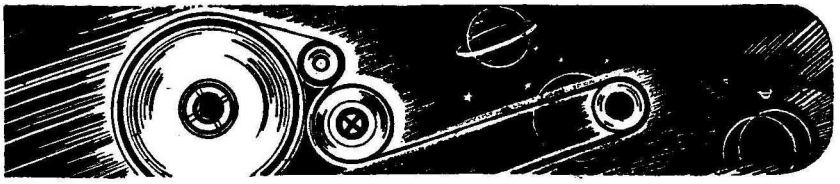
Three weeks passed; three months; three years. Nothing happened. When nothing happens, you have no proof. We gave up trying to explain, and we ended, the Boss and I, by doubting it ourselves.

The case never ended. Boulder could not be considered a criminal without being considered a world savior as well, and vice versa. He was ignored. And in the end, the case was neither solved, nor closed out; merely put in a file all by itself, under the designation "?" and buried in the deepest vault in Washington.

The Boss is in Washington now; a big wheel. And I'm Regional Head of the Bureau.

Boulder is still assistant professor, though. Promotions are slow at the University.

THE END.



MODERN CALCULATORS

BY E. L. LOCKE

***Meteorologists** know how to calculate the exact weather conditions six hours in advance. It's sadly useless knowledge, at present, because the best staff of computers needs six weeks of calculating to do it. But a machine, now—*

If you are a reader of the daily papers, you must have noted the frequent appearance of items relating to new large-scale computing devices. More often than not the articles manage to convey the impression that each such machine will replace at least a hundred mathematicians.

Certainly the interest in computing devices is widespread. Meetings devoted to the presentation of papers on this subject are attended by numbers well beyond the expectations of the organizers. There is even talk of forming a society to deal exclusively with this new branch of technology.

This tremendous activity raises some interesting questions. What will these machines do that mathematicians cannot? Are the days of the theoretical mathematician about over and will the future of mathematics lie in the development of ever more elaborate machinery? If not, what is likely to be the future relation between mathematics and mathematical machinery?

To get answers to these questions it is desirable to examine the relationship between technology and mathematics. In the early days of the industrial era, equipment was designed by trial and error methods. As machinery began to grow in complexity it was realized that such design procedures were uneconomi-

cal. It was gradually appreciated that mathematics had a great deal to offer in the solution of practical problems, particularly in those fields where the basic laws governing the phenomena were thoroughly understood. Today no one would think of designing a turbo-generator by making a series of experimental models of different proportions. It is clearly wasteful to do this when most of the details can be settled by a mathematical analysis. Even in much smaller scale equipment a preliminary analysis may be much cheaper than experimentation, particularly if a great many factors enter into a design.

While this is all to the good, troubles develop even with this approach. The reason is not hard to see. Certain older branches of mathematics were well developed and ready to be used immediately to give easy answers to practical problems. However, as the problems became not only more complicated but also more difficult in basic principles, it was found that usable answers could not be readily obtained by mathematics in the state it was in.

This came about because of the way mathematics developed in our civilization. While the Babylonians and Egyptians developed mathematics exclusively for its utilitarian, value, from the time of the Greeks onward the emphasis has been on pure mathematics. The main concern of this discipline is the discovery of the properties of concepts and the interrelations existing between them. Hence a pure mathematician will consider that his problem is solved when he succeeds in defining precisely a sequence of operations which, if carried through, will give a solution. He is definitely not concerned with the fact that the operations may be of such a nature that it would take the lifetimes of many mathematicians to carry them through. Of course, if the sequence is simple, his aesthetic sense will be gratified. If it should also happen that the results are applicable to practical problems, he will probably remain profoundly uninterested. He himself will not spend his time in pushing his work to this point. He does not conceive this to be any part of this function and besides it is dirty work of the hardest kind. He feels, and justifiably so, that he should be looking for basic theorems in the new mathematical field just around the corner.

The applied mathematician and the engineer thus find themselves blessed with the knowledge that a solution exists for their problem but that it generally involves an infinite sequence of operations. This does not mean that the full sequence has to be carried out because in general it converges on the true answer. It does mean that the resulting expressions are hopelessly complicated for practical work. Since the work load continues to pile up on these few applied practitioners they simply have to look for quicker means to get their answers.

They have at hand two alternatives. It may come as a surprise to some but it is nevertheless true that even the most recondite problems in applied mathematics can be solved by ordinary arithmetic. Thus, one obvious solution is to buy a lot of desk calculators and hire operators to run them. This, in fact, was done by many industrial concerns. Of course there is a partial catch to it. Numerical solutions will give the answer only for the specific data used and generally will tell you nothing about how the solution will change for somewhat different data. This essentially means that the same problem has to be solved over and over again to get a general picture of what is going on. A moderately thorough investigation may thus require a tremendous amount of computing.

The second alternative available is to devise machines to solve the problems. It is again true that the same problem has to be solved over and over again to see what happens as the parameters are changed. However, it is reasonable to expect that the machines could get these numerical solutions much faster than a group of human computers with their battery of desk calculators.

Again the applied mathematicians are faced with two basic alternatives. One of these is to make calculators that will carry out the arithmetical operations fully automatically. The other is to build machines whose laws of motion can be described by the same equations as the ones which they wish to solve. Then all that needs to be done is to start the machine, observe how the shafts turn or the voltages change and presto, there is the solution.

Both lines of effort struck pay dirt. Certainly the results that have been achieved border on the miraculous. Yet it is a fair inference that the machine cannot be the ultimate answer. The future must still lie with the mathematician. The machine can give no more than what was initially built into it in the way of mathematical operations. If you were to bring up a problem which theoretical mathematics has not yet investigated and you were to ask an inventor of mathematical machinery to build a device for solving it, he would ask you as the first thing: What are the basic mathematical operations required to solve this problem? If you could not answer, he would probably say that he can't design a machine for you. That is, unless he also happened to be either a creative mathematician and perceived what was required, or was a natural genius who, without knowing quite how, cooked up an unheard of gadget. Even in this case, a mathematician could look at it and deduce a new set of mathematical concepts which could be added to the body of existing knowledge. For a machine to invent new procedures would require an internal complexity of about the same order of magnitude as that which exists in the human brain, plus that unknown something which makes us

tick. We are a long way from this as yet and hence it is reasonable to expect that the machine will be the servant of the mathematician at least until someone invents the Positronic Brain for the U. S. Robots Corp.

There is this, however, to be said: While the development of mathematical machines was stimulated by practical needs it will also contribute to pure mathematics. Many mathematicians are of the opinion that if they could only see enough numerical solutions to some of their problems they would get an insight into what is going on and enable them to work out new and better theories.

Before investigating the nature of modern mathematical machines let us glance at a few practical problems and thus get an idea of the demands that are likely to be made on such machines.

With jet propulsion promising to push aircraft speeds into the supersonic range there are hosts of unsolved mathematical problems. Perhaps the out tanding one is the behavior of air flows around bodies of arbitrary shape both at transonic and supersonic speeds. This involves a solution of partial differential equations describing the flow of compressible fluids around boundaries that are definitely not nice from a mathematical standpoint and are further complicated by the possible existence of shock waves.

In the military field consider the problem of designing a pilotless aircraft with a target seeker in its nose. The data from the target seeker goes to control mechanisms which in turn operate the rudder and the elevator. These i: turn react on the motion of the robot. Merely to formulate the equations which define the response of this system requires several pages. To solve these equations for all conceivable circumstances to get the optimum design is evidently a large task.

Then there is the problem of accurate weather prediction. This particular one can be formulated as a problem in fluid dynamics considered over a whole hemisphere. It could be licked if the equations could be solved faster than the weather changes. The data required for this problem are air pressure and temperature observations as a function of altitude and time from about four thousand suitably distributed observing stations. It is beginning to look as if one of the new machines will handle this fast enough to be of use. In fact, it is expected that the prediction for three hours from now can be ground out in one hour.

In understanding the nature of matter, quantum mechanics has been a powerful tool. It has resolved many of the difficulties of classical theory and has given us a great deal of insight into the phenomena connected with physics and chemistry. However, the complexity of the mathematical problems it poses are such that exact solutions have been obtained only for the hydrogen atom and a few other simple problems.

For larger atomic numbers and for molecular structures the solutions bristle with crude approximations. Here again the need for adequate mathematical machinery can easily be seen.

There is now underway a determined attempt to divorce the study of economics from the mumbo jumbo theories encrusting it and to put it on a solid basis. In some of its simpler aspects it involves the solution of several hundred equations in as many unknowns. Small scale calculations give definite promise that the investigators are on the right track. To make real progress proper machinery is needed.

Examples of equally staggering problems could be multiplied endlessly. There is not a field of science or technology that would not profit from devices capable of handling large scale calculations efficiently.

Let us now turn to an examination of the possible types of machines. Two basic forms appear to exist. One solves problems by arithmetic; the other utilizes the similarity between the equations to be solved and the equations which characterize the laws of motion of the machine. The first generic type is called a digital calculator; the second is the so-called analog machine. Fundamentally, the digital machine operates by counting since all arithmetical operations can eventually be reduced to a counting process. The most common example is the ten digits of a pair of hands—the use of shoes having deprived us of half the machine capacity. A more technical example is the desk calculator. The analog machines, on the other hand, are based on the use of physical quantities to represent the variables of the problem, operating with these and measuring the values thus obtained. A common example is the ordinary slide rule where lengths marked off on two or more scales represent the variables et cetera.

Their basic similarities and differences can be brought out by comparing them to the structure of a language. Ideas are expressed by means of words put together in accordance with the rules of construction. The number of words is not infinite and the rules also are relatively few in number. In mathematical machines the words of a language correspond to the gadgets which do the individual mathematical operations such as addition, multiplication, integration, shifting of a number from one place to another, et cetera. The rules of construction are the circuit connections between the gadgets, or the directions fed into the machine. There are only a very few such words, very much fewer, even, than in a rather primitive language, but the distinct combinations that can be made are enormous.

A digital machine is very economical on words. Machines could be designed which would solve everything by addition and subtraction

and looking up tables. Actually multiplication is always used and sometimes division is also provided for. On the other hand, analog machines may run to more syllables. For instance, they may have units which perform integration as a unit operation. In a digital machine this would be broken down into operations involving only addition and multiplication.

Digital machines are very much like language in another respect. A sentence carries one word after another and it is the sequence that conveys the idea. In digital machines there will, in general, be only one unit which will add and one which multiplies. These are used in sequence. For instance, if it has to add several numbers it will add the first two, remember the partial sum, then add the third number to it, et cetera. For this reason they are termed as being sequential in operation.

On the other hand, in an analog machine there may be a relatively large number of units of a given type provided. If there are umpteen integrations to be performed, this many integrators will have to be provided or the problem will not be solved. Thus the analog machine is characterized by the parallel operation of its components and bears the same analogy to a picture as the digital machine does to a series of sentences.

This leads to an apparent fundamental difference between the capabilities of the two types of which some proponents of the digital machine make much. They claim that their pet will handle a problem of arbitrarily large size if you give it enough time because after all, the size of the problem merely increases the number of additions and multiplications. If these await their turn, they will all be done. This statement is misleading as will be shown later.

The fact that a digital machine operates sequentially carries with it the need for a memory. This is obvious from the example cited of adding several numbers. Each partial sum must be remembered somewhere at least until the next number is added to it. In general the machine must have enough memory capacity to store the results of a sequence of computations until these partial results are no longer needed. Now the larger the problem to be handled, the greater must be this memory capacity. It is not yet easy to supply enormous memories which can quickly absorb information and pass it out again as quickly as needed. This is one fact that is overlooked by overenthusiastic advocates of digital machines in their claims that there are no limitations on problem size. It cannot be emphasized too strongly that the problem of providing enough high-speed memory capacity is the central problem in the design of practical digital computers.

On the other hand, analog machines need no memories. This is

because the problem as a whole is being solved simultaneously. Each component in use is at every instant carrying the latest information on the state of some particular variable.

Another basic difference between the two types is the manner in which instructions are put into them. In an analog machine this is a relatively simple problem. Since there is a component piece of equipment corresponding to every mathematical operation demanded by the equations to be solved, all that has to be done even in the most complicated problem is to connect these components in the desired way. This is a simple problem because the equations to be solved have a term-by-term physical counterpart in the machine. Anyone with moderate intelligence and training can inspect the equations, draw out the scheme of connections, and then proceed to make them.

It is quite otherwise with digital machines, at least in the present stage of the art. First of all, the equations have to be translated into the equivalent arithmetical process. This generally requires the services of a highly skilled mathematician. This formulation then has to be broken down into a very large number of elementary steps. If you want to get the product of two numbers, you have to tell the machine in its own language where the two numbers are to be found, what to do with them, into what pigeonholes of the memory the answer is to be put, whether one or both numbers are to be returned to their original pigeonholes or erased, and finally to look up the next instruction. Just the chore of keeping track of the pigeonholes without a mistake is a large task in itself.

The process of formulating instructions is called programming or coding. When one considers the huge number of detailed subdivisions that any practical problem runs into, the problem of programming appears to be a truly imposing one. It has been stated by the designer of the earliest electronic machine that he knows of one wartime problem in which the formulation of the program took several months while the solution was run off in about a day!

To be fair about it we must admit that the designers of digital machines are fully aware of this state of affairs and are doing something about it. There seems to be an excellent prospect that the machines available in the next few years will have a perfectly general code for each type of problem. For instance, if the problem to be solved is one involving simultaneous equations, all that will be necessary to do is to punch into the calculator the number of such equations to be solved and the specific values of the coefficients to be used. The "library" of the machine will contain a tape or spool of magnetic wire on which is recorded the general routine which is good for any number of equations. This particular tape or spool will be "borrowed" from the library by

the machine and away it will go without further instruction. Similar general codes are to be worked out for other types of problems. Of course, the preparation of a general program for a given class of problems may occupy a mathematician for several months, but once done it can be used over and over again. In this way it is expected that the digital machine can be made to receive its instructions as simply as the analog does now.

Another point on which a comparison should be made is the matter of accuracy. Here again we must not let overenthusiastic proponents of the digital machine mislead us. Their argument runs as follows: Since the digital machine operates by counting, every time you add one more decimal digit you have increased its accuracy by a factor of ten. Thus, if you have designed a ten-place machine, increasing it to eleven means only a ten percent increase in the amount of equipment. On the other hand, since analog machines operate by measuring physical quantities, there is a definite limit to their accuracy. For example, a one percent machine is easy to build, one tenth percent is only slightly more difficult, one hundredth percent is quite difficult and one thousandth percent is impossible, and that the increase in cost in going from one tenth percent to one hundredth percent is severalfold.

These statements are true but they are only part of the truth. The suppressed part has to do with what happens to a problem when it is arithmetized. Take, for instance, any problem in dynamics. The arithmetization requires us to work out the answers at a series of discrete values of time. This introduces what is called a truncation error. To make it negligible requires that a great many fine steps be taken.

Then there is "rounding" error which perhaps is the most important source of trouble. If you have built a ten-place machine and you multiply two ten-place numbers together, the product is a twenty-place number. But the machine can only store ten places and hence the last ten places are dropped and the answer is rounded off to the nearest digit in the tenth place. What of it, you might say. Isn't ten-place accuracy generally good enough? Certainly, but the final answer is not good to ten places. Remember that in arithmetizing the problem you had to break it down into very small steps. As a result, there will be an enormous number of operations required, every one of them involving this round-off error. Now it is known that a given problem may be arithmetized in a number of different ways, some methods being superior to others in the matter of accuracy of the final result. Nevertheless, after making due allowance for this, it turns out, for instance, that to solve ten simultaneous equations in ten unknowns you must work with nine digit numbers in order to wind up with an answer that is good to

three significant figures. Similar statements can probably be made about other types of problems.

On the other hand, with an analog machine it turns out that the accuracy of the components does not have to be very much better than the final accuracy required. Roughly speaking, if the extreme limits of the variability in the components is three parts in ten thousand, the machine will give an answer which, on the average, will be good to one part in one thousand.

This puts a better perspective on the whole matter. There is no denying that digital machines can be made more accurate than analog devices. They can, but you pay for it in that a considerable fraction of the equipment needed is required merely to counteract the rounding errors.

A similar situation exists on the speed of operation. Again proponents of the digital machine point with pride to the fantastic speeds with which individual operations can be carried out. For instance, it appears that two twelve-digit numbers can be added in two microseconds while they can be multiplied in one hundred microseconds. Again the picture is truthful in part. The fact not stated is that arithmetization breaks the problem into so many individual operations that these speeds are vital if a problem is to be solved in the interval during which the digital machine is expected to operate without a failure. In fields where a direct comparison can be made as in the case of ordinary differential equations, it appears that the analog machine is holding its own even in comparison with the new digital machines and is superior by a very large margin over some of the new but already obsolete types.

It may be interesting to look at a few figures about the actual numbers of operations involved. These are customarily reckoned by counting the number of multiplications and then multiplying them by three to allow for such other operations as addition, shifting of numbers into and out of the memory, et cetera. Figuring then on this basis, the weather-prediction problem will require about thirty million equivalent multiplications for each unit of prediction time, namely three hours. At one hundred microseconds each, these operations will take three thousand seconds or fifty minutes. Thus, it is seen that the machine has to be fast or it will not keep ahead of the changes in the weather.

Or take as another example the problem of how a magnetic field will build up inside of a square chunk of iron when a voltage is suddenly impressed on a coil around the iron. This particular problem is tough because the permeability of the iron varies with the field and hysteresis and eddy currents must be taken into account to get an accurate picture. Problems of this type are solved by dividing the cross section into uniform cells. Assuming that each

dimension of each such cell is taken as five percent of the width of the iron, it can be shown that the time scale for the phenomenon has to be divided up into one thousand intervals and a calculation made for each cell at every one of these time units. This amounts to four hundred thousand distinct evaluations. Assuming that each such cell requires ten multiplication times at one hundred microseconds apiece, the solution time will be four hundred seconds. If now we should decide that the net is too coarse, we can repeat the calculation for two and one half percent spacing. However, it turns out that the time scale now has to be divided into four thousand parts. The problem now will require about sixty-four million multiplication times or six thousand four hundred seconds even with the highest speed machine in prospect.

There is one more comparison that should be made, and that is in relation to the types of problems that can be handled. As already mentioned, most problems in applied mathematics can be solved by arithmetic. This, then, makes it possible for a digital machine to solve any and all problems that can be formulated provided that it has enough memory capacity. Analog machines on the other hand can only solve those problems for which the mathematical operations have physical counter parts in some gadget or other. An outstanding example of a case where a deficiency exists is in the matter of partial differential equations of nontrivial varieties. Since no one has yet invented a physical device to effect partial differentiation or its equivalent, present day analog machines have to use rather cumbersome dodges to crack even the simplest problems of this class. Since solutions of equations of this type are of the greatest practical importance, the digital machine can well boast of something that we cannot do very well by any other known means.

Digital Calculators

Having seen, in a general way, the similarities and differences of the two known basic types of machines, let us turn to a closer examination of the principles on which digital devices operate.

In solving a problem by arithmetic, a human being would need to use the basic operations; namely addition, subtraction, multiplication and perhaps division. He would also be called on to perform certain other simple acts. These include reading of numbers, looking up tables and writing down answers. In some cases he must make a choice of one out of a group of possible procedures, the choice depending on the numerical results obtained earlier in the computation. Finally, he has to follow instructions as to the order in which various operations are to be carried out.

The digital computer is essentially a fully mechanized version of the above described abilities. The equipment within it may be broadly seg-

regated into five main groups or organs. The precise function of each organ may vary somewhat from design to design. What devices go into each group and how they carry out their functions and with what speed and efficiency, is also subject to wide differences in the calculators built or proposed. Nevertheless, looked at from a distance, all these devices are broadly similar and we shall so treat them.

The five organs referred to are the calculator, the control, the memory, the input and the output. The calculator performs the purely arithmetical operations. The memory corresponds basically to the work sheet. In the most modern designs it also has the additional function of remembering the control orders. This would correspond to a human computer writing at the top of his work sheet the verbal instructions that have been given him. The input device contains the data of the problem, such mathematical tables as the machine may need to consult, and also the instructions. In the older designs, the instructions are permanently kept in the input. In the newest ones they are copied into the memory right at the start. The output has the job of receiving the final answers and eventually transcribing them into a printed form. Finally, the control sets up the proper paths at the proper time so that information can flow from one organ to another.

Let us now see how the solution of a problem may be handled by these organs. Assume that all of the orders and some or all of the data are transferred from the input to the memory for ease of access. The latter is divided into numbered cells or their equivalents and thus the transfer takes place in an ordered manner. Now the operations start. The control looks at the first order in the memory and acts on it. This might read: "Take the numbers from memory cells 756 and 2354, add them and put the result in cell 1711." The control then sets up a path between the memory and the adding unit in the calculator. It then causes the contents of cell 756 to flow to the adder. Next it does the same thing to cell 2354. When the addition is over, the control then opens up cell 1711 in the memory to receive the answer. It then clears the adder, disconnects the paths and looks for the second order. If at some stage it receives an order to look up the value of a tabulated function for a certain value of the argument, it causes the input to look for this table and then hunt in it until the particular entry is found. It then connects a path between the input and the point in the machine where this tabular value was needed. If an order includes a direction for printing, the number obtained will be routed to the output.

If a given formula has to be evaluated for a number of equally spaced values of the variable, at the end of the first evaluation the control might well find a group of orders which read in effect: "Repeat

all the steps from the beginning for a new argument which differs by one unit from the value just used. The numbers to be operated on are to be found in cells whose designations are one unit greater than the former value. The results are to be put in cells whose numbers are likewise increased by one unit." Choices in procedure can be ordered in a similar way. In this case, the orders might read: "If the number just found is greater than—, jump to the order recorded in cell 1827. If less, look at the order in cell 4096."

Knowing the general procedure, the next question is in what form are these orders and data kept in the machine? The answer is that all modern digital machines whether electronic or electromechanical, use electrical signals for this purpose. The simplest characteristic of a signal that can be used is its presence or absence. If it is there, one thing happens; if not, something else does. A property as simple as this does not need a very elaborate signal. An ordinary voltage pulse will do. Its size is not critical provided that it is not down in the mud.

How can such a yes-no proposition be used to represent a number? Consider any decimal number, say 237. This is a shorthand way of representing the sum of $2\times100+3\times10+7\times1$. The point to note is that the *position* of a digit tells what power of 10 the digit is to be multiplied by. The use of this trick is not restricted to the base 10. Any other number can be used if desired. For instance, the Babylonians used 60. The fact that we have ten fingers got us accustomed to the use of 10 as a base, but other than this there is little to recommend it. With a machine we can use whatever is convenient.

The simplest number to use as a base is 2. Analogously with the decimal notation where there are ten digits, 0 to 9, the base 2 uses two digits, namely, 0 and 1. The idea of positional significance is also carried over except that now it refers to the successive powers of 2. For instance, the number 9 can be expressed as the sum of $1\times8+0\times4+0\times2+1\times1$. Accordingly, the notation for it would be 1001. The table below gives a few decimal numbers in the binary notation.

Table

Decimal	1	2	3	4	5	6	7	8
Binary	1	10	11	100	101	110	111	1000

It will be seen that it takes more digits to describe a number in the binary than in the decimal notation. In fact, it takes approximately three point three times as many. Thus, if we wish to express a 12 decimal digit number in the binary notation, we will need forty binary digits. Incidentally, some wag proposed to refer to these as bigits. Happily, this term has been contracted to "bits." Thus, in the future we will speak of a forty digit binary number as being composed of forty bits, and will use prefixes "kilo" and "mega" to indicate groups of one

thousand and one million, respectively.

The great merit of this system is that addition and multiplication are extremely simple. The rules for addition are

$$0 + 0 = 0$$
$$0 + 1 = 1$$
$$1 + 1 = 10$$

The whole multiplication table consists only of the combinations

$$0 \times 0 = 0$$
$$0 \times 1 = 0$$
$$1 \times 1 = 1$$

In connection with these simple rules the story is told that K. F. Gauss, the great mathematician, was interested in missionary work. He proposed that the savages be taught this system of arithmetic. Nothing came of this proposal. However it was revived a few years ago when the designer of a digital machine wanted to chisel out the equipment which translates from decimal to binary. He wanted to teach the operators to handle the binary system and feed the data into the machine in this form. His boss vetoed the idea, which may or may not indicate the way the boss felt about the relative intelligence of his operators and savages.

The applicability of binary notation to machine computation can easily be seen. If a digit is present, there is an electrical signal and not otherwise. This scheme can also be used to represent orders because the various types of orders might be denoted by numbers. For instance, the order to multiply could be designated by 1, the order to add by 11, the order to divide by 101. No confusion need arise in the machine as to whether a group of digits represent a number or an order as long as a definite group of cells in the memory are allocated to orders only.

It should not be assumed that the binary notation has no competitors. Other systems have their enthusiastic proponents. It is generally admitted that the binary is the most economical in its use of apparatus. However, it is pointed out that at the expense of a moderate amount of additional equipment, other valuable features can be bought such as self-checking. As one instance of a very useful system, take the so-called bi-quinary which was invented by the Chinese for the abacus. In it any decimal number between zero and nine is represented by two digits. The first digit is either 0 or 1 and stands in decimal equivalent for 0 or 5. The second digit may be 0, 1, 2, 3, or 4. Thus the symbols 04 stand for 4, 10 for 5 while 13 stands for 8, et cetera.

Let us now turn to a consideration of the structure of the organs. Since the provision of a large memory presents the greatest practical problems, let us look at some of the types that have been used or proposed.

There are two main requirements to be met by a successful memory.

It should be able to absorb or dish out the information quickly and it should have a large capacity, preferably at a low unit cost. The first requirement means not only that it should be fast in accepting or passing out the information but that the locating of the desired data should also be speedy. Many devices which would otherwise be satisfactory fail on the latter count. These may, however, be satisfactory for that part of the input organ which is sometimes called the "slow memory".

The need for the second requirement is obvious. It is interesting to observe the increase in high speed memory capacity provided by successive developments. The Bell Telephone Laboratories' Relay Calculator provided a memory for thirty seven-digit decimal numbers or about seven hundred bits. The Eniac developed at the Moore School had about the same capacity. The Edvac which was a later development of the Moore School, will provide forty-three kilobits. The design now under joint development of the Institute of Advanced Study at Princeton and the RCA will store one hundred sixty kilobits while an MIT design is projected to have six hundred forty kilobits. It is expected that future devices will provide for capacities enormously greater than even the largest mentioned here. For instance, a figure of fifty megabits has been provisionally set as a goal for the next major advance.

It is also interesting to make a comparison between memory capacity of such devices and two familiar objects, the printed page and the picture. A page of printed matter is likely to contain about three thousand characters. Since the twenty-six letters in the alphabet can be represented by combinations of five bits, that is 2^5, the potential storage capacity of a page is fifteen kilobits. Actually, the requirements of grammar and dictionary cut this to about nine kilobits.

In a television picture which is defined by 500 x 600 or 300,000 points, a three percent accuracy in intensity is considered to give good results. This accuracy corresponds to about thirty-two steps or five bits. Thus such a picture is equivalent to a memory of 1.5 megabits or to a book of about one hundred fifty pages.

Disregarding for a moment whether a memory is slow or fast, consider the variety of means which have been proposed. One of the earliest to be used is the punched card now used in I.B.M. business machinery and elsewhere. It provides a large capacity at a low cost, but it is rather slow. Somewhat faster is the punched telegraph tape. Much faster than this is magnetic wire, principally because it can be accelerated very fast. In the Princeton design, the storage capacity of the wire will be about one megabit per cubic inch which it will be capable of discharging at a rate of

about seventy kilobits per second. They expect to provide enough wire to give a storage up to ten thousand megabits, which is the equivalent of a million pages of printed matter! Storage of information on photographic film has also been suggested where a dot would stand for a pulse and a clear space for no pulse. The storage capacity appears to be enormous and it is very cheap. How fast it will be is uncertain.

Coming to devices that have been successfully used for high speed memory, the earliest one is the electromagnetic relay. It is moderately fast, having a reading time of about fifteen milliseconds. It is not exactly cheap but has certain practical advantages in reliability, possibility of using self-checking circuits and in that it can operate several contacts simultaneously. The Relay Calculator was built around this device and used several thousands of them.

The first really fast acting device to be used was the vacuum tube flip-flop circuit used extensively in the Eniac. This is essentially an arrangement involving two tubes in such a way that the system has two positions of neutral equilibrium. It can, therefore, store one bit for each pair of tubes used. It is bulky and certainly not cheap.

The designers of this machine came up with a really fine proposal when they were considering the Edvac, the successor to the Eniac. It is an acoustic tank, or more technically an acoustic delay line in which pulses are stored as pressure waves in a fluid medium. The tank consists of a tube of mercury about a meter in length with a piezoelectric crystal at each end. When the first crystal is pulsed, a pressure wave starts traveling down the mercury. Eventually it reaches the second crystal and bumps it. This then gives out an electrical pulse which is amplified, shaped and then returned to the first crystal. In this way a pulse can be kept circulated indefinitely. One tube will hold a string of one thousand yes-no signals. These are tagged and numbered. Whenever a particular one is wanted, an electrical gate is conditioned so that when the desired signal reaches it, the gate opens permitting the pulse to pass out of the tank.

This idea has been so successful that other suggestions of a similar nature have been made. One such is the use of electrical delay lines or "time sticks." It has even been suggested—why not use a radar, bounce the pulses off the moon and recirculate them? The capacity would certainly be large. Taking the mean distance to be two hundred thirty-five thousand miles, the round trip for a pulse would take about 2.5 seconds. Assuming that pulses can be spaced .2 microseconds apart, this tank would have a capacity of 12.5 megabits. This is going some, but aside from the practical difficulties, the access time to a pulse would be too great. You might have to wait 2.5 seconds for the desired one.

The other major contender in the field and one that seems to have almost everything in the way of desirable properties is the Selectron, now being developed by RCA for the Princeton Computer. It is an electronic device which in a three-inch diameter tube manages to store four thousand ninety-six bits and has an access time of only ten microseconds.

The basic principle is quite simple. There is a target of mica with a metal backing plate. In front of the target there is a square grid of wires, sixty-five in each direction. These wires are electrically insulated from one another and form four thousand ninety-six distinct windows. There is an electron beam which can cover all these windows simultaneously. If the four wires which form the sides of a particular window are all made positive, and the backing plate is pulsed positive, a charge will be deposited on that part of the mica which is just in front of this window. This constitutes the reading-in process. It is interesting to note, by the way, if only three sides of the window are made positive no electrons will get through to the mica. To read out the answer the proper window is again energized and the backing plate is pulsed negative. If there is a charge there, a pulse of current will flow from it and not otherwise.

Now for the arithmetic organ: This has two main components, the adder and the multiplier. Basically the circuit configurations are such that there is a one-to-one correspondence between the rules of arithmetic and the behavior of the circuits under the influence of pulses. For instance, one rule of binary addition says that $1+1=10$. For an electronic circuit to duplicate this, it has to have two inputs and two outputs so arranged that when the inputs are pulsed simultaneously no pulse shall appear at one of the outputs but that one unit of time later a pulse shall appear at the other output. These correspond respectively to the 0 in the digit and the 1 to be carried. The carry goes to a similar circuit for the next digit where in turn it acts as a signal.

Multiplication is merely a case of repeated addition and is particularly simple in the binary system. For instance, suppose we wish to multiply 1101×11. The numerical process is shown below.

1101	13
$\times 11$	$\times 3$
1101	
1101	
100111	39

The electronic equivalent is to form the set of pulses 1101 and allow them to go into an adder if, and only if, the digit of the multiplier is 1. In this example, the pulses do go to the adder. The process is then repeated with the next digit of the multiplier except that when the pulses are routed to the adder they are shifted spatially one unit to the

left and then added. For each digit in the multiplier, one shifting operation takes place. After every such shift we have the partial sum up to that point.

The only other organ that needs comment is the control. There is nothing mysterious about it. It is based on an extensive use of an electrical "gate". This is merely a vacuum tube which conducts when pulsed and not otherwise. From what we have seen, we know that the memory needs to be connected sometimes to the calculator, at other times to the output or to the input et cetera. Therefore, a gate is provided in each such possible path. When the order says that the memory and the calculator are to be connected, this particular gate is pulsed and the connection is thus established. Of course, in practice the circuits are quite complicated and actually contain the major fraction of all the equipment that makes up a digital calculator.

Analog Devices

Analog machines come in a bewildering variety. Sometimes it seems that there is no end to the number of forms which can be and have been cooked up to solve one and the same problem. This is not too surprising because the sole requirement is that the equations which describe the performance of the device shall be the same as the ones to be solved. Since the designer can draw on electrical, magnetic, optical, mechanical, hydraulic, thermal and other forms of phenomena, singly or in combination, the number of possibilities is limited only by the ingenuity of the designer.

Analog devices may be broadly classified into two functional classes. One is the type which is intended to solve a single problem of frequent recurrence and the other type is intended to handle any problem within a given class or classes. The first is characterized by the more or less permanent nature of the interconnections. The second is composed of several types of "building blocks" present in various proportions which can be connected into any desired pattern with relative ease.

That analog machines are able to compete with the more universal digital machines is probably due to the economics of the situation. As we have seen, digital machines are quite elaborate affairs and hence require an extremely thorough design study before they can be constructed. As a result, the cost generally runs into many hundreds of thousands of dollars and the development may take a period of several years. On the other hand, if you need the same problem to be solved over and over again, the versatility of the digital machine is not needed and you can construct a suitable analog with a relatively small amount of planning at a correspondingly low cost.

Since each analog machine is a law unto itself, even moderately exhaustive cataloging of the ways in

which they solve their respective problems would run into volumes. All that we can do here is to pick a few at random.

A simple device that has been useful in the study of electron trajectories in vacuum tubes is a rubber membrane stretched over a group of vertical pegs whose heights and locations represent the distribution of electrical potentials within the tube. A steel ball placed on the membrane will, under the action of gravity, trace out the same path that an electron would follow if placed in the corresponding electrical field.

In catalytic cracking of hydrocarbons, the chemical constituents of the end product are most conveniently analyzed by means of the mass spectrograph. In order to find the relative proportions present, it is necessary to solve a set of linear equations in as many unknowns as there are components present. The Consolidated Engineering Company now markets an electrical device which will solve for as many as twelve unknowns. It consists of twelve groups of thirteen electrical potentiometers on which the experimental data is set up. These settings represent the coefficients. There are also present another group of twelve potentiometers which represent the variables. These can be manipulated in turn in such a way that the voltages at twelve given points in the circuit are reduced to zero. The potentiometer settings then represent the values of the unknowns. Fully automatic devices of the same class using high gain amplifiers have been built on an experimental basis but none of these are yet available.

A problem that recurs frequently in the design of frequency selective electrical circuits is the calculation of the complex roots of high degree polynomials. This particular problem has received a tremendous amount of attention. Two devices that have been built in recent years are "Rudy the Rooter" of the Moore School and the "Isograph" of the Bell Telephone Laboratories. They are essentially the same in principle except that Rudy is electrical in nature while the Isograph is mechanical. The idea behind Rudy is essentially simple, being a duplication of one way in which a human computer could solve the same equation. He could guess at a root, substitute it in the equation and see if the result added up to zero. If not, he would try another value. Rudy merely substitutes a voltage whose magnitude and phase are under the control of the operator. These are varied in a specified manner until a zero reading for the sum is obtained.

The electrical gun director represents an example to what lengths it may be desirable to go in a single purpose device. The problem it solves is a very complicated one, being the determination of the position of a moving target in the near future and the orientation of the gun so that a missile fired at any time will hit the target. Since one variety of this device has already

been described in this magazine, we shall say no more about it here.

Coming to analog devices of a broad scope, the outstanding example is the new MIT differential analyzer. This device was built for evaluating the solutions of ordinary differential equations. Within this class of problems it has no important limitations except those imposed by the amount of equipment available. It incorporates the "building block" principle in that it contains a number of basic mathematical units with several of each type being available. While the units are of a mechanical nature, their interconnection is affected electrically through the use of servomotors. The electrical terminals of each unit are "subscribers" to a special automatic telephone exchange. Any desired pattern of interconnections can be set up in a matter of moments.

Not only this but the initial data is set in through the same exchange and the various mathematical units are automatically positioned to their proper starting values. The required circuit configuration and initial data are punched on paper tape which operates the exchange when fed to a transmitter. This results in a very important operating advantage. If the user wishes to study the partial results he has received, the machine will not be tied up while he decides what to do next. Somebody else's problem can go on at once.

The machine is divided into three sections. This permits the machine to solve three distant problems at the same time if they are not unduly complicated. Or, if desired, it can solve two moderately complicated ones simultaneously. Only if the problem is of the greatest complexity will the whole of the machine be utilized.

Besides its flexibility it has remarkable accuracy. Experience has shown that on the average its precision is about one part in ten thousand, at least in the sense that in those cases where it was not reached there were others where it was well exceeded. On certain types of problems, average accuracies of one part in twenty-five thousand have been attained.

The device has only four types of mathematical units. The heart of the unit is the integrator of which eighteen are provided. It is essentially of the wheel and disk type but constructed with the utmost refinement and precision. Besides integration, they are also used to effect multiplication and division. Addition is performed through the use of differential gears which function essentially the same way as those in an automobile transmission. Multiplication by fixed constant is done through gear boxes whose ratios can be easily set anywhere between one and ten thousand.

The only other mathematical unit is the input table. This consists of a drum carrying a graph of a function which may be required for the problem at hand. This graph is fol-

lowed manually by an operator and the motion thus obtained is fed into the analyzer proper.

The answers given by the machine can be plotted or typed out. The latter is done automatically by means of high-speed electrical counters which determine the positions of the various shafts representing the quantities of interest. The counter-readings are transmitted in sequence to a teletypewriter which records the results to five figures.

The theory by which this machine solves problems is quite beautiful, but unfortunately would require a good deal of space to describe in detail. Essentially, however, the various mathematical units when connected together bear the same relationship to one another as the corresponding terms of the original equation. Thus the law of motion obeyed by the machine configuration are describable by precisely this equation. Therefore, if the primary driving shaft is turned, the other shafts must follow in the prescribed manner and hence a record of their motion will constitute the solution. Those who are interested in the full details will find an excellent description in a paper by V. Bush and S. H. Caldwell entitled "A New Type of Differential Analyzer" printed in the *Journal of Franklin Institute,* October 1945.

Having made a rather sketchy survey of the types of mathematical machines now in existence a science fiction fan will naturally wonder what may be expected in the future. In the field of analog machines there will probably be new types which will have considerable versatility, being able to handle many classes of problems. In the field of digital machines, there are plans to build machines with even larger memories and ones that require less in the way of detailed formulation of the problems. Even now some are at work on the idea that all that should be necessary is to put a piece of paper in a special kind of typewriter and type out the basic equations. From there on everything else would be done by the machine. Even, perhaps, to printing and binding 5,000 copies of the results!

But men's imaginations have gone even beyond this point. Theoretical studies are now under way about the principles of machines which would solve problems symbolically. One example relates to the solution of problems in symbolic logic, another to a machine which will perform mathematical—not arithmetical—operations directly. There is even a proposal for a machine to play chess. What will follow these is anybody's guess. Perhaps ultimately we may even have machines matching Asimov's robots in ability.

THE END.

THE PLAYERS OF Ā

BY A. E. VAN VOGT

Part IV. *Conclusion. The hidden Chess Player—he who moved the great Pieces of that deadly Galactic game, where Empires spanning a galaxy were pawns—had made his moves long ago and far away indeed! But Gilbert Gosseyn moved across the board under the impetus of that great move!*

Illustrated by Rogers

Non-aristotelian Venus was saved from conquest by the fortitude of its semantically trained inhabitants, and by the extra brain of Gilbert Gosseyn. After the defeat of the galactic forces that attacked the solar system, as chronicled in "The World of Ā"—August, September, October, 1945, Astounding Science Fiction; Simon and Schuster, 1948, —Gosseyn discovers that the Follower, a being who seems to be made

of shadow substance, has developed a sinister interest in him.

In spite of his precautions, he is caught in a trap which the Follower sets for him, and is "instantaneously" transported by similarity means to the planet, Yalerta, where the Predictors live. The Predictors have been forced by the Follower to enter the service of Enro the Red, who has launched a great battle in the Sixth Decant of the galaxy for the control of all galactic systems. It seems to Gosseyn that Enro cannot possibly lose the war so long as he has the help of people who can foretell every move of the enemy, unless a method is discovered to counteract the prophecies.

He discovers that whenever he uses his extra brain his own future cannot be foretold by a Predictor. This is personally valuable but it seems of little importance against thousands of Predictors.

He succeeds in escaping from the Follower with the help of Leej, a woman Predictor. But the Follower comes aboard Leej's skytrailer, and attacks him. Although the result of the struggle that follows is a draw, Gosseyn realizes that the shadow-man could defeat him under proper circumstances, and that he is not ready for a decisive battle.

He escapes from the planet Yalerta by capturing the galactic warship that is stationed there for the purpose of similarizing Predictors to the fighting fleets of Enro in the Sixth Decant. For a second time, then, his "mind" is transferred into the body of Prince Ashargin.

The first time that such a transfer took place, Gosseyn had found himself in Ashargin's body, just as Ashargin, heir to the Greatest Empire, was taken to the fortress palace of Enro the Red, usurper, on the planet Gorgzid. The prince has been a prisoner attached to the work camp of the Temple of the Sleeping God, a prisoner so badly used that he has become unbalanced. Since this unbalance is on the unconscious level, Gosseyn realizes that the man will have to have semantic training.

Before he can give the prince the necessary training, he is back in his own body, apparently returned there by a mysterious "player" whose motives he cannot fathom.

When Gosseyn's "mind" is similarized for a second time into the prince's body, he discovers that Ashargin is still with Enro's fleet, and that these forces, with the help of Predictors, are sweeping all before them.

He decides that only the Venusian Ās can possibly turn the tide of battle, and they are cut off in the remote solar system because they have no means of galactic transport. Somehow, he must contact them, or get back to Venus personally. By Enro's orders he returns to Gorgzid, and there, because he has a definite purpose, he immediately sets out to flout the dictator's commands. He discovers that, in his absence, he has been married by decree to Nirene, a member of the former nobility of

the Greatest Empire. He starts to train Ashargin semantically, and, anxious for the safety of the body of Gilbert Gosseyn, sends orders to the destroyer that Gosseyn and Leej are to be brought to Gorgzid but treated with consideration.

This order, and his other defiances, arouse the suspicions of Enro, who forces a showdown in the presence of Eldred Crang and Patricia Hardie, and also in the presence of Secoh, Lord Guardian of the Sleeping God. This crisis ends in a partial victory for Gosseyn-Ashargin. He confuses a lie detector with his double identity, and persuades Enro that he will be more valuable to him alive than dead. He agrees to co-operate to prevent revolutions within the Greatest Empire. He realizes that Enro will kill Ashargin the moment the war is over.

He learns one disturbing fact from Enro. The destroyer on which his body is lying unconscious cannot be contacted, and his orders to Captain Free were not transmitted for that reason.

Boldly, he contacts Madrisol, secretary of the League, but again is frustrated in his attempt to establish communication of some kind with Venus. The League secretary admits that it is impossible for League ships to get near the solar system. The only bases are those of the Greatest Empire.

He continues to train Ashargin semantically. He establishes a basis of co-operation with Eldred Crang, a secret Ā, who is ostensibly married to Patricia Hardie—who has turned out to be the sister of Enro. He persuades Secoh, the Lord Guardian of the Sleeping God, to let him have a look at the god. Somehow, he has come to believe that the god is one of the other bodies of Gilbert Gosseyn. He discovers that the Sleeping God is a stranger with the face of a moron, and that the Temple of the Sleeping God seems to be a globular spaceship.

Pondering this puzzle, as well as his continued inability to contact the long lost destroyer with his unconscious body aboard, he returns to the palace—and discovers that the crisis is upon him. Enro has decided to send a fleet to destroy Venus.

As soon as possible after hearing this information, Gosseyn-Ashargin heads for a Distorter, with the intention of similarizing himself to a base near Venus, and then somehow going from there to Venus. The moment he has similarized himself, he is transferred by the mysterious "player" back into his own body.

He learns why the destroyer has been lost for so long. Its "Distorter" has been sabotaged, and cannot function. It takes Gosseyn only a few hours to bring the ship back into repair, and they set out for Venus. As they approach the solar system, the destroyer's alarm system is set off, and they are attacked.

Gosseyn's purpose—to warn Venus of the arrival of Enro's fleet—is thus threatened by the highly

efficient defense system which the Venusians have organized.

XVII.

For the sake of sanity, be aware of SELF-REFLEXIVENESS. A statement can be about reality or it can be about a statement about a statement about reality.

Gosseyn took five quick steps toward the control board, and stood behind Captain Free, tense and alert. He shifted his gaze steadily from one to the other of the rear, side and front video plates. The roboperator spoke again in its "emergency" voice:

"Voices in space," it roared. "Robots sending messages to each other."

"Give us the messages," Captain Free commanded loudly. He glanced around and up at Gosseyn. "Do you think Enro's fleet is here already?"

Gosseyn wanted more evidence. "I was released," he thought, "from Ashargin's brain within a few minutes after Enro gave the order. It probably took about forty hours for me to get back to the destroyer, two hours more to get the ship moving, less than an hour at the base, and then just under eighty hours to get here to Venus—about a hundred and twenty-two hours, only three of which could be considered wasted."

Five days! The assigned fleet, of course, could have been detached from a base much nearer to Venus, in fact, probably had been. That was one trouble with his expectations. Similarity videophone communications involved the movement of electrons in a comparatively simple pattern. Electrons were naturally identical to eighteen decimal places, and so the "margin of error" in transmission was only fourteen seconds for every four thousand light-years—as compared to ten hours for material objects for the same distance.

Enro's fleet *could* be here ahead of them on the basis of time saved by the use of telephonic orders. But attacks on planetary bases involved more than that. It would take time to load the equipment for the type of atomic destruction that was to be rained down on Earth and Venus.

And there was another point, even more important. Enro had plans of his own. Even now, he could be delaying his orders to destroy the people of the solar system in the hope that the threat of such an attack would force his sister to marry him.

The roboperator was bellowing again. "I am now," it shouted, "transmitting the robot messages." Its tone grew quieter, more even. "A ship at CR-94-687-12 . . . *bzzzz* . . . similarize . . . Converge and attack . . . five hundred human beings aboard . . . *bzzzz* . . . zero 54 seconds . . . Capture—"

Gosseyn spoke in a hushed voice:

"Why, we're being attacked by robot defenses."

The relief that came had in it excitement and pride as well as caution. Scarcely more than two and a half months had passed since the death of Thorson. Yet here already were defenses against interstellar attacks.

The Ās must have sized up the situation, recognized that they were at the mercy of a neurotic dictator, and concentrated the productive resources of the system on defense. It could be titanic.

Gosseyn saw that Captain Free's fingers were quivering on the lever that would take them back to the star Gela, the base a thousand light-years behind them.

"Wait!" he said.

The commander was tense. "You're not going to stay here?"

"I want to see this," said Gosseyn, "for just one moment."

For the first time, Gosseyn glanced at Leej. "What do you think?"

He saw that her face was tense. She said: "I can picture the attack, but I can't see its nature. There's a blur a moment after it starts. I think—"

She was interrupted. Every radar machine in the control room stammered into sound and light. There were so many pictures on the viewplates that Gosseyn could not even glance at them all.

Because, simultaneously, something tried to seize his mind.

His extra brain registered a massively complex energy network, and recorded that it was trying to short circuit the impulses that flowed to and from the motor centers of his brain. Trying? Succeeding.

He had a swift comprehension of the nature and limitations of this phase of the attack. Abruptly, he made the cortical-thalamic pause.

The pressure on his mind ended instantly.

Out of the corners of his eyes, he saw that Leej was standing stiffly, a distorted expression on her face. In front of him Captain Free sat rigid, his fingers contracted like marble claws less than an inch from the lever that would take them back toward Gela.

Above him, the roboperator transmitted: " 'Unit CR- . . . *bbzzzzz* . . . incapacited. All personnel aboard but one seized—concentrate—on the recalcitrant—"

With one flick of his finger, Gosseyn pushed the lever which was set to "break" near the base a thousand light-years away.

There was blackness.

The destroyer Y-381907 poised in space, safe, slightly more than eight hundred light-years from Venus. In the control chair Captain Free began to lose that abnormal rigidity.

Gosseyn whirled, and raced for Leej. He reached her just in time. The stiffness that had held her on her feet let go. He caught her as she fell, limply.

As he carried her to the lounge in front of the transparent dome, he

visualized the happenings elsewhere on the ship. Men by the hundreds must be falling or had already fallen to the floor. Or if they had been lying down throughout the crisis, then now they were sagging, loose muscled, as if every tension in their bodies had suddenly let go.

Leej's heart was beating. She had hung so lax in his arms that for a moment the thought had come that she was dead. As Gosseyn straightened, her eyelids flickered and tried to open. But it was nearly three minutes before she was able to sit up and say wanly: "Surely, you're not going back?"

"Just a minute," said Gosseyn.

Captain Free was stirring, and Gosseyn had a vision of the commander convulsively tugging at switches, levers and dials in a frantic belief that the ship was still in danger. Hurriedly, he lifted him out of the control chair.

His mind was busy as he carried the man to the lounge beside Leej, thinking about what she had said. Now, he asked: "You see us returning?"

She nodded reluctantly. "But that's all. It's outside my range."

Gosseyn nodded, and sat staring at her. His sense of elation was dimming. The Venusian method of defense was so unique, so calculated to catch only people not A trained, that, once they engaged, only his presence had saved the ship.

Briefly, it had seemed as if the Venusians had an invincible defense.

But if he hadn't been aboard, then there would have been no blur to confuse Leej. She would have foreseen the attack in ample time for the ship to escape.

In the same way Enro's fleet, with its Predictors, would escape the first onslaught. Or perhaps the predictions could be so accurate that the fleet could keep on "breaking" toward Venus.

It was possible that the entire Venusian defense, marvelous though it was, was worthless. In building their robots, the Venusians had failed to take the Predictors into their calculations.

The fact was not surprising. Even Crang had not known about them. It might be, of course, that there'd be no Predictors on the fleet Enro was sending. But that surely could not be counted on.

His mind reached that far, and then circled back to what Leej had said. He nodded, visualizing the situation. Then he said:

"We'll have to try again, because we've got to get through those defenses. It's as important as ever."

In a way it was more important. Already there was in his mind a picture of robot defense forces like this opposing Enro's titanic fleet in the Sixth Decant. And if a method could be found to make them react a little faster, so that the attack came in one second and not in fifty-four, then even the prevision of the Predictors might be too slow.

Gosseyn considered several possibilities, then carefully explained the nature of the cortical-thalamic pause to Leej and the captain. They went through the routine several times, a mere brushing on the edge of the subject, but it was all there was time for.

The precautions might not work, but they were worth trying.

The preliminaries completed, he seated himself in the control chair, and looked around. "Ready?" he asked.

Leej said in a querulous tone, "I don't think I like being out in space." That was her only comment.

Captain Free said nothing.

Gosseyn said: "All right, this time we're going through as far as we can."

He pushed the lever.

The attack came thirty-eight seconds by the clock after the blackness ended. Gosseyn watched the nuances of its development, instantly nullified the assault on his own mind. But this time he took a further step.

He tried to superimpose a message upon the complex force. "Order attack to end!" He repeated that several times.

He waited for the command to be echoed by the roboperator, but it continued to transmit messages between the robotic brains outside the ship. He sent a second message. "Break all contacts!" he ordered firmly.

The ship's robovoice said something about all but one of the units being incapacitated, and, without a

single reference to his command, added, "Concentrate on the recalcitrant—"

Gosseyn pressed the similarity lever, and "broke" after five light-minutes.

In sixteen seconds, the attack resumed. He sent a quick glance at Leej and the commander. They were both sagging in their seats. Their brief Ā training hadn't proved very effective.

He forgot them, and watched the viewplates, waiting for a blaster attack. When nothing happened, he jumped a light-day nearer Sol. A glance at the distance gauges showed that Venus was still slightly more than four light-days away.

This time the attack resumed after eight seconds.

It was still not fast enough. But it helped to fill out the picture that was forming in his mind. The Venusians were trying to capture ships and not destroy them. The devices they had developed for that purpose would have been marvelous in a galaxy of normal human beings. And they were wonderful in their ability to distinguish between friend and foe. But against extra brains or Predictors they had a limited value. Gosseyn suspected that they had been rushed through the assembly lines in the belief that time was short.

Since that was truer every minute, he tried one more test. He sent a message to the unit that was still trying with a blind, mechanical obstinacy to capture him: "Consider me and everyone aboard captured."

Again, there was no response to show that anybody had heard. Once more Gosseyn pushed the similarity lever, the needle controls of which had been set so accurately by Leej. "Now," he thought, "we'll see."

When the momentary blackness ended, the distance indicators showed ninety-four light-minutes from Venus. In three seconds the attack came, and this time it was on a different level entirely.

The ship shuddered in every plate. On the view plate the defensive screen was a bright orange in color. The roboradar spoke for the first time, a whining howl: "Atomic bombs approaching!"

With the flip of his finger, Gosseyn moved the similarity lever back, and jumped nine hundred and eleven light-years towards Gela.

The second attempt to penetrate the Venusian defenses had failed.

Gosseyn, his mind already intent on the details of the third attempt, revived Leej. She came to consciousness, and shook her head.

"It's out of the question," she said. "I'm too tired."

He started to say something, but instead he studied her face. The lines of weariness in it were unmistakable. Her body drooped noticeably.

"I don't know what those robots did to me," she said, "but I need a rest before I can do what you want. Besides," she went on, "you haven't got the energy either."

His words reminded him of his own weariness. He rejected the obstacle, and parted his lips to speak. Leej shook her head.

"Please don't argue with me," she said in a tired voice. "I can tell you right now that there's slightly more than a six-hour pause to the next blur, and that we spend the time in much-needed sleep."

"You mean, we just sit out here in space?"

"Sleep," she corrected. "And stop worrying about those Venusians. Whoever attacks them will withdraw and look the situation over, as we did."

He supposed she was right. The logic behind her remark was Aristotelian, and without evidence to support it. But her general argument was more plausible. Physical weariness. Slow reflexes. An imperative need to recuperate from the friction of battle.

The human element had entered the list of combatants.

"This blur," he said finally, "what's it about?"

"We wake up," said Leej, "and there it is."

Gosseyn stared at her. "No advance warning?"

"Not a word—"

Gosseyn woke up in darkness, and thought, "I've really got to investigate the phenomenon of my extra brain." He felt immediately puzzled that he should have had such a thought during the sleep hour.

After all, his idea—a sound one—had been to leave the problem until he reached Venus.

There was a stirring in the next bed. Leej turned on the light. "I have a sense of continuous blur," she said. "What's the matter?"

He felt the activity then, within himself. His extra brain working as it had when an automatic process was reacting to a cue. It was a sensation only, stronger than his awareness of the beating of his heart or the expansion and contraction of his lungs, but as steady. But this time there was no cue.

"When did the blur start?" he asked.

"Just now." Her tone was serious. "I told you there'd be one at this time, but I expected it to be the usual kind, a momentary block."

Gosseyn nodded. He had decided to sleep up to the moment of the blur. And here it was. He lay back, closed his eyes, and deliberately relaxed the muscles of the blood vessels of his brain, a simple hypnotic process. It seemed the most normal method of breaking the flow.

Presently, he began to feel helpless. How did a person stop the life of his heart or lungs—or the interneuronic flow that had suddenly and without warning started up in his extra brain?

He sat up and looked at Leej, and parted his lips to confess his failure. And then he saw a strange thing. He saw her appear to get up from her bed, and go to the door fully dressed. And then she was

sitting at a table where Gilbert Gosseyn also sat, and Captain Free. Her face flickered. He saw her again, farther away this time. Her face was vaguer, her eyes wide and staring, and she was saying something he didn't catch.

With a start he was back in the bedroom, and Leej was still there, sitting on the edge of the bed gazing at him in amazement. "What's the matter?" she said. "It's continuing. The blur is continuous."

Gosseyn climbed to his feet and began to dress. "Don't ask me anything just now," he said. "I may be leaving the ship, but I'll be back."

It took a moment, then, to bring back into his mind one of the areas he had "memorized" on Venus two and a half months before.

He could feel the faint, pulsing flow from his extra brain. Deliberately, he relaxed as he had on the bed. He felt the change in the "memory". It altered visibly. He was aware of his brain following the ever changing pattern. There were little jumps and gaps. But each time the "photographic" image in his mind would come clear and sharp—though changed.

He closed his eyes. It made no difference. The change continued. He knew that three weeks had passed, a month, then the full elapsed time since his departure from Venus. And still his "memory" of the area remained on a twenty decimal level.

He opened his eyes, shook himself with a shuddering muscular movement, and consciously forced himself to become aware again of his surroundings.

It was easier the second time. And still easier the third time. At the eighth attempt the jumps and gaps were still there, but when he returned his attention to the bedroom, he realized that the uncontrolled phase of his discovery was over.

He no longer had the sensation of flow inside his extra brain.

Leej said: "The blur has stopped." She hesitated, then: "But there's another one due almost immediately."

Gosseyn nodded. "I'm leaving now," he said.

Without the slightest hesitation, he *thought* the old cue word for that "memorized" area.

Instantly, he was on Venus.

He found himself, as he had expected, behind the pillar he had used as a point of concealment on the day he arrived on Venus from Earth aboard the *President Hardie.*

Slowly, casually, he turned around to see if perhaps his arrival had been observed. There were two men in sight. One of them was walking slowly toward a partly visible exit. The other one looked directly at him.

Gosseyn walked toward him, and simultaneously the other man started forward, also. They met at a halfway mark, and the Venusian had a faint frown on his face.

"I'm afraid I'll have to ask you

to remain here," he said, "until I can call a detective. I was watching the spot where you"—he hesitated—"materialized."

Gosseyn said— "I've often wondered what it would seem like to an observer." He made no effort to conceal what had happened. "Take me to your military experts at once."

The man looked at him thoughtfully. "You're a null-A?"

"I'm a null-A."

"Gosseyn?"

"Gilbert Gosseyn," said Gosseyn.

"My name is Armstrong," said the man, and he held out his hand with a smile. "We've been wondering what had happened to you." He broke off. "But let's hurry."

He did not head for the door, as Gosseyn expected. Gosseyn slowed, and commented. Armstrong explained, "I beg your pardon," he said, "but if you want fast contact you'd better come along. Does the word 'Distorter' mean anything to you?"

It did indeed. "Just a few as yet," Armstrong amplified. "We've been building vast numbers but for other purposes."

"I know," said Gosseyn. "The ship I was on ran into some of the results of your labors."

Armstrong stopped as they came to the "Distorter". His gaze was intent, and his face slowly whitened. "You mean," he said, "that our defenses are no good?"

Gosseyn hesitated. "I don't know yet for certain," he said, "but I'm afraid they're not."

They went through the "Distorter" blackness in silence. When Armstrong opened the cage door, they were at the end of a corridor. They walked rapidly, Gosseyn slightly behind, to where several men were sitting at desks poring over piles of documents. Gosseyn was not particularly surprised to discover that Armstrong was unacquainted with any of the men. A Venusians were responsible individuals, and could go at will into factories where the most secret work was carried on.

Armstrong identified himself to the Venusian nearest the door, and then he introduced Gosseyn.

The man who had been sitting down stood up and held out his hand. "Elliott is my name," he said. He turned toward a nearby desk, and raised his voice. "Hey, Don, call Dr. Kair. Gilbert Gosseyn is here."

Gosseyn did not wait for Dr. Kair to arrive. What he had to say was too urgent for any delays. Swiftly he explained about the attack that Enro had ordered. That caused a sensation, but of a different kind than he expected.

Elliott said: "So Crang succeeded. Good man."

Gosseyn, on the point of continuing his account, stopped and stared at him. The light of understanding that broke over his mind then was dazzling for a moment. "You mean," he said, "that Crang went to Gorgzid for the purpose of some-

how persuading Enro to launch an attack on Venus—" He stopped, thinking of the still-born plot to assassinate Enro. Explained now. It had never been intended to succeed.

His brief exhalaration faded. Soberly, he told the group of Venusians about the Predictors. He finished with the utmost earnestness:

"I haven't actually tested my idea that Predictors can get through your cordons, but it seems logical to me that they can."

There was a brief discussion, and then he was taken over to a videophone where a man had been pressing buttons and talking in a low tone to a roboperator. He looked up now. "This is a hook-up," he said. "Tell your story again."

This time Gosseyn went into greater detail. He described the Predictors, their culture, the predominantly thalamic natures of individuals he had met, and he went on to give a picture of the Follower and his estimate of what the shadow-shape was. He described Enro, the court situation on Gorgzid, and the position of Eldred Crang.

"I have just now discovered," he went on, "that Crang went out into space for the purpose of tricking Enro into sending the fleet to destroy Venus. I can tell you that he has accomplished this mission, but unfortunately he didn't know that Predictors existed. And so, the attack which is now about due, will be fought by the enemy under more favorable conditions than anyone could have imagined who knew the nature of the defense forces which have been developed here on Venus and Earth."

He finished quietly, "I leave these thoughts with you."

Elliott sat down in the chair he vacated. He said earnestly, "Send in your comments to Robot Receiver in the usual manner."

Gosseyn learned upon inquiry that the usual method was for small groups of individuals to discuss the matter and come forth with as many reasonable suggestions as they could think of. Then one of their number joined in a similar discussion with other delegates like himself. The recommendations moved from level to level as each group of delegates in turn appointed delegates to still more broadly based groups. Thirty-seven minutes after Elliott asked for comments, Robot Receiver called him, and gave him five principle suggestions, in the order of priority:

(1) Draw a line on the star Gela, the base from which ships from the central mass of the galaxy would come, and concentrate all defenses along this line, so that the robot reaction to the appearance of warships would take place within two or three seconds.

Since the alternative was complete destruction, their hope must be that such a line defense, catching the enemy by surprise, would be able to capture the entire first fleet, Predictors or no.

(2) Have Leej bring in the destroyer, and see what a Predictor

could do *knowing* the nature of the defense.

(3) Abandon the plan to operate secretly against Enro in favor of the League, and offer the League all available weapons and secrets of such weapons in the full knowledge that the information might be misused and that a vindictive League peace would be hard to distinguish from an unconditional victory by Enro. In return, require the acceptance of Venusian emigrants.

(4) Abandon Venus.

Gosseyn returned to the destroyer, and the arrangements for the third attempt to break through the defenses were made. He would have liked to remain aboard, but Leej herself rejected his presence.

"One blur, and we'd be lost. Can you guarantee there won't be any?"

Gosseyn couldn't. He had control to some extent of his new ability to predict the future in so far as blurs were concerned.

"But suppose there's a blur while I'm on the ground?" he asked. "It's in your range."

"But you're not concerned," Leej pointed out. "All these things have their limitations, as I've told you."

Her ability didn't look limited when at one minute to two the Y-381907 materialized three miles above the galactic base on Venus, and plunged off at an angle through the atmosphere. It was followed a moment later by a line of torpedoes. It darted like a shooting star in and out of the atmosphere of the planet, out of sight most of the time except for the videoplate picture they had of its spasmodic flight.

A dozen times atomic torpedoes exploded where it had been an instant before, but each time it was gone beyond the farthest reach of the explosion. At the end of an hour of fruitless chase, Central Robot Control ordered all robot units to discontinue the chase.

Gosseyn similarized himself aboard the destroyer, took the controls away from a weary Leej, and brought the ship down in the yards of the Military Industrial Branch.

He made no comment to any of the Venusians. The ship's breakthrough spoke for itself.

Predictors *could* get through robotic mind control defenses.

It was more than three hours later when they were having dinner that she suddenly stiffened. "Ships!" she said.

For seconds she sat rigid, then slowly relaxed. "It's all right," she said, "they're captured."

It was nearly fifteen minutes before Robot Control confirmed that a hundred and eight warships, including two battleships and ten cruisers, had been seized by a concentrated force of fifteen million mind-controlling robots.

Gosseyn accompanied a large boarding party that investigated one of the battleships. As swiftly as possible the officers and crew were removed. Meanwhile Ā scientists studied the controls of the ship. In that department Gosseyn proved.

helpful. He lectured to a large group of prospective officers on the information he had gained as to the operation of the destroyer.

Afterwards, he made several attempts to utilize his new ability to foresee events, but the pictures jumped too much. Whatever relaxation he had achieved must still be incomplete. And he was too busy to more than discuss the problem with Dr. Kair, briefly.

"I think you're on the right track," the psychiatrist said, "but we'll have to go into that thoroughly when we have more time."

Time became a watchword during the days that followed. It was discovered on the basis of interviews —Leej foresaw the discovery by twenty-four hours—that there were no Predictors with the fleet.

It made no difference to the Venusian plan. A survey of Venusian opinion indicated the general belief that there could be a second fleet within a few weeks, that it would have Predictors aboard, and that it *might* be captured despite the presence of the prescient men and women from Yalerta.

It made no difference. Venus would still have to be abandoned. Action groups of scientists worked in relays on a twenty-four-hour basis, setting up auxiliary "Distorters" in each of the captured ships, similar to those which had been used to send the Predictors from Yalerta to the fleet in the Sixth Decant.

The capture of the warships of the Greatest Empire made it possible to set up a chain of ships stretching to within eight hundred light-years of the nearest League base, which was just over nine thousand light-years distant. From that near point videophonic communication was established.

The arrangement with the League proved surprisingly easy. A planetary system that would shortly be attaining a daily peak production of twelve million robotic defense units of a new type made a surprising amount of sense to the rigid-minded Madrisol.

A fleet of twelve hundred League ships used the chain of captured warships to "break" toward Gela. The four planets of that sun were overwhelmed in four hours, and so further attacks by future Enro forces were cut off until he could recapture his base.

It made no difference. To the Venusians, the League members were almost as dangerous as Enro. So long as the Ās were on one planet, they were at the mercy of people who might become afraid of them because they were different, people who would shortly be justifying the execution of millions of other neurotics like themselves, and who would also presently discover that the new weapons which they were being offered were not invincible.

The reaction to such a discovery could not be guessed. It might not mean anything. And then again all

the benefits derived from the defense units might be dismissed as unimportant if they failed to achieve that absolute perfection so dear to the hearts of the unintegrated.

The Ās did not bring up the possible weaknesses of their offerings during the conferences which decided that two hundred to two hundred thousand individuals would be allotted immediately to each of some ten thousand League planets.

Even as the details were discussed, the movement of families got under way.

Gosseyn watched the migration with mixed emotions. He did not doubt the necessity of it, but having made the concession, logic ended and feeling began.

Venus abandoned. It was hard to believe that two hundred million people would be scattered to the far distances of the galaxy. He did not doubt that in scattering there would be collective safety. Individuals might meet with disaster as still more planets were destroyed in the war of wars. It was possible, though only vaguely so, that some would be harmed on planets here and there. But that would be the exception and not the rule. They were too few to be considered dangerous, and each Ā would swiftly size up the local situation and act accordingly.

Everywhere now there would be Ā men and women at the full height of their integrated strength, never again to be cut off in one group on an isolated star system. Gosseyn selected several groups going to comparatively nearby planets, and went with them through the "Dis-

torters", and saw them safely to their destinations.

In each case the planets where they arrived were democratically governed. They were absorbed into the population masses that, for the most part, didn't even know they existed.

Gosseyn could only follow groups at random. More than a hundred thousand planets were receiving these very special refugees, and it would have taken a thousand lifetimes to follow them all. A world was being evacuated except for a small core of one million who would remain behind. The role of those who stayed was to act as a nucleus for the billions of Earth who knew nothing of what had happened. For them the Ā training system would carry on as if there had been no migration.

The rivers of Ā travelers flowing toward the "Distorter" transmitters became a stream, then a trickle. Before the last of the migrants were finally gone, Gosseyn went to New Chicago where a captured battleship, renamed the *Venus,* was being fitted out to take him, Leej, Captain Free and a crew of Ā technical experts into space.

He entered a virtually deserted city. Only the factories, which were not visible, and the Military Center were flamboyantly active. Elliott accompanied Gosseyn into the ship, and gave him the latest available information.

"We haven't heard anything from the battle, but then our units are probably just going into action." He smiled, and shook his head. "I doubt if anybody will bother to give us the details of what happens. Our influence is waning steadily. The attitude toward us is a mixture of tolerance and impatience. From one hand we get a pat on the shoulder for having invented weapons which, for the most part, are regarded as decisive, which they aren't. From the other hand we get a shove and an admonition to remember that we are now just a tiny, unimportant people, and that we must leave the details in the hands of those who are the experts in galactic affairs."

He paused, amused but grave.

"Whether they know it or not," he said, "almost every null-A will try to affect the ending of the war. Naturally, the direction we want events to take are peaceful rather than warlike. It may not show immediately, but we don't want the galaxy divided into two groups that violently hate each other."

Gosseyn nodded. The galactic leaders had yet to discover—though actually they might never do so; the process would be so subtle—that what one Ā like Eldred Crang had done, would shortly be multiplied by two hundred million. Thought of Eldred Crang reminded Gosseyn of a question he had been intending to ask for many days.

"Who developed your new robot devices?"

"The Institute of General Seman-

tics, under the direction of the late Lavoisseur."

"I see." Gosseyn was silent for a moment, thinking out his next question. He said finally: "Who directed your attention to the particular development that you've used so successfully?"

"Crang," said Elliott. "Lavoisseur and he were very good friends."

Gosseyn had his answer. He changed the subject. "When do we leave?" he asked.

"Tomorrow morning."

"Good."

The news brought a sense of positive excitation. For weeks he had been almost too busy to think, and yet he had never quite forgotten that such individuals as the Follower and Enro were still forces to be reckoned with.

And there was the even greater problem of the being who had similarized his mind into the nervous system of Ashargin.

Many vital things remained to be done.

XVIII.

Abstracts

For the sake of sanity, remember: "The map is not the territory, the word is not the thing it describes." Wherever the map is confused with the territory, a "semantic disturbance" is set up in the organism. The disturbance continues until the limitation of the map is recognized.

Out through the interstellar darkness the following morning sped the powerful battleship. In addition to its all Ā crew, it was loaded with a hundred thousand robotic mind control units.

They stopped the ship at Dr. Kair's request after the first "break".

"We've been studying you at odd intervals," he told Gosseyn, "though you were about as elusive as anyone could be. But still, we got something."

He brought some photographs out of his brief case, and handed them around. "This picture of the extra brain was taken a week ago."

The area glowed with millions of fine interlacing lines. "It's alive with excitation," Dr. Kair said. "When you consider that at one time its only contact with the rest of your body and brain tissue appeared to be the blood vessels that supply it and the nerve connections that affect the blood stream directly. When you consider that, then the present condition of the extra brain is by comparison one of enormous activity."

He broke off. "Now," he said, "about further training, my colleagues and I have been thinking about what you told us, and we have a suggestion to make."

Gosseyn interrupted: "First, a question."

He hesitated. What he had to say was in a way irrelevant. And yet, it had been pressing on his mind ever since his talk the day before with Elliott.

"Who," he asked, "gave the direc-

tion to the training I received under Thorson?"

Dr. Kair frowned. "Oh, we all made suggestions but in my opinion the most important contribution was made by Eldred Crang."

Crang again! Eldred Crang, who knew how to train extra brains; who had transmitted messages from Lavoisseur before the death of that earlier, older Gosseyn body—the problem of Crang was thus suddenly and intricately again to the fore.

Briefly, objectively, he outlined the case of Crang to the group. When he had finished, Dr. Kair shook his head.

"Crang came to me for an examination just before he left Venus. He was wondering if the strain was telling on him. I can tell you he is a normal null-A without any special faculties, though his reflexes and integration were on a level that I have seen only once or twice before in my entire career as a psychiatrist."

Gosseyn said: "He definitely had no extra brain?"

"Definitely not."

"I see," said Gosseyn.

It was another door closing. Somehow, he had hoped that Eldred Crang would be the "player" who had similarized his mind into the body of Ashargin. It wasn't eliminated from the picture but a different explanation seemed to be required.

"There's a point here," said the woman psychiatrist, "that we discussed once before, but which Mr. Gosseyn may not have heard about. If Lavoisseur gave Crang his knowledge of how to train extra brains, and yet now it turns out that the method is not a very good one, are we to believe that Lavoisseur—and all the earlier Lavoisseur-Gosseyn bodies—were only trained in what now seems to be an inefficient method?" She finished quietly, "The death of Lavoisseur seems to indicate that he had no ability at prevision, and yet already *you* are at the edge of that and other abilities."

Dr. Kair said: "We can go into those details later. Right now I'd like Gosseyn to try an experiment."

When he had explained what he wanted, Gosseyn said: "But that's nineteen thousand light-years away."

"Try it," urged the psychiatrist.

Gosseyn hesitated, and then concentrated on one of his "memorized" areas in the control room of Leej's skytrailer. He swayed as with vertigo. Startled, he fought a sense of nausea. He looked at the others in amazement. "That must have been a similarity of just under twenty decimals. I think I can make it if I try again."

"Try," said Dr. Kair.

"What'll I do if I get there?"

"Look the situation over. We'll follow you as far as the nearby base."

Gosseyn nodded. This time he closed his eyes. The changing picture of the "memorized" area came sharp and clear.

When he opened his eyes, he was on the skytrailer.

He did not move immediately from the area of his arrival, but stood gathering impressions. There was a quiet, neural flow from the near reaches of the ship. The servants, he decided, still on duty.

He walked forward, and looked out. They were over open countryside. Below was a level plain. Far to his right he caught the shimmer of water. As he watched, and the ship moved on, he lost sight of the sea. That gave him an idea.

He bent over the controls, and straightened again almost immediately as he saw how they were set. The trailer was still following the circular route that he had set for it just before he made his successful effort to seize the destroyer.

He made no attempt to touch the controls or alter them. The ship could have been tampered with in spite of its appearance of being exactly as he had left it.

He probed for magnetic current flow, but found nothing unusual. He relaxed his mind, and tried to see what was going to happen. But the only picture of the control room that he could get showed no one in it.

That brought up the question, "Where am I going next?"

Back to the battleship? It would be a waste of time. He had an impulse to know how long it had taken him to come to Yalerta, but that was something he could check on later.

Great events were transpiring. Men and women for whose safety he felt partially responsible were still in danger areas. Crang, Patricia, Nirene, Ashargin— ..

A dictator must be overthrown, a great war machine brought to a halt by any possible means.

Abruptly, he made his decision.

He arrived at the Follower's *Retreat* at his "memorized" area just outside the door of the power house. He reached the upper floor without incident, and paused to ask a man the way to the Follower's apartment.

"I'm here for an appointment," he explained, "and I must hurry."

The servant was sympathetic "You came in the wrong way," he said, "but if you will follow that side corridor you'll come to a large anteroom. They'll tell you there where to go next."

Gosseyn doubted if anyone would tell him what he wanted to know. But he came presently to a room that was not as large as he had expected, and so ordinary that he stared at it wondering if he had come to the right place.

A number of people sat in lounges, and directly across from him was a little wooden fence inside which were eight desks. A man sat at each desk apparently doing clerical work.

Beyond the desks was a glass in-

closed office with one large desk in it.

As he passed through the gate, and into the little fenced area, several of the clerks rose up from their chairs in a half protest. Gosseyn ignored them. He was shifting the wire in the control room of the sky-trailer again, and he wanted to get inside the glass office before letting Yanar become aware of him.

He opened the door, and he was closing it behind him when the Predictor became aware of him. The man looked up with a start.

There was another door beyond Yanar, and Gosseyn headed straight for it. With a jump, Yanar was on his feet and barring his way. He was defiant.

"You'll have to kill me before you can go in there."

Gosseyn stopped. He had already penetrated with his extra brain the room beyond the door. No impulse of life came. That was not final proof that it was unoccupied. But his sense of urgency dimmed considerably.

He frowned at Yanar. He had no intention of killing the man, particularly when he had so many other ways at his disposal of dealing with the Predictor. Besides, he was curious. Several questions had bothered him for some time. He said:

"You were aboard Leej's ship as an agent of the Follower?"

"Naturally," Yanar shrugged.

"I suppose you mean by that, how else would the ship have been waiting for us?"

Yanar nodded warily. His eyes were watchful.

"But why allow any means of escape?"

"The Follower considered you too dangerous to be left here. You might have wrecked his *Retreat.*"

"Then why bring me to Yalerta?"

"He wanted you where Predictors could keep track of your movements."

"But that didn't work?"

"You're right. That didn't work."

Gosseyn paused at that point. There was an implication in the answers that startled him.

Once more now, more sternly, he stared at the Predictor. There were several other questions he had in mind, particularly about Leej. But actually they didn't matter. She had proved herself to his present satisfaction, and the details could wait.

That settled it. He similarized Yanar into the prison cell which Leej and Jurig and he had occupied weeks ago.

Then he opened the door and stepped into the room he believed to be the Follower's private office.

As he had sensed, the place was unoccupied.

Curiously, Gosseyn looked around him. An enormous desk faced the door. There were built-in filing cabinets against the wall to the left, and an intricate system—it looked intricate and somewhat different—

of "Distorter" mechanisms and controls to his right.

Feeling both relieved and disappointed, Gosseyn considered his next move. Yanar was out of the way. Not that that meant much one way or the other. The man was a nuisance, and not a danger.

Gosseyn headed for the filing cabinets. They were all magnetically locked, but it was the work of a moment to open each circuit with his extra brain. Drawer after drawer slid outward at his touch. The "files" were of the plastic variety, similar to the palace directory which Nirene had shown him when he was in Ashargin's body.

The equivalent of scores of pages of print were impressed on successive layers of molecules. Each "page" showed up in turn as the index slide at the edge was manipulated.

Gosseyn searched for and found a plate with his own name on it. There were four printed "pages" in the file. The account was very objective, and for the most part detailed what had been done in connection with him. The first item read:

"Transferred name from GE-4-408C." It seemed to indicate another "file" elsewhere. There followed a reference to his training under Thorson with the notation, "Have been unable to find any of the individuals who participated in the training, and discovered it too late to prevent it."

There were several references to Janasen, then a description of the "Distorter" relay system that had been used to transport Gosseyn from Janasen's apartment on Venus. "Had this device built by the same people who made F. for me, so that it would actually seem to be an ordinary cooking table." That was printed, but there was a notation in longhand on the margin: "Very cunning."

Gosseyn read the four "pages" with a sense of disappointment. He had expected to find an overtone of reference that would fill out his own picture of what had happened between the Follower and himself. But the account was too brief and too matter-of-fact. At the bottom of the fourth page was a note: "See Ashargin."

Gosseyn secured Ashargin's "file". That was longer. In the early "pages" the writer dealt principally with Ashargin's life from the time he arrived at the Temple of the Sleeping God. It was not until the last "page" that there was any cross reference to Ashargin's "file". The comment was brief. "Under lie detector questioning by Enro, Ashargin made several references to Gilbert Gosseyn." Beside the item, in longhand, was written: "Investigate."

The final paragraph on Ashargin said:

"The forced marriage of the Prince and Princess Ashargin seems to have developed into a relationship of fact as well as name. The change in this man calls for an urgent in-

quiry, although Enro is coming around to the idea that a co-operative Ashargin will be valuable even after the war. The Predictors find his conduct exemplary during the next three weeks."

There was no indication as to when the three weeks had begun, no mention of the trip to Venus on which Gosseyn-Ashargin had started, nor any definite statement that he was back at the palace.

Gosseyn put the "file" back in its drawer, and continued his examination of the room. He found a narrow door skillfully built into the "Distorter" panels. It led into a tiny bedroom that contained one piece of furniture, a neatly made up bed.

There was no clothes closet, but there was a very small bathroom with toilet and wash basin. A dozen towels hung on a plain metal towel rack.

The Follower, if this was indeed his inner sanctum, did not coddle himself.

It took most of the day to explore the *Retreat.* The building had no unusual features. There were servants' quarters, several entire sections devoted to a busy clerical staff, the power plant was in the basement, and a wing was made up of prison cells.

The clerks and power attendants lived in cottages along the coast line farthest from the main building. Yanar and five other Predictors had apartments on one corridor. There was a hangar in the rear of the structure large enough to house a dozen skytrailers. When Gosseyn looked into it, there were seven large machines and three small planes. The latter were of the type that had attacked him during his escape from the prison.

No one interfered with him. He moved at will through the buildings and around the island. Not a single person seemed to have the authority or the inclination to bother him. Such a situation had probably never existed before on the island, and apparently they were all waiting for the Follower to come to do something about it.

Gosseyn waited also, not without some doubts. But with a strong determination not to depart. He had a will to action, a sense that events were moving to a head much faster than his almost passive existence at the *Retreat* indicated.

His plans were made, and it was only a matter of waiting till the battleship arrived.

He slept the first night in the little bedroom adjoining the Follower's office. He slept peacefully with his extra brain cued to respond to any operation of the "Distorter" equipment. He had not yet established that the Follower manipulated his curious shadow-shape by means of "Distorter" relays, but the available evidence pointed in that direction.

And he knew just what he intended to do to prove or disprove the theory.

The next morning he similarized to Leej's skytrailer, ate breakfast with three waitresses hovering around him anxious to do his slightest bidding. They seemed puzzled by his politeness. Gosseyn didn't have time to train them in self-respect. He finished his meal and set to work.

First, he laboriously rolled up the drawing room rug. And then he began to cut free the metal floor plates as near as he could remember to the point where the Follower had materialized on the ship.

He found the "Distorter" within inches of where he expected it to be.

That was fairly convincing. But he had another verification in the cell where he had been imprisoned when he first arrived on Yalerta. A wild-eyed Yanar watched him through the bars as he broke open the seemingly solid metal cot, and there, also, found a "Distorter".

Surely, the picture was becoming clearer, sharper. And the crisis must be near.

The second night passed as uneventfully as the first. Gosseyn spent the third day going through the "files". There were two "pages" on Secoh that interested him, because the information in them had not been a part of Ashargin's memory. The forty-seven "pages" on Enro were divided into sections, but they merely confirmed what he had already heard, with many added details. Madrisol was listed as a dangerous and ambitious man. Grand Admiral Paleol was depicted as a killer. "An implacable character," the Follower had written, which was quite a tribute from a person who had some fairly implacable characteristics himself.

He investigated only names that he knew, and a few cross references. It would take a staff of experts to go through the tens of thousands of "files" and make a comprehensive report.

On the fourth day he left the "files" alone, and worked out a plan for himself and the battleship to follow. It was uneconomical in terms of time wasted for the ship to trail him over the galaxy, when his purpose as well as the purpose of Elliott and the others was to get through to Gorgzid.

He wrote, "Enro has safeguarded his home planet by a system of doling out 'matrices' for the Gorgzid base under such a strict system that it is highly improbable that any could be secured by normal methods.

"But a man with an extra brain should be able to secure a 'matrix'—"

He reached that early point in his summing up when the long expected relay closed in his brain, and he knew that the battleship had similarized to a "break" halt near the base eleven hundred light-years away.

Gosseyn made the jump back to the *Venus* instantly.

"You must have similarized yourself from the ship to Yalerta in a

little over an hour," Dr. Kair estimated.

They couldn't figure it out exactly. But the "speed" was so much greater, the margin of error so very small compared to the ninety-odd hours the battleship had required for the journey, that the time involved scarcely mattered.

One hour plus. Awed, he walked a hundred feet to the towering transparent dome of the battleship's control room. He was not exactly a man who had to have the vastness of space explained to him, and that made the new potential of his extra brain seem even more impressive.

The blackness pressed against the glass. He had no particular sense of distance with the stars that he could see. They were tiny bright points a few hundred yards away. That was the illusion. Nearness. And, now, for him they *were* near. In five and a half hours he could similarize himself across the hundred thousand light-year span of this spinning galaxy of two hundred thousand million suns—if he had a "memorized" area to which he could go.

Elliott came up beside him. He held out a "matrix" which Gosseyn took.

"I'd better be going," he said. "I won't feel right until those filing cabinets are aboard the *Venus*."

He checked to make sure the "matrix" was in the sheath, and then similarized himself to the Follower's office.

He took the "matrix" out of its protective sheath, and carefully laid it on the desk. It would be too bad if the battleship actually similarized *to* the "matrix", but Leej was aboard

to make sure that the ship's "break" toward Yalerta fell short of a complete jump.

As he had expected, the *Venus* arrived successfully above the island just under three hours later. Study units were landed, and Gosseyn went aboard for a conference.

To his surprise, Dr. Kair planned no experiments and no training.

"We're going to use a work therapy," the psychiatrist explained. "You will train yourself by doing."

He amplified briefly. "Frankly, Gosseyn, training would take time, and you're doing all right. The advantage that you appear to have had over Lavoisseur is that you found out that there were other things that could be done, and you tried to do them. It seems certain that he knew nothing of the Predictors, or he would have mentioned them to Crang. Accordingly, he never had any reason to believe that he could train himself to foresee the future.

Gosseyn said: "That means I go back immediately and go 'through' the 'Distorter' in the Follower's office."

There was one other thing he had to do, and he did it the moment he was down in the *Retreat* again. He similarized Yanar to his one "memorized" area on the island of Crest.

That humane duty performed, he joined the group investigating the Follower's private "Distorter" system. Already the results were interesting.

"This is the most advanced setup we've seen to date," one of the Ās told him. "More intricate. Some of the printed circuits inside that paneling will take time to trace."

They had already decided to work on the assumption that the Follower's "Distorters" operated on a better than twenty decimal similarity basis.

"So we're going to remain on Yalerta for a while, and give you a chance to come back. Besides, we have to wait for that battleship of Enro's which you mentioned. It's due any day now."

Gosseyn agreed that the final purpose at least was important. It was vital that no more Predictors be sent to Enro's fleet.

He was not so sure about waiting for his return. The action he was about to take could become involved, and might require a prolonged effort. Still, if the "Distorter" was really fast, only the journey "through" it would take time. He could now be sure of similarizing himself back to the ship with minimum time error, and then back again to whereever he had been.

It was the opinion of all that there was no time to waste, and that a thorough investigation of the instruments would take quite a while.

Once again Gosseyn agreed. His own examination had shown him that the paneling was divided into two sections. In one division were three "Distorters", the controls of which could be adjusted to any patterns.

The second division had in it only one instrument. It had as its control a single protruding tube, which could be pulled or pushed by a tiny lever. In the past he had discovered that such single control "Distorters" were similarizable to any one destination to which they had a permanent "matrix". He hoped that this one was tuned to the Follower's **real** headquarters in the galaxy.

He pulled the lever without hesitation.

Gosseyn did not move immediately after the blackness ended. He was in a large, book-lined room. Through a half open door he could see the edge of a bed.

He let his extra brain become aware of the life in the building. There was a great deal, but it seemed on a quiet and peaceful level. As far as he was able to make out, there was no one in the adjoining room.

His gaze was moving around swiftly now. He saw that the "Distorter" to which he had been similarized was one of two set at right angles to each other in a corner.

That seemed to complete the general picture.

He "memorized" a floor area at his feet, then walked over and picked one of the books out of the bookcase. It was printed in the Gorgzid language.

That gave him a moment of exhilaration, but as he was turning to the flyleaf he thought, *"It doesn't necessarily mean I'm on Gorgzid. Many people in the Greatest Empire will have books printed in the language of the capitol planet."*

At that instant his thought poised.

He stared down at the name in the flyleaf, shook his head, and put the book back on the shelf.

But five other volumes he selected at random had the same name in them.

It was the name of Eldred Crang.

Gosseyn walked slowly to the bedroom door. He was puzzled, but not very worried. As he moved across the bedroom, he sensed the presence of people in the room beyond. Cautiously, he opened the door a crack. A corridor. He opened the door wider, slipped through and closed it behind him.

If necessary he could make a retreat at the speed of similarity. But he wasn't sure yet whether he was going to retreat.

He reached the end of the corridor, and stopped. From where he stood he could just see the back of somebody who looked like Patricia Hardie. She spoke then, and the identification was complete.

Her words had no importance, nor had the answer Crang gave her. What mattered about them was that here they were, and in the library adjoining their bedroom was a "Distorter" that connected with the Follower's *Retreat* on Yalerta.

It was a bewildering discovery, and Gosseyn decided against confronting the couple until he had discussed the matter with Elliott and the others.

But he was not yet ready to leave Gorgzid. He returned to the library, and stood contemplating the second "Distorter". Like the one in the *Retreat,* which he had already used, it was a single control affair.

It seemed logical to find out where it would take him. He pressed the lever.

He emerged in what seemed to be a small storeroom. There were piles of metal cases in one corner, and several shelves. A single, closed door seemed the only normal entrance.

There was no "Distorter" except the one through which he had come.

Swiftly, Gosseyn "memorized" a floor area, and then tried the door. It opened out upon a rather bare office. A desk, two chairs and a rug completed the picture.

Beyond the desk was another door.

Gosseyn paused on his way across the room, and tried the drawers of the desk. They were locked with key locks, and could not be opened by an extra brain, without the use of power.

The office door opened onto a corridor about ten feet long, at the end of which was another door. Gosseyn pushed it wide without hesitation, stepped through, and stopped.

The large chamber that spread before him hummed with faint undercurrents of sound. A narrow buttress extended twenty feet from one wall. It was so skillfully integrated that it seemed to be a projection of the wall itself, a prolonged curving out instead of the flat surface which the wall normally should have been.

The nearer curve of the outjutting wall was translucent, and glowed with an all-pervading light. Tiny stairways led from the floor to the top of the crypt of the Sleeping God of Gorgzid.

The effect of it upon him was different than when he had seen it through the eyes of Ashargin. Now, with his extra brain, he sensed the pulsing currents of energy that operated the invisible machines. Now, there came a faint sense of life force, a human neural flow, slight, steady, and with scarcely any variation in intensity.

Gosseyn climbed the steps without benefit of the Ceremony of the Beholding, and looked down at the Sleeping God of Gorgzid. His examination of the face and of the crypt was different from that of Ashargin, sharper, more alert. He saw things to which the duller senses of the prince had been blind.

The "coffin" was a structure of many sections. The body was held by a series of tiny, viselike arms and hands. He recognized their purpose. They were designed to exercise the muscles. If the Sleeping God ever wakened from his long sleep, he would not find himself stiff and weak, as Gilbert Gosseyn had after a month of being unconscious on the destroyer Y-381907.

The sleeper's skin was healthy. His body looked firm and strong. Whoever had planned his diet had had more equipment than had been available to Leej on the destroyer.

Gosseyn came down the steps, and examined the base of the "coffin". As he had expected, the stairs were movable, and the base panels could slide back.

He slid them out of the way, and stood looking down at a machine.

Almost immediately he realized that he had come to the end of a trail. On all his journeyings, on the mightiest ships of the Greatest Empire, he had never seen a machine quite like this one.

After he had gazed at it a while, he shook his head in wonder. The circuits were printed in intricate designs, but he was able to identify more than a dozen purposes.

He recognized a "Distorter" circuit, a lie detector, a robot relay, and other more simple devices. But that electronic brain had no less than one hundred and forty-seven main circuits, each one of which was a unit in depth, the surface and interior of which was interlaid with many thousands of smaller circuits.

Even the almost human robot weapons which Lavoisseur had turned over to the Venusians had only twenty-nine main sections.

Intent now, Gosseyn studied the artificial brain. On that closer examination, several of the wires seemed burned out. The discovery alerted him, and in quick succession he saw several other damaged segments. How so well-built and protected an instrument could have been damaged was not easy to understand, but the end result was unmistakable.

It would take an immense amount

of skill to repair the machinery and awaken the Sleeping God.

It would probably not be his job. He was in the front line, and not in the technical department. It was time he went back to the battleship.

He similarized himself, and arrived on the *Venus* to hear the alarm bells ringing.

Elliott explained that the battle was over. "When our robots acted, I don't think they even knew what hit them. We captured the entire personnel."

It was a very satisfying victory, for more reasons than one. The captured battleship was the one Enro had sent more than a month before to replace the Y-381907. It had come to start a new flow of Predictors to the fleet of the Greatest Empire. It would take time for another ship to replace it. That was one result.

The second result, it seemed to Gosseyn, was the more important when properly considered. The *Venus* was free to follow him to Gorgzid.

No Ā had any explanation to offer for the mystery of Eldred Crang. Elliott said: "We can only assume that he did not know about the Predictors, and therefore made no statements on a concrete predictable level. Your discovery seems to indicate that Crang is more aware of what is going on than we suspected."

A short time later Gosseyn was given another "matrix", and Elliott told him, "We'll leave at once, and we'll see you in about three days."

Gosseyn nodded. He intended to explore the Temple of the Sleeping God in more detail. "I want to see if the atomic drive is still in working order. Maybe I can take the whole temple out to space." He grinned. "They might take that as an omen that the god disapproves of their aggression."

He finished more seriously: "Except for that, I'll lie pretty low until you people arrive."

Before leaving the ship, he sought out Dr. Kair. The psychiatrist motioned him to a chair, but Gosseyn rejected the offer. He stood frowning, then said:

"Doctor, there's something at the end of this trail we're following that's going to be different from anything we expect. I've had some hazy pictures—" He paused, then: "Twice, now, my 'mind' has been similarized into the body of Prince Ashargin. On the surface it looks as if someone was helpfully giving me a look at the larger scene of events, and I'm almost willing to accept that as the motive."

"But why through Ashargin's eyes? Why is he necessary?"

"You see, it comes down to this, If it's possible to put my 'mind' into other people's bodies, why wasn't it put into the body of Enro? With Enro under my control, I *think* I could end the war like that."

He snapped his fingers.

"The logic of that seems so inescapable that I can only conclude we are looking at the picture from

the wrong angle. There must be another answer, possibly an answer bigger than the war itself.

He stood frowning, then held out his hand. Dr. Kair shook it silently. Gosseyn stepped away, and, still holding on to the "matrix", similarized himself to the little storeroom in the Temple of the Sleeping God on Gorgzid.

Even as he came out of the blackness, he realized with a thalamic sense of frustration that he was going to wake up in the body of the Prince Ashargin—for the third time in as many months.

XIX.

Abstracts

For the sake of sanity, remember: First is the event, the initial stimulus; second is the nervous impact of the event, via the senses; third is the emotional reaction based on the past experience of the individual; fourth comes the verbal reaction. Most individuals identify the first and fourth steps, and are not aware that the second and third exist.

"It's dinner time," said Nirene.

Gosseyn-Ashargin climbed to his feet, and they walked in silence along the corridor. Her face was thoughtful, and when she tucked her fingers lightly under his arm, it looked like an automatic gesture. But the very unconscious nature of it emphasized for Gosseyn what he had already realized from Ashargin's memory, that this marriage had indeed developed into an affectionate relationship.

"I'm not so sure," said Nirene, "that the privilege of being at the royal dinner table is one that I enjoy. I can't decide whether I've been promoted or not."

Gosseyn-Ashargin did not reply. He was thinking of the body of Gilbert Gosseyn lying in the storeroom in the Temple of the Sleeping God. At any moment, Secoh might walk in and find it.

Beside that fact, the private life of the Prince and Princess Ashargin faded into insignificance.

Neither Enro nor Secoh were present for dinner, which did not make Gosseyn feel any better. He had a vision of the Lord Guardian deciding to spend this night of all nights at the Temple. There was no question of what he himself must do, but the details occupied his attention for most of the meal.

So it was with a sense of something wrong that he looked up suddenly and saw that the two women were very pale. Patricia was saying:

"I didn't think I'd feel this way, but the possibility of a complete League victory makes me almost as uneasy as I used to be when I thought of my brother winning unconditionally."

Nirene said: "The terrible thing about being pulled into a war against your will is that, no matter how little you had to do with it, you discover finally that your own fate is bound

up with the fortunes of your side."

Briefly, Gosseyn was drawn aside from his urgent private purposes. He knew what they were thinking, and there must have been a real reverse to shock them so violently.

Defeat would be a personal disaster for everyone in the Greatest Empire. There would be humiliation, armies of occupation, a ruthless search for war criminals, vengefulness that would show little or no comprehension of the possible effects on the nervous systems of both victors and vanquished.

He parted his lips to speak, and then closed them again, struck. If the situation was really serious, then this might be the explanation for the dictator's absence from dinner.

Before he could say anything, he had confirmation. Patricia said:

"Enro's with the fleet. They lost four divisions without a trace, and the battle of the Sixth Decant is stopped while they plan counter measures."

"And where is Secoh?" Gosseyn asked.

Nobody knew, but Crang gave him a sharp questioning look. All he said, however, was: "It's important, of course, that there be no complete victory. Unconditional surrender is an illusion."

Gosseyn did not hesitate. They might as well know the facts. Briefly, succinctly, without giving his source of information, or describing the robotic weapons and their effect, he told them what the possible result would be in the war.

He finished: "The sooner Enro realizes that he's got a long war of attrition on his hands, and makes or accepts overtures of peace, the more quickly he'll insure that no accident of fate brings about complete ruin."

He stood up. "If Enro comes back before I do, tell him I want to see him."

He excused himself, and walked rapidly out of the room.

Arrived in the outer corridor, he headed for the roof. Several planes were parked near the stairway from which he emerged. As he seated himself in the front seat of the nearest one, the plane's electronic brain spoke to him through a loud-speaker:

"Where to?"

"Over the mountain," said Gosseyn, "I'll tell you where to go from there."

They took off into the darkness, and sped swiftly over the city. To the impatient Gosseyn, it seemed as if the spread of lights below would never end. Finally, however, the blackness began, and soon it was general except for vagrant spots of light that dotted the horizon.

Once more the roboplane spoke: "We're over the mountains. Where to?"

Gosseyn looked down. He could see nothing. The sky was cloud-filled, the night like pitch.

"I want you to land on a little road about half a mile this side of

the Temple of the Sleeping God," he ordered.

He described it in detail, estimating the distance of various clumps of trees, and picturing the curve of the road on the basis of Ashargin's sharp memory of the scene.

The flight continued in silence. They came down in darkness, and bumped to a stop.

Gosseyn's parting admonition was: "Come back every hour."

He stepped down onto the road, walked a few feet, and stopped. He waited then for the plane to make its almost silent take-off—a rush of air and a slight hiss of power—and then he started off along the road.

The night was hot and still. He met no one, but that was expected. This was a road that Ashargin knew of old. A thousand and more nights like this he had tramped from the potato fields back to his cot in one of the work huts.

He reached the even deeper shadows of the temple itself, and paused again. For a long minute he listened for sounds that would indicate activity.

There was no sound.

Boldly, yet with care, he pushed open the metal door, and started down the same metal stairway which had been his route during the Parade of the Beholding.

He reached the door of the inner chamber without incident, and to his surprise it was unlocked. The surprise lasted only a few moments. He had brought along an instrument for picking locks, but it was just as well not to have to make Ashargin's poorly co-ordinated fingers cope with it.

He slipped inside, and closed the door softly behind him. The now familiar scene of the crypt spread before him. Swiftly, he walked to the small corridor that led to the private office of the Lord Guardian.

At that door he paused again and listened. Silence. Safely inside, he headed for the storeroom door. He held his breath as he peeped into the dim interior, and sighed with relief as he saw the body lying on the floor.

He was in time. But the problem now was to get the unconscious body to safety.

First, he hid the "matrix" under a metal box on an upper shelf. Then, quickly, he knelt beside the still form, and listened for life in it. He heard the heartbeat, and felt the pulse, and felt the warmth of the slow, measured breathing of the unconscious Gosseyn. And it was one of the strange experiences of his existence to be there watching over his own body.

He climbed to his feet, bent down, and slipped his hands under the armpits. He drew a deep breath, and jerked. The limp body moved about three inches.

He had expected difficulty in moving the body, but not that much. It seemed to him that if he could get it started that would be the important thing. He tried again, and this time he kept going. But his muscles began to ache as he crossed

the little den. And he took his first rest at the door.

His second rest, somewhat longer, came at the end of the short corridor. When he reached the middle of the chamber of the crypt nearly twenty minutes later, he was so worn out that he felt dizzy.

He had already decided on the only possible place in the temple where he could hide the heavy body. Now, he began to wonder if he would have the strength to put it there.

He climbed the steps to the top of the crypt. From that vantage point, he studied the mechanism of the covering, not the transparent plates near the head of the sleeper, but the translucent sections farther along the twenty-foot length of the "coffin."

They slid back. It was as simple as that. Slid back, and revealed straps and tubes and holding devices for three more bodies. Two of them were on a slightly smaller scale than the other. At the sight understanding dawned on Gosseyn. The smaller ones were for women.

This spaceship was designed to take two women and two men across the miles of interstellar space and the years of time between star systems that had not had similarity travel established between them.

He wasted no time pondering the implications, but bent his muscles to the enormous task of dragging the Gosseyn body up the steps and into the crypt.

How long it required he had no idea. Again and again he rested. A dozen times it seemed to him that Ashargin was being driven beyond all the resources of his thin physique. But at last he had the body tied in place. Tied because there must be a mechanism for disposing of dead bodies. Parts of this machine were so faulty that they probably had no operating function that would tell them when a body was alive. That might explain why the women and one of the men had not been replaced.

It was as well to take precautions.

He slid the panels back in place, moved the steps back into position, and he was standing on top of them making sure that there was no sign that they had been tampered with, when he heard a sound from the direction of the storeroom. He turned, tense.

Eldred Crang came in.

The Ā detective stopped short, and put one finger to his lips in a warning fashion. He came forward swiftly, pushed the other stairway toward the rear of the crypt, and climbed up it.

With a gesture he slid back the panels where Gosseyn-Ashargin had put the Gosseyn body. For several seconds he gazed down at the body, and then he pulled the panels shut, climbed to the floor, and pulled the stairway back where it had been.

Ashargin meanwhile had returned to the floor also. Crang took his arm.

"Sorry," he said in a low voice,

"that I didn't get a chance to help you cart it up there. But I wasn't in my apartment when the machine first sent a warning to me. I came as soon as I could to make sure"—he smiled—"that you hid it where it ought to go.

"But now, quick, come along."

Gosseyn followed him without a word. There was not an Ā aboard the *Venus* who had questioned Crang's motives, and he was not going to start now. His mind bubbled with questions, but he was prepared to accept the implications of Crang's words, that there was need for haste.

Through the little office, and into the storeroom they hurried. Crang stepped aside, when they came to the "Distorter". "You first," he said.

They emerged in Crang's library. Crang started forward as urgently as ever, and then, halfway across the floor he paused and turned. He indicated the "Distorter" through which Gosseyn had originally come from Yalerta.

"Where does that lead?" he asked.

When Gosseyn told him, he nodded. "I thought it was something like that. But I could never be sure. Going through from here depends upon the operation of remote controls, which I've never been able to locate."

Crang asking a question about something *he* didn't know was a new experience for Gosseyn. Before Gosseyn could ask any questions of his own, Crang said:

"Enro has been away for eight days, but he's due back any minute. That's according to word we received shortly after dinner. So go to your room as fast as you can"—he hesitated, evidently considering his next words—"and sleep," he finished finally. "But quick now."

Patricia in the drawing room said, "Good night!" quietly.

At the outer door Crang said earnestly: "Have a good night's rest. And I mean *sleep!*"

Gosseyn headed sedately along the corridor. He felt strangely blank, and he had a feeling that too many things had happened too swiftly. Why had Crang assured himself that the Gosseyn body was in the "right" place, after having first been warned by a machine? What machine? There was only one that had any relevancy, so far as Gosseyn could make out. And that was the damaged electronic brain under the crypt.

Had Crang established some control over that machine? It sounded as if he had.

But what did he mean, sleep?

He was two floors down, starting along the corridor to Nirene's and Ashargin's apartment, when a Venusian robotic weapon snatched at his mind.

He had time for one startled realization: This couldn't be the Ā-manned battleship *Venus*. There hadn't been time for it to arrive.

It could only be that this was a major, League attack. But how had they got through?

The thought ended. He was fight-

ing desperately to save Ashargin's body from being controlled.

XX.

Abstracts

For the sake of sanity, each individual should break down the blockages in his own nervous system. A blockage is a semantic disturbance in which adequate response is inhibited. Blockages can often be eliminated by the proper use of the thalamo-cortical "delayed reaction", by self-analysis, or by heteroanalysis.

Almost, he was overwhelmed before he could think. The feel of the complex force was so much stronger than when he had felt it in his own brain, its effect so swiftly paralyzing that he stopped involuntarily.

It was possible that that was what saved him then. He had to stand there, and he thought back to the old, simple version of establishing the famous cortical-thalamic pause, the method used to condition trainees:

"I am now relaxing," he told himself, "and all stimuli are making the full circuit of my nervous system, along my spinal cord, to the thalamus, *through* the thalamus and up to the cortex, and *through* the cortex, and then, and only then, back through the thalamus and down into the nervous system.

"Always, I am consciously aware of the stimulus moving up to and through the cortex."

That was the key. That was the difference between the Ā superman and the animal man of the galaxy. The thalamus—the seat of emotions—and the cortex—the seat of discrimination—integrated, balanced in a warm and wonderful relationship. Emotions, not done away with, but made richer and more relaxed by the association with that part of the mind—the cortex— that could savor unnumbered subtle differences in the flow of feeling.

All through the palace, men would be struggling in a developing panic against the powerful force that had struck at them. Once that panic began it would not stop short of hysteria. And instant by instant it would grow. The stimulus flashing down from the fearful thalamus, quickening the heartbeat, speeding up the breathing process, tensing the muscles, stimulating the glands to more violent production—and each overexcited organ in its turn sending a new stimulus to the thalamus. Quickly, the cycle gained in speed and intensity.

Yet all that the individual had to do was to stop for an instant, and think: "The stimulus is now going through my cortex. I'm thinking and feeling, not just feeling."

And so he achieved for Ashargin a full cortical-thalamic pause.

The complex force continued to struggle against him, and he realized that he would have to be alert to make sure that Ashargin was not overwhelmed by a surprise emotional shock.

He ran without hindrance to the

apartment, and headed for the bedroom. He knew in what condition he'd find Nirene. He let the thought of it come consciously into his mind, so that Ashargin would know, also, and not be surprised. As he expected Nirene was in bed rigid and unconscious. She had apparently wakened at the moment of attack, for there was a twisted look of amazed horror on her face.

It was her expression that sent a shock through Ashargin. Anxiety, alarm, fear—like lightning the emotion ran its gamut.

Like lightning, the complex force pressed in and seized his mind.

In a desperate effort Gosseyn threw himself across the bed, so that he would be able to relax. It did no good. His muscles stiffened. He lay tautly sprawled at the foot of the bed.

He had wondered what it would be like, what a controlled person thought and felt. And it really wasn't very complicated at all. He slept.

And he dreamed a strange dream.

He dreamed that the body of Gosseyn in the crypt was now receptive as it had never been before, and that only in that unconscious position, and inside the memory crypt was it possible in its comparatively untrained state to achieve the tremendous *rapport* that had at last been established.

The thought came not from Gosseyn but through him.

" 'I' am the memory of the past." The thought reached to his mind through the unconscious body of Gosseyn. "In 'me', the machine beneath the crypt, is the only memory of the Migration that has survived, and 'my' memory is the result of an accident.

"All the machines were damaged to some extent in passing through great clouds of matter, the nature of whose basic energy was not suspected. As a result the memories of most of them were lost. What saved 'mine' was that a key circuit was burned out before the greater damage could be done.

"In spite of their injuries, most of the machines that succeeded in making the journey were able to revive the bodies they carried, for that is a simple mechanical function. I could also revive the one body still in my care, but unfortunately he would not be able to survive. And I am not allowed willfully to destroy a body until it is dead. Those who have tended me in recent years have forgotten that their ancestors came to this planet in the same way as the human being they worshiped, and still worship, as the Sleeping God.

"The ancestors arrived memoryless, and quickly forgot the manner of their arrival. The struggle for existence was fierce and demanding. The ships in which they came lie buried and forgotten in the soil drift of the ages. I arrived late, so my ship has not yet been covered.

"Everywhere their descendants have built up false pictures of their

evolution on the basis of studying the fauna of their new homes. They do not yet realize that all life seeks movement, and that macrocosmic movement is limited to certain forms, and that the struggle to stand erect is part of the will to movement of particular species.

"The Great Migration was undertaken on the basis of an assumption not necessarily true, but true as far as was and is known. The assumption that the human nervous system with its cortical and higher developments is unique in time-space. It has never been imitated, and, when considered in all its intricate aspects, probably never will be—"

Two bodies, two nervous systems interacting, the greater to the lesser in the similarity fashion. The first picture came then, of men watching a bright point as it moved nearer the edge of a shadowed substance.

What that substance was neither the man in the crypt nor the machine whose vibrations were suffusing him knew.

A bright point that moved sedately, and men thoughtfully watching it. Men who had lived and died many million years before. The bright point hovered at the edge of the shadowed substance, poised for a moment, and then slipped over the edge.

It was gone instantly.

The pattern of surrounding space altered slightly. There was a sudden strain, a tension that brought a break in a basic rhythm. Matter began to change.

An entire galaxy shifted its time balance, but long before the physical crisis the decisive moment came for the inhabitants. The alternatives were bleak. To remain and die, or go to another galaxy.

They knew that the time required for such a journey would be vast beyond all the powers of mechanical and human ingenuity. As the years passed, even electronic patterns would alter radically, and would in many instances become meaningless.

More than ten thousand million ships started out, each with its crypt, each with its intricate machine designed to control the life cycles of two men and two women for a million or more years. Those ships were wonderfully made. Through the darkness they sped at three quarters the speed of light. For this was no "Distorter"-swift journey. There were no set matrices where they were going, no "memorized" areas to which men and their machines could flash with the speed of thought. All that must yet be laboriously built up.

Once more, the dream changed. It grew more relaxed, more personal, though the thoughts that came were still not particularly *directed* at either Ashargin or Gosseyn.

" 'I' similarized the 'mind' of Gosseyn into the body of Ashargin. Gosseyn possesses the only extra brain in the galaxy, besides that of the Sleeping God—which does not count. The 'god' could probably be

awakened now, but certain mechanical processes necessary to his development have long been out of operation, so he could not remain alive more than a few minutes."

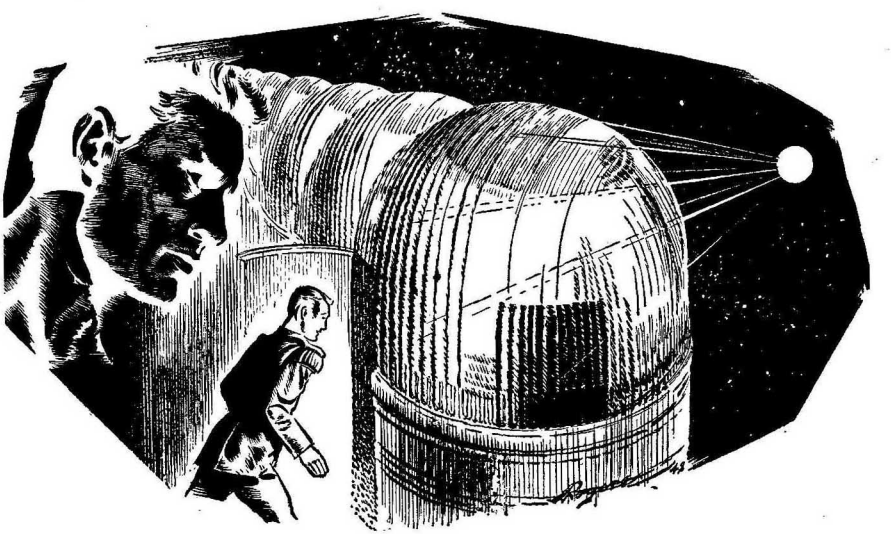
"Why did I choose Ashargin? Because he was a weakling. From experience, I know that a stronger personality could have fought Gosseyn's control consciously. His being nearby was also a factor.

"After the first time, after the channel had been established, it didn't matter of course where he was.

"But there was another more important reason why Ashargin was the logical person. Because of the intricate Imperial plans of Enro, the prince could be in a position to do more than any other individual to bring Gosseyn to the crypt. And, naturally, it was reasonable to believe that he would also be valuable to Gosseyn himself.

"How tremendous this achievement is you may guess from the fact that I have now for the first time been able to tell the story of the Migration to a direct survivor of the expedition. Many times I have tried to maneuver a Lavoisseur-Gosseyn body into this crypt in the way that Gosseyn is there now. But I succeeded only in making successive generations of the Gosseyn body wary of me. The attempt previous to this one had extremely dangerous repercussions.

"I succeeded in similarizing the 'mind' of old Lavoisseur into the body of the work priest whose duty it was to sweep out this inner chamber. My purpose was to give Lavoisseur an opportunity to repair the damage that had been done to the vi-



tal elements in my structure. The plan proved impossible, for two reasons. First, the priest was not in a position to obtain the necessary equipment. And, secondly, he resisted being 'possessed'.

"At first the resistance was not too great, and so some work was done, and some investigation made by Lavoisseur into the nature of the machinery of the crypt. As it turned out, it was unfortunate that even this brief opportunity existed. For Lavoisseur repaired a device over which I have no control, an instrument for initiating the matter change which caused the destruction of the other galaxy. The device was sent along in one of every ten thousand ships for study purposes only, and it interested Lavoisseur because there was nothing like it on the ship in which he had come.

"Although Lavoisseur did not know it, this device automatically attuned itself to the body of the priest, a result of the precaution taken by the builders to insure that the instrument would always be under the control of a human being.

"Naturally, they intended the human being to be one of themselves.

"The priest need now merely *think* himself out of phase in time, and the change, fortunately limited, occurs. By using 'Distorter' transport, he can direct the nebular substance to any point in the galaxy where he has a 'Distorter'.

"When the priest's resistance to Lavoisseur's control grew too strong, it was necessary to break the contact. What followed was something I admit I did not foresee. After the priest recovered from his fright at what had happened, *he came to believe that he had been possessed by the Sleeping God.*

"His ability to assume the shadow-shape seemed to confirm this analysis, and in a sense, of course, it is true that he gains his power from the Sleeping God. But only in the same way that I am the Player who has been manipulating your 'mind'. The real 'gods' and the real Players have been dead nearly two million years.

"But now, you are about to waken. Your position is a difficult one, but you have one duty. You must kill the priest who possesses this power. How you can do this once he is in his shadow shape I do not know.

"Yet kill him you must.

"And now, there is not much left to tell. Ashargin need merely transmit himself through a 'Distorter', and I will free him from Gosseyn's control, and Gosseyn will immediately awaken. Or Ashargin could be killed, and Gosseyn's 'mind' would automatically return to his own body. Those are the only two methods.

"Eldred Grang was a confidant of Lavoisseur, and some years ago as a result of information he secured from Lavoisseur, he came here and did some work on my damaged structure. At that time he was unsuccessful in making adequate repairs. More recently, he succeeded in setting up a relay by which I

could send him warnings with sound and light signals—the kind of warning by which I called him here when Ashargin was hiding the Gosseyn body.

"One last warning. The attack which has captured the palace only seems to be a League attack. Actually, the priest chose that method to strike for power in order to discredit Enro—"

The "dream" began to fade. He tried to pull it back, but it retreated even further. Then he grew aware that he was being physically shaken.

Gosseyn-Ashargin opened his eyes, and stared up at Nirene. Her face was white, but she was calm.

"Darling, Secoh is here to see you. Please get up."

There was a sound at the bedroom door. Nirene drew back slowly; and Gosseyn had a clear view of the bedroom doorway.

Secoh, the Lord Guardian of the Sleeping God, stood just inside the bedroom staring at him with unsmiling eyes. "Secoh," Gosseyn was thinking, "the work priest who had once been sweeper in the inner chamber of the temple."

Secoh—the Follower.

XXI.

Ābstracts

It is not enough to know about Ā training techniques. They must be learned on the automatic, that is, the "unconscious" level. The "talking-about" stage must give way to the "doing" stage. The goal is flexibility of approach below the verbal level to any event. General semantics is designed to give the individual a sense of direction, not a new set of inflexibilities.

He had a flash glimpse now of the whole picture. Entirely aside from the "dream", so many things fitted. That mechanic on the destroyer killing himself rather than taking a chance on being questioned. What private emotional reason could have driven him to it? Religious, of course.

And who would be in a better position than Secoh for finding out when a new planet like Yalerta had been discovered? As a chief adviser of Enro, he would have the resources of an empire at his disposal.

Millions of bits of information would be catalogued, condensed and organized for him to pass on to Enro—if he chose. Science as well as information of every kind would be submitted to him for submission to the dictator. And so, radically new and different "Distorter" instruments had come to the attention of a man who knew little or nothing about any of the sciences, and who needed just such a development to give galactic-wide scope to his private wanderings.

A man who called himself the Follower, a name with religious meaning.

The rest of the scene, the motivation for everything, could be a growth based on the religion itself. It seemed natural that the Lord

Guardian of the Sleeping God should have spurred the ambitions of a planetary emperor like Enro, driving him to conquer the Greatest Empire, then consolidating the galaxy in order to spread the religion farther.

The picture was not complete in all its parts, but in that flash moment it seemed logical to Gosseyn that he adopt it as the assumption on which he must base his actions now.

Secoh was the Follower. Secoh was a sincere believer in the religion of the Sleeping God. Secoh was a fanatic, sharp and alert on almost every level of thought—except his religious belief, and even there his very conviction must give him a flexible way of looking at things.

But if there was a weakness in this man, that was it. Gosseyn-Ashargin sat up slowly, as Secoh approached the bed, and sat down facing him. The priest said in a rich tone:

"Prince, you are about to be given an opportunity to win back for your family a measure of your former position."

Gosseyn guessed then what was coming. He was not mistaken. He listened to the offer, which was in effect a vice regency with, as Secoh carefully put it, "Only the Sleeping God himself above you."

Meaning himself. And yet he undoubtedly believed what he said.

There was no pretense that League forces had captured Gorgzid. The Lord Guardian was frank. "It seemed to Crang it might be a good bargaining point if the League appeared to have captured the capitol."

He waved a hand, dismissing that aspect of the subject.

"I can tell you, he said sincerely, "that Enro was no longer satisfactory to the Sleeping God, and I need hardly say that the calls you have received from the Temple are an indication of where the God is trying to point my attention."

He meant it. This man believed in his curious religion. His eyes glowed with honest purpose. Gosseyn studied him, and was only too conscious of how *un*sane the man was.

He wondered then: Was Enro dead? He asked the question.

Secoh hesitated, but only for a moment. "He must have suspected something," he confessed. "I went to his apartment last night after his return to the palace, hoping to hold him in conversation until it was too late for him to get away. We had rather an explosive conversation."

He scowled. "The sacrilegious scum! In the past he has dissembled his hatred of the Sleeping God, but last night he was in a state of anxiety, and so he forgot himself, and actually threatened to destroy the temple.

"Then, just as the attack began, he similarized himself to Paleol's flagship."

Secoh paused. Some of the fire went out of his eyes. He said

thoughtfully, "Enro is a very able man."

It was a grudging admission. But the fact that Secoh could make such a statement was a measure of his own ability. His failure to capture Enro was clearly a major defeat, and yet he had already adjusted to it.

"Well," said Secoh, "are you with me or against me?"

It was a bald way of putting it, especially as there was no indication of what refusal might mean. Gosseyn decided against a direct question about that. He said instead:

"What would you have done with Enro if you had caught him?"

The Lord Guardian smiled. He stood up, and walked over to the bedroom window. He beckoned Gosseyn-Ashargin, who came without hesitation.

Gosseyn stood beside the priest, and looked down on a courtyard that was changed. Gallows were going up. More than a dozen were already in position, and there were silent shapes hanging from nine of them. Gosseyn stared at the dead men thoughtfully. He was neither shocked nor impressed. Wherever men acted thalamically there usually would be found a full quota of hangmen. Beside him, Secoh said:

"Enro managed to get away but I did seize a number of his uncompromising supporters. Some of them I am still trying to persuade." He sighed. "I am easy to please, but in the final issue I must have co-operation. Accordingly, such scenes as that"—he pointed downward—"are necessary concomitants to the elimination of evil forces." He shook his head. "One can have no mercy on recalcitrants."

Gosseyn had his answer. This was what happened to people who were "against" instead of "for".

He knew now what crisis he must try to arrange. But it would be staking a great deal—Ashargin's life, among other things—on the intensity of Secoh's beliefs.

It was surprisingly easy to say the nonsense words. It took a moment to realize why: Ashargin's nervous system would have established channels for false to fact verbalisms about the Sleeping God—a point he'd have to remember in his final plans for the prince, who was obviously not yet trained in general semantics.

But he spoke the necessary words about having received a summons from the Sleeping God to the effect that a great honor was planned for Secoh. He must come to the temple, bringing with him Ashargin and a "Distorter" circuit — Gosseyn watched tensely for the Lord Guardian's reaction to the inclusion of the "Distorter", since that would be a deviation from long established rituals. But apparently Secoh accepted any direct command of his god, regardless of past formalisms.

And so the first and simplest step was accomplished.

XXII.

Abstracts

General semantics is a discipline, and not a philosophy. Any number of new Ā oriented philosophies are possible, just as any number of geometrical systems can be developed. Possibly, the most important requirement of our civilization is the development of an Ā oriented political economy. It can be stated categorically that no such system has yet been developed. The field is wide open for bold and imaginative men and women to create a system that will free mankind of war, poverty and tension. To do this it will be necessary to take control of the world away from people who identify.

Secoh decided to make a pageant of it. In three hours, lines of planes, loaded with troops and priests from the capitol, dotted the sky on the route over the mountain to the Temple of the Sleeping God.

Gosseyn-Ashargin had hoped that they would make the journey through the "Distorter" in Crang's and Patricia's apartment. But when that didn't happen, he requested that Crang be in the same machine as he himself.

They sat down together.

There were many things Gosseyn wanted to know. He assumed, however, that there might be listening devices. So he began gravely: "I have only gradually realized the nature of the friendship between yourself and the Lord Guardian."

Crang nodded, and said with equal wariness: "I am honored by his confidence."

To Gosseyn, the fascinating aspect of the relationship so suddenly revealed was that Crang had, four years before, unerringly chosen Secoh instead of Enro as the person to whom he should attach himself.

The conversation went on in that polite fashion, but gradually Gosseyn obtained the information he wanted. It was an amazing picture of an Ā Venusian detective—Crang—who had secretly gone out to space from Venus to discover the nature of the threat against Ā.

It was Secoh, as Enro's adviser, who had put Crang in charge of the secret Enro base on Venus. Why? So that the Gorgzin Reesha would be beyond the reach of her brother's determination to make her his wife.

At that point Gosseyn had a sudden memory of Enro accusing Secoh: "You always were taken with her!" the dictator had said.

He had a vision then of a work priest aspiring to the hand of the highest lady on the planet. And because such emotions became "set" on the unconscious level, all his triumphs since then meant nothing beside the potent early love feeling.

Another phrase of Crang's brought him a vivid picture of how the marriage of Crang and Patricia had been presented to Secoh as not a true marriage, but as another protection for her. They were *saving*

her for the day when the Follower could claim her for his own.

A subsequent statement of Crang's made later, and seeming to have no connection with what had gone before, justified the dangerous deception. "When a person has put away the fear of death," the detective said quietly, "he is free of petty fears and petty tribulations. Only those who want life under any conditions suffer bad conditions."

Clearly, if the worst came to the worst, Mr. and Mrs. Eldred Crang would take death.

But why the attack driving out Enro? The explanation for that required even more caution in the telling. But the answer was dazzling. It was important that the dictator be put in a frame of mind where he would consider, or even initiate, negotiations for ending the war. Enro, driven from his home planet, his sister in the control of his enemy, would have a reason for making outside peace, so that he could concentrate on restoring his position in his own empire.

The amazing Crang had actually found a way that might end the war.

Crang was hesitating. And there was the faintest note of anxiety in his voice as he added carefully: "It will be a great privilege to be present at the temple on so great an occasion, but isn't it possible that some of those who will be there are so delicately balanced emotionally that the very nearness of their 'god' will upset them?"

"I'm sure," said Gosseyn-Ashargin firmly, "that the Sleeping God will *personally* insure that everything will take place as it should."

That was as near as innuendo would take them to his plan.

Brilliant lights shone from hidden sources. Priests lined each side wall holding glittering scepters of power, and banners of rich cloth. Thus the preliminary ritual ended in the great chamber of the Sleeping God.

At the moment of crisis, Gosseyn-Ashargin put his hand lightly on the control lever of the "Distorter". Before activating it, he took a final look around through the eyes of Ashargin.

He had an inexorable will to action, but he forced himself to examine the environment in which he intended to make his moves.

The guests were clustered near the door. There were priests there, also, headed by Yeladji, the Lord Watcher, arrayed in his gold and silver cloak of office. He had a frown on his plump face, as if he was not altogether happy about what was taking place. But apparently he knew better than to say anything.

The others were equally subdued. There were court functionaries whom Gosseyn-Ashargin knew by sight, and others whom he did not know. And there was Nirene, Patricia and Crang.

They would be in danger if Secoh tried to use energy, but that was a risk that would have to be taken. This was the showdown. Vast issues were at stake, and no danger

could be considered too great.

Secoh stood alone in front of the crypt.

He was naked, a humble state which he had decreed years ago for all important ceremonials in the inner chamber, particularly those where robes of office were subsequently bestowed on the honored individual. His body thus revealed was slender but firmly fleshed. His black eyes glowed with a feverish light of expectancy. There seemed little likelihood that he would grow suspicious at this final hour, but Gosseyn decided to take no chances.

"Most noble Lord Guardian," he began, "after I have similarized myself from this 'Distorter' to the one near the door, there must be complete silence."

"There will be silence," said Secoh. And he put a threat into the words for everyone present.

"Very well—*now!*" said Gosseyn-Ashargin. As he spoke he activated the "Distorter".

He found himself, as the machine had promised him in the "dream", back in the crypt in his own body. He lay quiet, aware of the nearness of the "god". Then he directed a thought.

"Machine."

"Yes?" The answer came swiftly into his brain.

"You indicated that henceforth you and I could communicate at will."

"That is correct. The relationship, having been established, is permanent."

"You said, also, that the Sleeping God could now be awakened, but that he would die very quickly."

"Death would come within a few minutes," was the reply. "Due to damage to the equipment, the endocrine glands are atrophied, and I have been replacing their functions artificially. The moment the artificial supply is cut off, the brain will begin to deteriorate."

"Do you think the body would be physically able to respond to my commands?"

"Yes. This body, like all the others, has received a pattern of exercises that were designed to enable it to function when the ship arrived at its destination."

Gosseyn drew a deep breath, and then he gave his next order. "Machine, I am going to similarize myself into the storeroom at the rear of this chamber.

"When I do that, put my 'mind' into the body of the Sleeping God."

At first there was only blankness. It was as if his consciousness had been blotted up by an all-absorbing material.

But the pressures driving him were too strong for that state to last long. He had a sense, finally, of time passing swiftly; and that brought his first thought in his new body.

"Get up!"

No. Not that first. Slide the lid. The lid must come first. Action must follow an orderly pattern. Sit up, and slide the lid.

There was a blur of light, and a vague awareness of movement. And then, filling his ears and seeming to echo through his head, a cry of wonder from many throats.

"I must have moved. The lid must be sliding. Push harder. Harder."

He was conscious of pushing, and of his heart beating rapidly. His body ached with an all-embracing pain.

Then he stood up. That was a sharper sensation, for there was more vision with it. He saw blurred figures in the mist before him, and a bright room.

Still the pressure to act and move and think faster grew inside him. He thought in anguish, *This body has only minutes to live.*

He tried to mutter the words he wanted, and to force the stiff larynx to movement. And, because sound like vision is in the mind and not the organ only, he was able presently to form the words that he had planned.

For the first time, then, he wondered how Secoh was taking the awakening of his "god".

The effect should already be tremendous. For this was a peculiarly unsound and dangerous religion for a man to have. Like the old idol worship of Earth, which it resembled, it was based upon symbol identification, but unlike its counterparts elsewhere in space and time, it was subject to a special kind of disaster because the "idol" was a living though unconscious human being.

Such a religion's continued acceptance by individuals depended on the god remaining asleep.

Its temporary acceptance by Secoh, if an awakening should occur, depended on the god taking it for granted that his chief guardian was above reproach.

This awakened god stood up before a throng of notables, pointed an accusing finger straight at Secoh, and said thickly:

"Secoh—traitor—you must die."

In that instant, the innate will to survival of Secoh's nervous system demanded that he reject his religious belief.

He couldn't do it. It was too deeply ingrained. It was associated with every tension in his body.

He couldn't do it—which meant that he must accept his god's sentence of death without question.

And he couldn't do that.

All his life he had balanced himself precariously like a tightrope walker; only, instead of a balancing pole, he had used words. Now, those words were in conflict with reality. It was as if the man on the rope suddenly lost his pole. He began to sway, wildly. With panic came innumerable dangerous and disturbing related stimuli of the thalamus. Swiftly, threshing violently, he fell.

Madness.

It was the madness that comes from unresolvable inner conflict. Through all the ages of human existence such conflicts have been set up in the minds of millions of men.

Hostility to a father conflicting with the desire for the security of parental protection; attachment to an over-possessive mother conflicting with the need to grow up and become independent; dislike of an employer conflicting with the need to make a living— Always, the first step was *un*sanity, and then, if the balance became too hard to maintain, escape into the relative security of *in*sanity.

Secoh's first attempt to escape his conflict was physical. His body blurred, and then, to the sound of a faint moan from the spectators, it grew shadowy.

The Follower stood before them.

For Gosseyn, still in control of the untrained nervous system of the "god", Secoh's transformation into his Follower shape was expected.

But it was the crisis.

Slowly, he started down the steps. Slowly, because the "god's" muscles were too stiff to permit of swift movement. The exercising they had received within the confined space of the sleeping "chamber" had opened up vital nerve channels, but only on a limited scale.

Without Gosseyn's knowledge of how it was done, the almost mindless human thing could scarcely have crawled, let alone walk.

Driving him was the ever more desperate realization that he only had minutes.

Minutes during which the Follower must be defeated. Down the

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steps he faltered, and straight toward the wavery shape of blackness.

The strain of watching one's god walk towards one with hostile intent must be a mind-destroying experience. In a very frenzy of terror, the Follower protected himself by the only method at his disposal.

Energy poured from the shadow-shape. In a flare of white flame, the "god"-body dissolved into nothingness. In that instant Secoh became a man who had destroyed his god. No human nervous system trained as his had been could accept so terrible a guilt.

So he forgot it.

He forgot that he had done it. And since that involved forgetting all the related incidents of his life, he forgot those also. His training from early childhood had been for the priesthood. All that had to go, so that the memory of his crime could be utterly banished.

Amnesia is easy for the human nervous system. Under hypnosis it can be induced with almost alarming simplicity. But hypnosis is not necessary. Meet an unpleasant individual, and soon you will not be able to recall his name. Have an unpleasant experience, and it will fade away, fade as a dream fades.

Amnesia is the best method of escaping from reality. But it has several forms, and one at least is devastating. You cannot forget the memory of a lifetime of experience, and remain adult.

There was so much that Secoh *had* to forget. Down he went, and down and down. To Gosseyn, who had instantly—when the "god" was killed—returned to his own body, and who stood watching now from the doorway that led to the back office, what followed was anticipated.

The Follower's shadow-shape disappeared, and Secoh was revealed teetering on legs that supported him a few moments only.

He fell limply. Physically, he had only a few feet to go, but mentally his journey continued down. He lay on his side on the floor, and his knees drew up tightly against his chest, his feet pressed against his thighs, and his head flopped loosely. At first he sobbed a little, but quickly he grew silent. When they carried him out on a stretcher, he lay unaware of his surroundings, curled-up and silent and tearless.

A baby that has not yet been born does not cry.

THE END

Beginning in the next issue:

"SEETEE SHOCK," by Will Stewart

BRASS TACKS

Fuller explanation of the dynamics of the Weizsäcker Theory. And this material our correspondent did not get out of "1, 2, 3, ∞" He's done some research!

Dear Mr. Campbell:

Professor Robert S. Richardson's explanation of the Weizsäcker Theory of planet formation seemed to miss a very salient point, unless this point was considered so obvious as to be unworthy of mention to ASF readers. I read a version of the theory last year in Gamou's book "1, 2, 3, ∞" which made me want to learn more about the Weizsäcker Scholium, but Professor R. S. R. let me down badly. The essential brilliant stroke of the theory is to take cognizance of the monitor effect of an average upon the action of particular components.

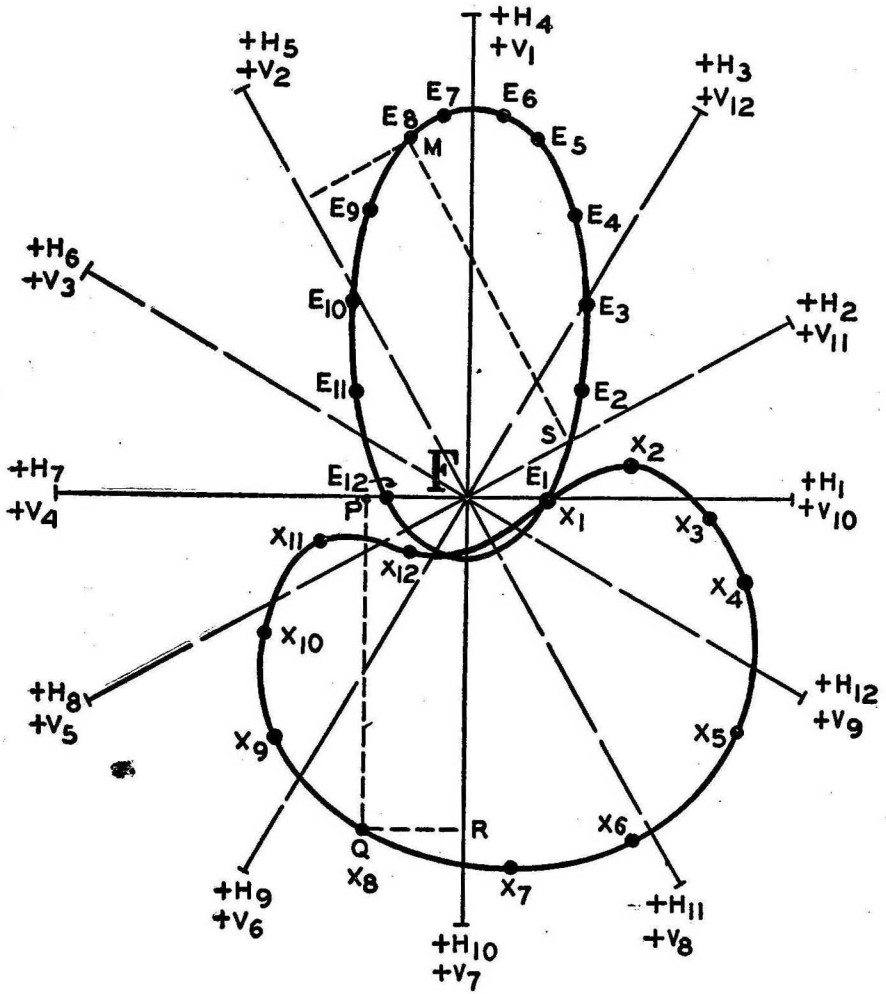
Particles describing random coplanar elliptic orbits about a gravitational focus and all having the same period will tend to adjust their motions so as to provide for minimum collision. The total motion or average motion is the circulation of a mass about the gravitational center in simple circular motion at uniform speed, and this circular motion acts as a monitor lash upon the individual particles. The following construction should demonstrate just what the action of this monitor accomplishes:

1. Given a particle describing a gravitational elliptic orbit about a focus F. What is the trajectory of the particle relative to a set of coordinate axes rotating uniformly about F with the same period as the particle?

Draw the ellipse and mark off twelve successive positions of the particle in accordance with a fixed time interval of one-twelfth period. Call these E_1, E_2, et cetera. Divide the space about F into twelve equal angles, obtaining twelve sets of coordinate axes. Label the positive horizontal arm of the first set $+H_1$

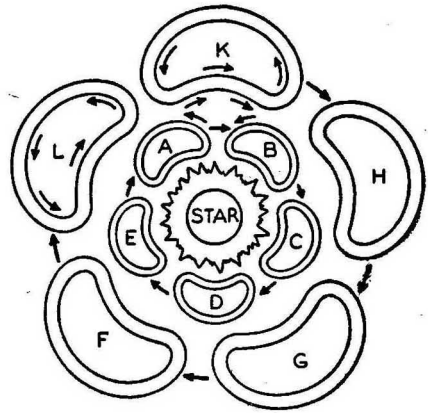
and the positive vertical arm $+V_1$ and proceed counterclockwise to $+H_2+V_2$ et cetera. In order to find say, X_8, a point on the trajectory of the particle relative to the rotating axes, find the position of E_8 relative to H_8V_8 and plot these co-ordinate values on the base co-ordinates H_1, V_1. The result is the lima bean shown here:

WEIZSÄCKER'S SCHOLIUM



Thus, for minimum collision—in fact for zero collision—all the particles having the same period should be constrained to assume one or more systems of concentric bean-shaped trajectories relative to the sweep-arm of the capitulate circular motion. Nature imposes one further logical rule upon the process. A minimum number of collisions must happen—but with a minimum of modification of the original random orbits:

For example, "H" is a collection of bean-shaped concentric trajectories taken relative to an imaginary sweep arm describing a circular motion about the star with period equal to that of all the particles of "H."



A period-group is a group of particles all describing random elliptic orbits about a common focus with same period. Group A, B, C, D, E is one such period group and might

be said to represent one stellar quantum of planet-building potential. F, G, H, K, L, represent a second period-group and comprise a potential second planet, and so on. Now, for maximum random orbits, but minimum collision, each period group should be resolved into five beans—as was shown by Weizsäcker—but this I cannot prove.

The only possibility of collision is between particles of contiguous period-groups, so that ultimately the material of any one quantum will be concentrated in the period border zone and form a planet. The relative linear speeds of the periods can impart a spin to the planet. The young, forming planet will have a new period and speed of its own, and move past all the residual beans of both contiguous systems, thus collecting material of both.—Aaron B. Miller, 3230 Steuben Avenue, Bronx 67, New York.

Of course we're infallible! Van Vogt must have changed his name that month!

Dear John:

Darned if I know why everyone is beating their brains out to tell you that you duplicated a title by publishing two stories called "The Incredible Invasion" even if they were published twelve years apart. I have known of a duplication of titles for several years and have managed to refrain from inflicting myself on you on that score. I suspect you already know about it but the two stories referred to are "The Beast" by Hubbard in the October 1942 issue and "The Beast" by van Vogt in the November 1943 issue. *Tsk, tsk,* I am surprised that somebody didn't have your job for that considering the furor that the recent duplication stirred up because this duplication was only thirteen months apart not twelve years. In looking up my files to confirm this information I also noticed that van Vogt has had other initial trouble besides that on the April 1947 cover because in the November 1943 issue his name is given in the story heading as A. B. vanVogt. Well I guess this proves that even ASF is not infallible.

Analytical Laboratory on the July issue:

1. "Police Operation": I wonder if Piper is related to Raymond F. Jones. Parts of this story seem to tie in with parts of Jones' story in the April 1946 issue titled "Black Market." How about it?
2. "Burning Bright": reminds me somewhat of Padgett and his "Fairy Chessmen" what with the people floating around the ceiling.
3. "Decision Illogical": Not too bad not too good.

Haven't read the serial yet so it isn't represented here. I really enjoyed the article and I think Ley's articles are about the best of all

the ones you publish and they are all pretty good.

I wish you would twist your arm a little and let Don Stuart try his hand again. How about it, huh?—Jack C. Rea, Mercer Hotel, Tulsa, Oklahoma.

It would be exceedingly boring if we knew all the answers to everything! How could an omniscient, intelligent being remain sane?

Dear Mr. Campbell:

Here again is my monthly report for the Lab. Before giving it, though, I will say that I think the July issue of Astounding is the best single entire issue that I have read since I started taking the magazine in 1946. Last month's issue was good, but the July number is superb.

1—"Decision Illogical". Probably a lot of your readers won't like this, for it is not actually straight science-fiction. I don't think I have ever read a story quite like it before. It positively teems with unexplained mysteries, but these, presented as they are, increase the effectiveness. Up to the last page the story seemed ordinary, but the close was magnificent, giving one a glimpse into the infinite and eternal qualities which so subtly help to make our universe what it is. As a minor point, though, I found that I was unable to understand the italicized parts in detail.

If these paragraphs were supposed to represent conferences of the supreme government of Earth, why didn't they decide to send off a whole fleet of rocket liners to the stars before the noval explosion occurred?

2—"Police Operation". Though on a totally different plane—figuratively and literally—from "Decision Illogical", this novelette was almost as good as the short story. This whole time track idea has always had a great fascination for me, and nowhere have I seen it so well presented as in "Police Operation". Contrary to the Fortean quotation and the general tone of "He Walked Around the Horses", "Police Operation" is not occult, but good, healthy science-fiction. I much prefer that sort of solution to such things as the flying saucers and the envoy's disappearance.

3—"Burning Bright". Also well-done and thought-provoking. I thought a little too much time was spent on the silly Homer, but generally it was good, and the ending in particular was excellent.

4—"Dreadful Sanctuary" (II). You may wonder why this once-promising serial has plummeted from the top to the bottom in my estimation. It still is good, but in the July issue it had plenty of competition. Nevertheless, it is far from living up to my earlier hopes. Russell seems to be writing something like what Williamson wrote in his late, unlamented serial. Man cannot stand on his own two feet, but is a mere pawn of vague forces working against one another, neither of which is really on his side. It seems to me that not only is this serial needlessly complicated but also that it is often illogical. Armstrong may be sane, but he certainly is no genius, despite Russell's claims to the contrary. How he possibly could think that it was feasible to proceed to wherever it is he thinks he's going —*I* certainly don't know what this goal is—without finding out if Lindle's story was true is beyond me. He at least might have availed himself of the "Norman's" suggestion to examine the psychotron. And why is there all of this furious activity by the Normans to stir up world wars, et cetera, to prevent rockets from being sent, when all their other-worldly allies have to do is what they have apparently been doing anyway, to ray the rockets, one and all, as they leave the atmosphere, until rocketry is eventually abandoned as hopeless? Above all, why are men that have attained "near-godhood" and who have invented such machines as the psychotron unable to cure sick minds? We can even do that to some extent today, although we aren't gods and have no psychotrons. I wish Russell would forget about the Normans and tell about a few wonderful things done by humans, as he did so superbly in his incomparable "Metamorphosite" a year and a half ago.

By the way, who in the world is Neal B. Wilkinson? I don't think I've heard of him before. He seems to be really a new author, and not just a pseudonym. Please induce him to contribute some more gems to Astounding. He apparently has some faith left in the human race, something which many of your authors appear to have lost completely.

And finally, this thiotimoline gag is getting a bit stale. Next month, why don't you limit letters discussing it in Brass Tacks to fifty percent of the published missives? I yearn to hear if anybody agrees with my opinions about these last two serials.—Warren Carroll, South Berwick, Maine.

That time theory seems too unsubstantial and vague to be arguable.

Dear Mr. Campbell:

Canedo's cover for the August ASF wasn't too bad but I still think that you ought to alternate Alejandro and Bonestell with an occasional Timmins, and keep the other so called artists off the cover!

Somehow, I seem to remember an editorial some time ago that was much the same as "The Atomic Secret" in the August issue. At any rate, I liked this one better.

As for the stories:

1. "Dreadful Sanctuary," by Eric Frank Russell. In the second installment I thought that was going to turn out to be an oversized "Person from Porlock" and was all for the Normans. The visible speeding up of action in the conclusion improved the story quite a bit.

2. "The Monster," by A. E. Van Vogt. One of the best Van Vogt's that has come up in many an issue.

3. "Time Trap," by Charles Harness. Following close on the miscellaneous tails of vV's story. Very interesting.

4. "Smaller Than You Think," by Kenneth Gray. Fair.

I don't consider "Dawn of Nothing" worth rating at all.

"Time Trap," though it didn't go into detail, brought out a new angle of time, and time travel. As far as I remember, nothing has appeared in Brass Tacks to represent a reader's theory on time or anything astronomical, either. If there have, they have been few and far between. At any rate, I am going to be so bold as to state a personal theory in that field. Until I made that last statement, I suppose I had a fair chance of getting this letter printed. Now, of course, that chance is rapidly evaporating.

This theory was first expounded by Dr. George Zyckelfritz who, at the time of his death recently, was professor of astronomy at the Barktown University at Barktown, Illinois. According to the theory, each microsecond of time in the past, present, and future, is composed of an infinite number of probability spaces, each lasting for just a microsecond and then branching off into more probability spaces. While there is no connection between any

two of these spaces, they all are connected to a common "Hyperspace" by "subelectronic" carrier beams, each of a different frequency. Thus, the trick to time-travel is to follow our "subelectronic" beam to hyperspace and there pick the beam that will lead us to the probability space that we want to enter. It isn't as easy as it sounds.

Hyperspace itself is vaster than all its tributary spaces put together and is composed of absolutely pure energy. This energy is distributed among the various spaces by means of the subelectronic beams and forms numerous small islands of energy in them. Suns, running through these islands, pick up fuel which, by means of atomic transubstantiation, lasts them for billions of years. When, over a period of years, a sun fails to go through one of these islands, it dies out and becomes a dwarf star. Occasionally, an island of energy is overly compressed. When a sun runs through it, it does not transmutate the energy but burns it up at once, creating a nova.—Evan H. Appelman, 253 Linden Park Place, Highland Park, Illinois.

Time out while we catch up on our purring!

Dear Mr. Campbell:

May I extend my congratulations on your perfect magazine. As a mature fan I think that your magazine has all the qualities that make up my dream magazine. Please let me enumerate.

First, I consider the cover to be of prime importance. The cover serves to be the "spearhead" to the complete enjoyment of the magazine. Any cover with harsh tones, "voluptuous" females, and utterly fantastic creatures, create the idea —no matter how false—that the reading matter of the stories is in the same classification as the cover.

Your covers are always pleasing to the eye without detracting from the intriguing nature of the stories.

Secondly, your stories are not the same "hack" which is ground out by most of the popular authors in the science-fiction field. We readers will be forever grateful to you for such stories as "Slan," "The World of Ā," "Children of the Lens," and "Dreadful Sanctuary."

And, thirdly, the layout and composition of your magazine lacks nothing. PLEASE! Keep the trimmed edges and the small size.

Since a little criticism enhances praise, let me make a suggestion. I believe that if, at the end of each year you issued a pamphlet containing an index of the articles and stories for the past year, this would help those fans who have missed one or two issues. This would also be a help to those who have the space to keep a collection of your magazines and, very kindly, lend them out to new fans.—Lee D. Quinn, 316 East 211th Street, New York 67, New York.

"BELIEVE IT OR NOT, HOPE HAS AN INTELLIGENT IDEA!"

says CROSBY

CROSBY:

Folks, this is fantastic, but old Hope has a great idea. He thinks *everybody* ought to give U. S. Savings Bonds for Christmas presents!

HOPE:

Thanks for the kind words, son. But no kidding, ladies and gentlemen, those Bonds are sensational. They're appropriate for *anyone* on your list. On Christmas morning, nothing looks better in a stocking—except maybe Dorothy Lamour.

CROSBY:

Old Ski Nose is correct. And don't forget—you can get 'em at any bank or post office.

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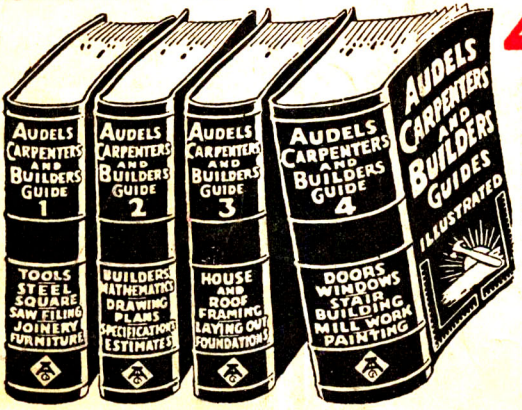

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