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In this issue: **THE GREAT GRAY PLAGUE**
by Raymond F. Jones

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# UTOPIAN VOTERS

AN EDITORIAL BY JOHN W. CAMPBELL

■ Judging from the general shape of historical trends, it looks as though Governments, like living things, are operational only so long as they are in dynamic equilibrium. That the first thing any group setting out to establish a new government must recognize is that government is a dynamic system, and that there can not ever be a secure, stable, dependable government, in the sense that all men, at all times, have always wanted —a government secure and stable in the sense that you can count on it to remain what it is.

The moment a government does become stable, dependable—something you can count on from generation to generation—it's dead. *It* will henceforth and forever remain what it was . . . but a new government moves in and takes over by revolution, conquest, or simple anarchy-disintegration.

Rome, which was one of the first large-scale true republics, showed the syndrome that has appeared in every century since; it started off with an oligarchy of wise citizens, the patricians. Citizenship was hereditary, of course. And genetics being what it is, that is unstable—but unstable in a random, not a dynamic, fashion. All the molecules in a mass of gas may be moving at ten miles per second—but it may be either an extremely hot gas standing still, with molecules moving at random, or a cold gas moving at high velocity. What government needs is not the instability of random effects, simple heat, but the instability of dynamic motion.

When genetics gets in its licks on an hereditary class, two things are happening: The Ins are, usually, a minority of unusually competent people, at the start. Random genetics will tend to level this group downward toward the norm. And, meanwhile, the larger group of Outs is continuing, by genetic statistics, to produce abnormally talented individuals who want, and deserve, position at the In level. Being abnormally talented, they're apt to work out ways and means of getting there, too.

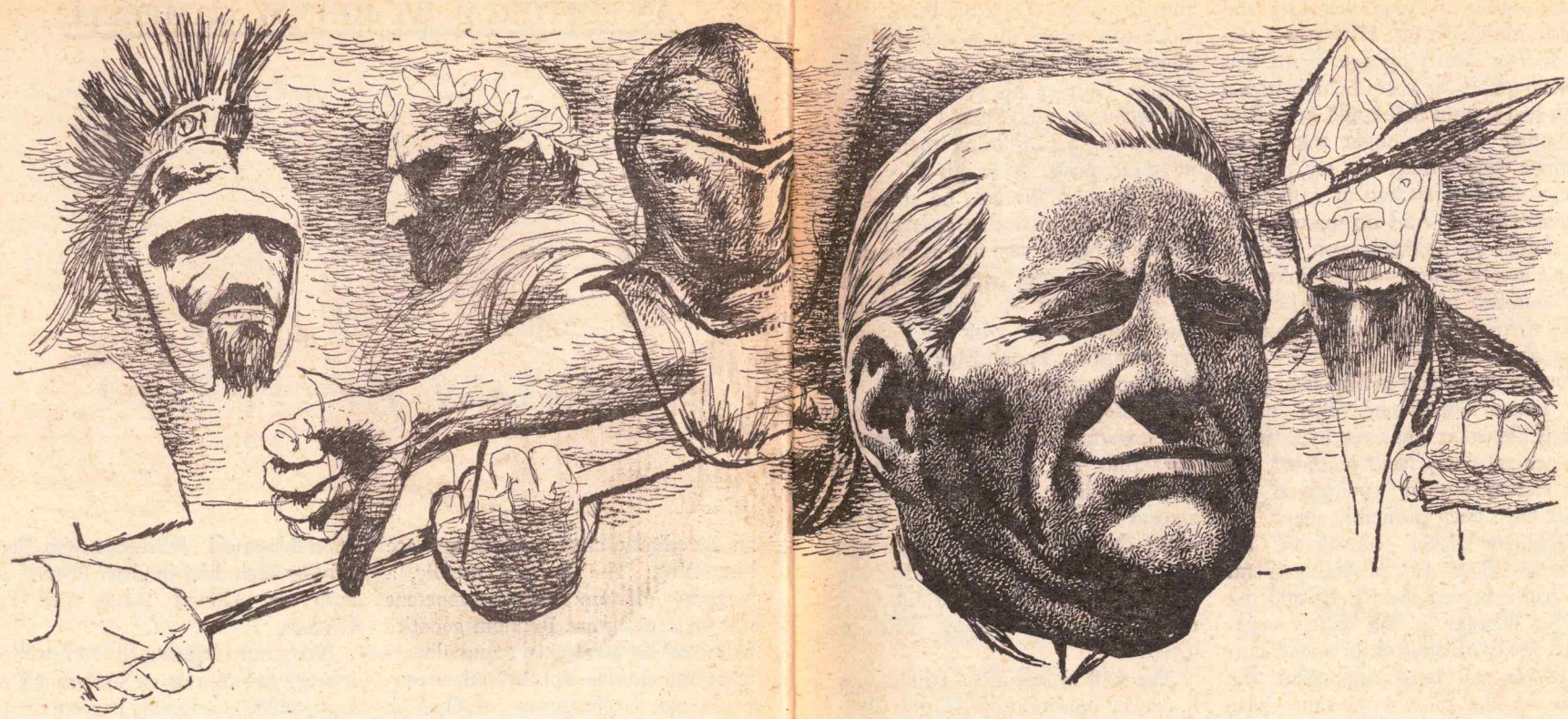
Scanning Roman history—the *Encyclopaedia Britannica* does a good job of boiling the enormously complex picture down to a sort of cartoon outline, a caricature of the portrait, so to speak—you'll find that mechanism at work through every stage of Roman development.

And you'll find it at work in every other historical civilization, too. Specifically including modern history, in both the United States and the U.S.S.R.

No culture is going to work well if it seeks to suppress its individuals of high talent; it doesn't pay to try to oppress men who are smarter than you are yourself. You can enslave someone who is stronger than you are, or more numerous—but things are going to get into extremely bad trouble if you try it with the individuals who are smarter than you.

A government can work, and work well, which denies the vote to 80% of its people—provided that 80% is simply strong, determined, courageous, numerous, but stupid. That is, in fact, the situation that has obtained in each of the world's histori-

«*Continued on page 174*»



# THE GREAT GRAY PLAGUE

There is no enemy so hard to fight as a dull gray fog. It's not solid enough to beat, too indefinite to kill, and too omnipresent to escape . . . **BY RAYMOND F. JONES**

■ Dr. William Baker was fifty and didn't mind it a bit. Fifty was a tremendously satisfying age. With that exact number of years behind him a man had stature that could be had in no other way. Younger men, who achieve vast things at, say, thirty-five, are always spoken of with their age as a factor. And no matter what the intent of the connection, when a man's accomplishments are linked to the number of years since he was born there is always a sense of apologia about it.

But when a man is fifty his age is no longer mentioned. His name stands alone on whatever foundation his achievements have provided. He has stature without apology, if the years have been profitably spent.

William Baker considered his years had been very profitably spent. He had achieved the Ph. D. and the D. Sc. degrees in the widely separated fields of electronics and chemistry. He had been responsible for some of the most important radar developments of the World War II period. And now he held a post that was the crowning achievement of those years of study and effort.

On this day of his fiftieth birthday he walked briskly along the corridor of the Bureau building. He paused only when he came to the glass door which was lettered in gold: National Bureau of Scientific Development, Dr. William Baker, Director. He was unable to regard that door without a sense of pride. But he was convinced the pride was thoroughly justifiable.

He turned the knob and stepped into the office. Then his brisk stride came to a pause He closed the door slowly and frowned. The room was empty. Neither his receptionist nor his secretary, who should have been visible in the adjoining room, were at their posts. Through the other open door, at his left, he could see that his administrative assistant, Dr. James Pehrson, was not as his desk.

He had always expected his staff to be punctual. In annoyance that took some of the glint off this day, he twisted the knob of his own office door and strode in.

He stopped just inside the room, and a warm wave of affection welled up within him. All nine members of his immediate staff were gathered around the table in the center of his office. On the table was a cake with pink frosting. A single golden candle burned brightly in the middle of the inscription: Happy Birthday, Chief.

The staff broke into a frighteningly off-key rendition of "Happy Birthday to You." William Baker smiled fondly, catching the eye of each of them as they badgered the song to its conclusion.

Afterward, he stood for a moment, aware of the moisture in his own eyes, then said quietly, "Thank you. Thank you very much, Family. This is most unexpected. None of you will ever know how much I appreciate your thoughtfulness."

"Don't go away," said Doris Quist, his blond and efficient secretary. "There's more. This is from all of us."



He opened the package she offered him. A genuine leather brief case. Of course, the Government didn't approve of gifts like this. If he observed the rules strictly, he ought to decline the gift, but he just couldn't do that. The faces of Doris and the others were glowing as he held up the magnificent brief case. This was the first time such a thing had occurred in his office, and a man hit fifty only once.

"Thanks so much for remembering," Baker said. "Things like this and people like you make it all worth while."

When they were all gone he sat down at his desk to take up the day's routine. He felt a little twinge of guilt at the great satisfaction that filled him. But he couldn't help it. A fine family, an excellent professional position—a position of prominence and authority in the field that interested him most—what more could a man want?

His meditation was interrupted by the buzzing of the interphone. Pehrson was on the other end. "Just reminding you, Chief," the assistant said. "Dr. Fenwick will be in at nine-thirty regarding the request for the Clearwater grant. Would you like to review the file before he arrives?"

"Yes, please," said Baker. "Bring everything in. There's been no change, no new information, I suppose?"

"I'm afraid not. The Index is hopelessly low. In view of that fact there can be no answer but a negative one. I'm sorry."

"It's all right. I can make Fenwick understand, I'm sure. It may take a little time, and he may erupt a bit, but it'll work out."

Baker cut off and waited while Pehrson came in silently and laid the file folders of the offending case on the desk. Pehrson was the epitome of owl-eyed efficiency, but now he showed sympathy behind his great horn-rimmed spectacles as he considered Baker's plight. "I wish we could find some way to make the Clearwater research grant," he said. "With just a couple of good Ph.D.'s who had published a few things, the Index would be high enough—"

"It doesn't matter. Fenwick is capable of handling his own troubles." Pehrson was a good man, but this kind of solicitousness Baker found annoying.

"I'll send him in as soon as he comes," Pehrson said as he closed the door behind him.

Baker sighed as he glanced at the folder labeled, Clearwater College. Jerkwater is what it should be, he thought. He almost wished he had let Pehrson handle Fenwick. But one couldn't neglect old friends, even though there was nothing that could be done for shortsighted ones.

Baker's memories shifted. He and Fenwick had gone to school together. Fenwick had always been one to get off into weird wide alleys, mostly dead ended. Now he was involved in what was probably the most dead ended of all. For the last three years

he had been president of little Jerkwater—Clearwater College, and he seemed to have some hope that NBSD could help him out of the hole.

That was a mistake many people made. Baker sometimes felt that half his time was spent in explaining that NBSD was not in the business of helping people and institutions out of holes. It was in the business of buying for the United States Government the best scientific research available in the world.

Fenwick wanted help that would put Clearwater College on its feet through a research contract in solid state physics. Fenwick, thought Baker, was dreaming. But that was Fenwick.

The President of Clearwater College entered the outer office promptly at nine-thirty. Pehrson greeted him, and Doris showed him into Baker's office.

Dr. John Fenwick didn't look like a college president, and Baker, unknowingly, held this vaguely against him, too. He looked more like a prosperous small business man and gave the impression of having just finished a brisk workout on the handball court, and a cold shower. He was ruddy and robust and ill-equipped with academic dignity.

Baker pumped his hand as if genuinely glad to see him. "It's good to see you again, John. Come on over and sit down."

"I'll bet you hoped I'd break a leg on the way here," said Fenwick. He took a chair by the desk and glanced at the file folder, reading the title Clearwater College. "And you've been hoping my application would get lost and the whole thing would just disappear."

"Now, look, John—" Baker took his own seat behind the desk. Fenwick had always had a devilish knack for making him feel uncomfortable.

"It's all right," said Fenwick, waving away Baker's protests with a vigorous flap of his hand. "I know Clearwater isn't MIT or Cal Tech, but we've got a real hot physics department, and you're going to see some sparks flying out of there if you'll give us half a chance in the finance department. What's the good word, anyway? Do we get the research grant?"

Baker took a deep breath and settled his arms on the desk in front of him, leaning on them for support. He wished Fenwick wasn't so abrupt about things.

"John," Baker said slowly. "The head of your physics department doesn't even have a Ph. D. degree."

Fenwick brightened. "He's working on that, though! I told you that in answer to the question in the application. Bill, I wish you'd come down and see that boy. The things he can do with crystals would absolutely knock your hat off. He can stack them just like a kid stacking building blocks—crystals that nobody else has ever been able to manipulate so far. And the electrical characteristics of some of them—you wouldn't believe the transistors he's been able to build!"



"John," said Baker patiently. "The head of the physics department in any institution receiving a grant must have a Ph. D. degree. That is one absolutely minimum requirement."

"You mean we've got to wait until George finishes his work for his degree before we get the grant? That puts us in kind of a predicament because the work that we hoped to have George do under the grant would contribute towards his degree. Can't you put it through on the basis that he'll have his degree just as soon as the present series of experiments is completed?"

Baker wiped his forehead and looked down at his hands on the desk. "I said this is *one* minimum requirement. There are others, John."

"Oh, what else are we lacking?" Fenwick looked crestfallen for the first time.

"I may as well be blunt," said Baker. "There is no conceivable way in which Clearwater College can be issued a research grant for *anything*—and especially not for basic research in any field of physical science."

Fenwick just stared at him for a minute as if he couldn't believe what he had heard, although it was the thing he had expected to hear since the moment he sat down.

He seemed deflated when he finally spoke. "I don't think it was the intent of the Congressional Act that made these funds available," he said, "that only the big, plush outfits should get all the gravy. There are plenty of smaller schools just like Clearwater who have first rate talent in their science departments. It isn't fair to freeze us out completely—and I don't think it's completely legal, either."

"Clearwater is not being frozen out. Size has nothing to do with the question of whether an institution receives a grant from NBSD or not."

"When did you last give a grant to a college like Clearwater?"

"I am afraid we have never given a grant to a college—like Clearwater," said Baker carefully.

Fenwick's face began to grow more ruddy. "Then will you tell me just what is the matter with Clearwater, that we can't get any Government research contract when every other Tom, Dick, and Harry outfit in the country can?"

"I didn't state my case in exactly those terms, John, but I'll be glad to explain the basis on which we judge the qualifications of an institution to receive a grant from us."

Baker had never done this before for any unsuccessful applicant. In fact, it was the policy of the Bureau to keep the mysteries of the Index very carefully concealed from the public. But Baker wanted Fenwick to know what had hung him. It was the one more or less merciful thing he could do to show Fenwick what was wrong, and might be sufficient to shake him loose from his dismal association with Clearwater.

Baker opened the file folder and Fenwick saw now that it was considerably fuller than he had first sup-

posed. Baker turned the pages, which were fastened to the cover by slide fasteners. Chart after chart, with jagged lines and multicolored areas, flipped by under Baker's fingers. Then Baker opened the accordian folds of a four-foot long chart and spread it on the desk top.

"This is the Index," he said, "a composite of all the individual charts which you saw ahead of it. This Index shows in graphical form the relationship between the basic requirements for obtaining a research grant and the actual qualifications of the applicant. This line marks the minimum requirement in each area."

Baker's finger pointed to a thin, black line that crossed the sheet. Fenwick observed that most of the colored areas and bars on the chart were well inside the area on Baker's side of the line. He guessed that the significance of the chart lay in this fact.

"I take it that Clearwater College is in pretty sad shape, chartwise," said Fenwick.

"Very," said Baker.

"Can you tell me how these charts are compiled?"

Baker turned back to the sheaf of individual charts. "Each item of data, which is considered significant in evaluating an applicant, is plotted individually against standards which have been derived from an examination of all possible sources of information."

"Such as?"

"For example, the student burden per faculty Ph. D. That is shown on this chart here."

"The what? Say that again," said Fenwick in bewilderment.

"The number of students enrolled, plotted against the number of doctorate degrees held by the faculty."

"Oh."

"As you see, Clearwater's index for this factor is dismally low."

"We're getting a new music director next month. She expects to get her doctorate next summer."

"I'm afraid that doesn't help us now. Besides, it would have to be in a field pertinent to your application to have much weight."

"George—"

"Doesn't help you at all for the present. You would require a minimum of two in the physics department alone. These two would have to be of absolutely top quality with a prolific publication record. That would bring this factor to a bare minimum."

"You take the number of Ph. D.'s and multiply them by the number of papers published and the years of experience and divide by the number of students enrolled. Is that the idea?"

"Roughly," said Baker. "We have certain constants which we also inject. In addition, we give weight to other factors such as patents applied for and granted. Periods of consultation by private industry, and so on. Each of these factors is plotted separately, then combined into the overall Index."

Baker turned the pages slowly, showing Fenwick a bleak record of black boundary lines cutting through nearly virginal territory on the charts.



Clearwater's evaluation was reflected in a small spot of color near the bottom edge.

Fenwick stared at the record without expression for a long time. "What else do you chart?" he said finally.

"The next thing we evaluate is the performance of students graduated during the past twenty-five years."

"Clearwater is only ten years old," said Fenwick.

"True," said Baker, "and that is why, I believe, we have obtained such an anomalous showing in the chart of this factor."

Fenwick observed that the colored area had made a considerable invasion on his side of the boundary on this chart. "Why anomalous? It looks like we make a pretty good showing here."

"On the face of it, this is true," Baker admitted. "The ten-year record of the graduates of Clearwater is exceptional. But the past decade has been unusual in the scope of opportunities, you must admit."

"Your standard level must take this into account."

"It does. But somehow, I am sure there is a factor we haven't recognized here."

"There might be," said Fenwick. "There might be, at that."

"Another factor which contributes to the Index," said Baker, "is the cultural impact of the institution upon the community. We measure that in terms of the number and quality of cultural activities brought into the community by the university or college. We include concerts, lectures, terpsichorean activities, Broadway plays, and so on."

"Terpsichorean activities. I like that," said Fenwick.

"Primarily ballet," said Baker.

"Sure."

"Clearwater's record here is very low. It fact, there isn't any."

"This helps us get turned down for a research grant in physics?"

"It's a factor in the measurement of the overall status."

"Look," said Fenwick, "the citizens of Clearwater are so infernally busy with their own shindigs that they wouldn't know what to do if we brought a long-hair performance into town. If it isn't square-dancing in the Grange Hall, it's a pageant in the Masonic Temple. The married kids would probably like to see a Broadway play, all right, but they're so darned busy rehearsing their own in the basement of the Methodist Church that I doubt they could find time to come. Besides that, there's the community choir every Thursday, and the high school music department has a recital nearly every month. People would drop dead if they had any more to go to in Clearwater. I'd say our culture is doing pretty good."

"Folk activities are always admirable," said Baker," but improvement of the cultural level in any community depends on the injection of outside influences, and this is one of the functions of the university. Clearwater College has not performed its obligation to the community in this respect."

Fenwick appeared to be growing increasingly ruddy. Baker thought he saw moisture appearing on Fenwick's forehead.

"I know this is difficult to face," said Baker sympathetically, "but I wanted you to understand, once and for all, just how Clearwater College appears to the completely objective eye."

Fenwick continued to stare at him without comment. Then he said flatly, "Let's see some more charts, Bill."

"Museum activities. This is an important function of a college level institution. Clearwater has no museum."

"We can't afford one, in the first place. In the second place, I think you've overlooked what we do have."

"There *is* a Clearwater museum?" Baker asked in surprise.

"Two or three hundred of them, I guess. Every kid in the county has his own collection of arrowheads, birds' eggs, rocks, and stuffed animals."

"I'm not joking, John," said Baker bleakly. "The museum aspect of the college is extremely important."

"What else?" said Fenwick.

"I won't go into everything we evaluate. But you should be aware of several other factors pertaining to the faculty, which are evaluated. We establish an index of heredity for each faculty member. This is primarily an index of ancestral achievement."

Fenwick's color deepened. Baker thought it seemed to verge on the purple. "Should I open the window for a moment?" Baker asked.

Fenwick shook his head, his throat working as if unable to speak. Then he finally managed to say, "Apart from the sheer idiocy of it, how did you obtain any information in this area?"

Baker ignored the comment, but answered the question. "You filled out forms. Each faculty member filled out forms."

"Yeah, that's right. I remember. Acres of forms. None of us minded if it was to help get the research grant. We supposed it was the usual Government razzmatazz to keep some GS-9 clerk busy."

"Our forms are hardly designed to keep people busy. They are designed to give us needed information about applicant institutions."

"And so you plot everybody's heredity."

"As well as possible. You understand, of course, that the data are necessarily limited."

"Sure. How do our grandpas stack up on the charts?"

"Not very well. Among Clearwater's total faculty of thirty-eight there were no national political figures through three generations back. There was one mayor, a couple of town councilmen, and a state senator or two. That is about all."

"Our people weren't very politically minded."

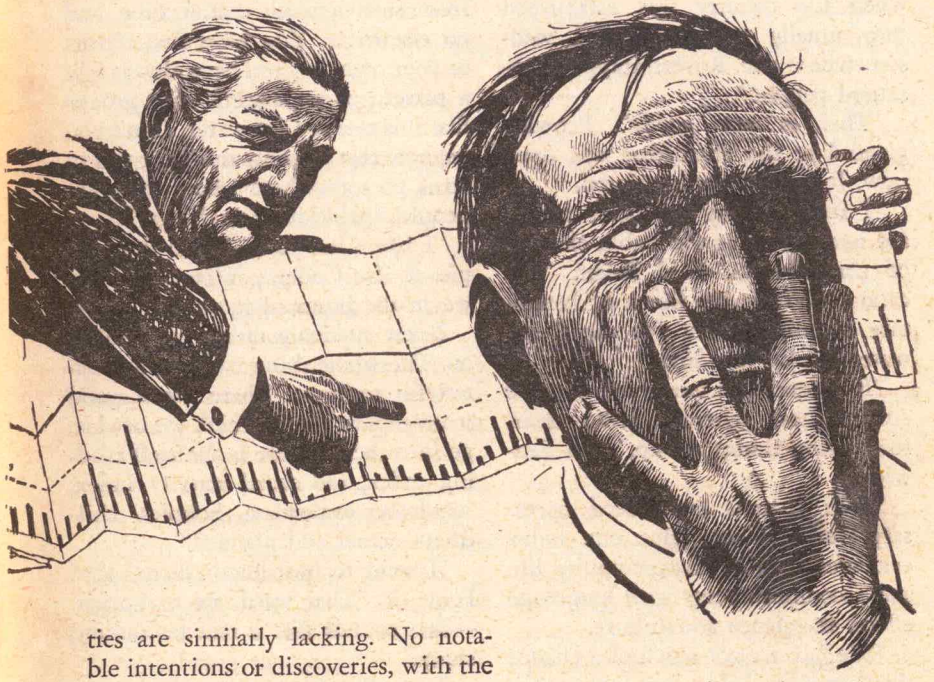
"This is a measure of social consciousness and contemporary evaluation."

Fenwick shrugged. "As I said, we aren't so good at politics."

"Achievements in welfare activities are similarly lacking. No notable intentions or discoveries, with the exception of one patent on a new kind of beehive, appear in the record."



*. . . But liars figure . . . !*



"And this keeps us from getting a research grant in physics? What *did* our progenitors do, anyway? Get hung for being horse thieves?"

"No criminal activities were reported by your people, but there is a record of singular restlessness and dissatisfaction with established conditions."

What did they do?"

"They were constantly on the move, for the most part. In the

ILLUSTRATED BY SCHOENHERR

eighteenth and nineteenth centuries they were primarily pioneers, frontiersmen, settlers of new country. But when the country was established they usually packed up and went somewhere else. Rovers, trappers, unsettled people."

"This is not good?" Fenwick glanced at the chart that was open now. It was almost uncolored.

"I regret to say that such people are not classed as the stable element of communities," said Baker. "We cannot evaluate the index of hereditary accomplishment for the Clearwater faculty very high."

"It appears that our grandpas were among those generally given credit for getting things set up," said Fenwick.

"Such citizens are indeed necessary," said Baker. "But our index evaluates stability in community life and accomplishments with longrange effects in science and culture."

"We haven't got much of a chance then, grandpa being foot-loose as he was."

"Other factors could completely override this negative evaluation. You see, this is the beauty of the Index; it doesn't depend on any one factor or small group of factors. We evaluate the whole range of factors that have anything to do with the situation. Weaknesses in one spot may be counterbalanced by strength in others."

"It looks like Clearwater is staffed by a bunch of bums without any strong spots."

"I wouldn't say it in such terms, but the reason I am pointing these things out to you, John, is to try to persuade you to disassociate yourself from such a weak organization and go elsewhere. You have fine talents of your own, but you have always had a pattern of associating with groups like this one at Clearwater. Don't you see now that the only thing for you to do is go somewhere where there are people capable of doing things?"

"I *like* Clearwater. I like the people at the College. Where else are we in the bums category?"

Baker suddenly didn't want to go on. The whole thing had become distasteful to him. "There are a good many others. I don't think we need to go into them. There is the staff reading index, the social activity index, wardrobe evaluation, hobbies, children—actual and planned."

"I want to hear about them," said Fenwick. "That wardrobe evaluation —that sounds like a real fascinating study."

"Actually, it's comparatively minor," said Baker. "Our psychologists have worked out some extremely interesting correlations, however. Each item of a man's wardrobe is assigned a numerical rating. Tuxedo, one or more. Business suits, color and number. Hunting jackets. Slacks. Sport coats. Work shoes. Dress shoes. Very interesting what our people can do with such information."

"Clearwater doesn't rate here?"

Baker indicated the chart. "I'm afraid not. Now, this staff reading index is somewhat similar. You recall the application forms asked for the number of pages of various types of material read during the past six months—scientific journals, newspapers, magazines, fiction."

"I suppose Clearwater is a pretty illiterate bunch," said Fenwick.

Baker pointed soundlessly to the graph.

"Hobbies and social activities are not bad," Baker said, after a time. "Almost up to within ten points of the standard. A few less bingo parties and Brownie meetings and that many more book reviews or serious soirees would balance the social activity chart. If the model railroad club were canceled and a biological activity group substituted, the hobby classification would look much better. Then, in the number of children, actual and planned, Clearwater is definitely out of line, too. You see, the standard takes the form of the well-known bell-shaped curve. Clearwater is way down on the high side."

"Too much biological activity already," Fenwick murmured.

Baker looked up. "What was that? I didn't hear what you said."

Fenwick leaned back and extended his arms on the desk. "I said your whole damned Index is nothing but a bunch of pseudo-intellectual garbage."

Baker felt the color rising in his face, but he forced himself to remain calm. After a moment of silence he said. "Your emotional feelings are understandable, but you must remember that the Index permits us to administer accurately the National Science Development Act. Without the scientific assurance of the Index there would be no way of determining where these precious funds could best be utilized."

"You'd be better off putting the money on the ponies," said Fenwick. "Sometimes they win. As it stands, you've set it up for a sure loss. You haven't got a chance in the world."

"You think Clearwater College could make better use of some of our funds than, say, MIT?"

"I wouldn't be surprised. Don't get me wrong. I'm not saying the boys at MIT or Cal Tech or a lot of other places couldn't come up with a real development in the way of a fermodacular filter for reducing internucleated cross currents. But the real breakthroughs—you've closed your doors and locked them out."

"Who have we locked out? We've screened and fine combed the resources of the entire country. We know exactly where the top research is being conducted in every laboratory in the nation."

Fenwick shook his head slowly and smiled. "You've forgotten the boys working in their basements and in their back yard garages. You've forgotten the guys that persuade the wife to put up with a busted-down automatic washer for another month so they can buy another hundred bucks worth of electronic parts. You've remembered the guys who have Ph. D.'s for writing 890-page dissertations on the Change of Color in the Nubian Daisy after Twilight,

but you've forgotten guys like George Durrant, who can make the atoms of a crystal turn handsprings for him."

Baker leaned back in his chair and smiled. He almost wished he hadn't wasted the effort of trying to show Fenwick. But, then, he had tried. And he would always have regretted it if he hadn't.

"You're referring now to the crackpot fringe?" he said.

"I suppose so," said Fenwick. "I've heard it called that before."

"One of the things, above all else, which the Index was designed to accomplish," said Baker, "was the screening out of all elements that might be ever so remotely associated with the crackpot fringe. And believe me, you'll never know how strong it is in this country! Every two-bit tinkerer wants a handout to develop his world-shaking gadget that will suppress the fizz after the cap is removed from a pop bottle, or adapt any apartment-size bathtub for raising tropical fish."

"You ever heard of the flotation process?" said Fenwick abruptly.

Baker frowned at the sudden shift of thought. "Of course—"

"What would the world be like without the flotation process?"

"The metals industry would be vastly different, of course. Copper would be much scarcer and higher priced. Gold—"

"A ton of ore and maybe a pound of recovered metal, right?" said Fenwick. "Move a mountain of waste to get anything of value. Crush millions of tons of rock and float out the pinpoint particles of metal on bubbles of froth."

"That's a rough description of what happens."

"You've heard of high-grading."

"Of course. A somewhat colloquial term used in mining."

"The high-grader takes a pick and digs for anything big enough to see and pick up with his hands. He doesn't worry about the small stuff that takes sweat and machinery to recover."

"I suppose so. I fail to see the significance—"

"You're high-grading, Bill," said Fenwick. He leaned across the desk and spoke with bitter intensity. "You're high-grading and you should be using a flotation process."

Fenwick slowly drew back in his chair. Baker felt overwhelmed by the sudden intensity he had never before seen displayed in John Fenwick. Any reaction on his part seemed suddenly inadequate. "I fail to see any connection—," he said finally.

Fenwick looked at him steadily. "Human creativeness can be mined only by flotation methods. It's in low-grade ore. Process a million stupid notions and find a pin point of genius. Turn over enormous wastes of human thought and recover a golden principle. But turn your back on these mountains of low-grade material and you shut out the wealth of creative thought that is buried in them. More than that, by high-grading only where rich veins have appeared in the past, you're mining lodes that have played out."



"An ingenious analogy," said Baker, recovering with a smile now. "But it's hardly an accurate or applicable one. The human mind is not a piece of precious metal found in a mountain of ore. Rather, it's an intricate device capable of producing computations of unbelievable complexity. And we know how such devices that are superior in function are produced, and we know what their characteristics are. We also know that such a device does not 'play out'. If it is superior in function, it can remain so for a long time."

"High-grading," said Fenwick. "And the vein is played out. You'll never find the thing you're looking for until you develop means of processing low-grade material."

Baker watched Fenwick across the desk. He was weary of the whole thing. He certainly had no need to prove himself to this man. He had simply tried to do Fenwick a favor, and Fenwick had thrown it right back in his face. Yet there was a temptation to go on, to prove to Fenwick the difference between their two worlds. Fenwick belonged to a world compounded of inevitable failure. The temptation to show him, to try again to lift him out of it was born of a kind of pity for Fenwick.

Baker's own life had arrowed decisively, without waver, to a goal that was as correct as the tolerances of human error could make it. He often permitted himself the pride of considering his mind somewhat as a computer that had been programmed through a magnificent gene inheritance to drive irresistibly toward the precise goals he had reached. But Fenwick—Fenwick was still fumbling around in a morass of uncertainty. After years of erratic starts and stops he was now confusedly trying to make something out of that miserable little institution called Clearwater College.

It wasn't particularly friendship that urged Baker to show Fenwick. Their friendship was of a breed that Baker had never quite been able to define to his own satisfaction. It seemed to him there was a sort of deadly fascination in associating with a man who walked so blindly, who was so profoundly incapable of understanding his own blindness and peril.

"I'm going to show you," Baker said abruptly, "exactly what it would mean if we were to do as you suggest. I'll show you what it would be like to give attention to every half-wit and crackpot that comes begging for a handout." He switched the intercom and spoke into it. "Doris, please bring in the Ellerbee file. Yes—the crackpot section."

He switched off. "Doris has her own quaint but quite accurate way of cataloguing our various applications," he explained.

In a moment the secretary entered and placed the file on the desk. "There's a new letter in there," she said. "Dr. Pehrson initialed it. He said you didn't want to be bothered any more with this case."

"That's right."

Baker opened the file and shoved it toward Fenwick. "This boy has a gadget he wants us to look at. Doesn't really need any money, he says. That's the kind we really have to be on guard against. If we looked at his wonder gadget, we'd be pestered for a million-dollar handout for years to come."

"What's he got?" Fenwick asked.

"Some kind of communication device, he says. He claims it's nothing but a grown crystal which you hold in your hand and talk to anybody anywhere on Earth."

"Sounds like it wouldn't take much to find out whether he's got anything or not. Just let him put on a five-minute demonstration."

"But multiply that five minutes by a thousand, by ten thousand. And once you let them get their teeth into you, it doesn't stop with five minutes. It goes on into reams of letters and years of time. No, you have to stop this kind of thing before it ever starts. But take a look at some of this material in the file and you'll see what I mean."

Fenwick picked up the top letter as Baker pushed the file toward him. "He starts this one by saying, 'Dear Urban.' Is that what he calls you? What does he mean?"

"Who knows? He's a crackpot, I told you. Who cares what he means, anyway. We've got far more important things to worry about."

Fenwick scanned the letter a moment, then looked up, a faint smile on his face. "I know what he means. Urban—Pope Urban—was the one responsible for the persecutions of Galileo."

Baker shrugged embarrassedly. "I told you he was a crackpot. Delusions of grandeur and of persecution are typical."

"This boy may not be as crazy as he sounds. You're giving him a pretty good imitation of a Galileo treatment—won't even look at his device. He says here that 'Since you have previously refused to examine my device and have questioned my reliability as an observer, I have obtained the services of three unbiased witnesses, whose affidavits, signed and notarized, are attached. These men are the Fire Chief, the Chief of Police, and the Community Church Pastor of Redrock, all of whom testify that they did see my device in full operation this past week. I trust that this evidence will persuade you that an investigation should be made of my device. I fail to see how the bullheadedness and cocksureness of your office can withstand any more of the evidence I have to offer in support of my claims.'"

"A typical crackpot letter," said Baker. "He tries to be reasonable, but his colors are soon shown when he breaks down into vituperative language like a frustrated child."

Fenwick thumbed through the large pile of correspondence. "I'd say anybody would likely blow his stack a good deal harder than this if he'd been trying to get your attention this long. Why didn't he ever send you one of his gadgets in the mail?"



"Oh, he did," said Baker. "That was one of the first things he did."

"What did you do?"

"Sent it back. We always return these things by registered return mail."

"Without even trying it out?"

"Of course."

"Bill, that isn't even reasonable. These earlier letters of his describe the growing of these crystals. He tells exactly how he does it. He knows what he's talking about. I'd like to see him and see his crystal."

"That's what I was hoping you'd say! All we have to do is get Doris to give him a call and he'll be here first thing in the morning. You can be our official investigator. You can see what it's like dealing with a crackpot!"

James Ellerbee was a slim man, impetuous and energetic. Fenwick liked him on sight. He was not a technical man; he was a farmer. But he was an educated farmer. He had a degree from the State Agricultural College. He dabbled in amateur radio and electronics as a hobby.

"I'm certainly glad someone is finally willing to give me a break and take a look at my device," he said as he shook Fenwick's hand. "I've had nothing but a runaround from this office for the past eight months. Yet, according to all the publicity, this is where the nation's scientific progress is evaluated."

Fenwick felt like a hypocrite. "We get pretty overloaded," he said lamely.

They were in Baker's office. Baker watched smugly from behind his desk. Ellerbee said, "Well, we might as well get started. All you have to do, Mr. Fenwick, is hold one of these crystal cubes in your hand. I'll go in the other office and close the door. It may help at first if you close your eyes, but this is not really necessary."

"Wait," said Fenwick. Somehow he wanted to get away from Baker while this was going on. "I'd like to take it outside, somewhere in the open. Would that be all right?"

"Sure. Makes no difference where you try it," said Ellerbee. One place is as good as another."

Baker waved a hand as they went out. "Good luck," he said. He smiled confidently at Fenwick.

As far as Fenwick could see, the crystal was not even potted or cased in any way. The raw crystal lay in his hand. The striations of the multitude of layers in which it was laid down were plainly visible.

Ellerbee dropped Fenwick off by the Jefferson memorial, then drove on about a mile. Still in sight, he stopped the car and got out. Fenwick saw him wave a hand. Nothing happened.

Fenwick glanced down at the crystal in his hand. About the size of a child's toy block. He could almost understand Baker's position. It *was* pretty silly to suppose this thing could have the powers Ellerbee said it had. No electric energy applied. It merely amplified the normal telepathic impulses existing in every human mind, Ellerbee said. Fenwick

sighed. You just couldn't tell ahead of time that a thing wasn't going to pan out. He knew his philosophy was right. These had to be investigated—every lousy, crackpot one of them. You could never tell what you were missing out on unless you did check.

He squeezed harder on the crystal, as Ellerbee had told him to do.

It was just a little fuzzy at first, fading and coming back. Then it was there, shimmering a little, but steady. The image of Ellerbee standing in front of him, grinning.

Fenwick glanced down the road. Ellerbee was still there, a mile away. But he was also right there in front of him, about four feet away.

"It shakes you up a little bit at first," said Ellerbee. "But you get used to it after a while. Anyway, this is it. Are you convinced my device works?"

Fenwick shook his head to try to clear it rather than to give a negative answer. "I'm convinced *something* is working," he said. "I'm just not quite sure what it is."

"I'll drive across town," Ellerbee offered. "You can see that distance makes no difference at all. Later, I'll prove it works clear across the country if you want me to."

They arranged that proof of Ellerbee's presence on the other side of the city could be obtained by Fenwick's calling him at a drug store pay phone. Then they would communicate by means of the cubes.

It was no different than before.

The telephone call satisfied Fenwick that Ellerbee was at least ten miles away. Then, within a second, he also appeared to be standing directly in front of Fenwick.

"What do you want?" said Fenwick finally. "What do you want the Bureau to do about your device? How much money do you want for development?"

"Money? I don't need any money!" Ellerbee exploded. "All I want is for the Government to make some use of the thing. I've had a patent on it for six months. The Patent Office had sense enough to give me a patent, but nobody else would look at it. I just want somebody to make some use of it!"

"I'm sure a great many practical applications can be found," Fenwick said lamely. "We'll have to make a report, first, however. There will be a need for a great many more experiments—"

But most important of all, Baker would have to be shown. Baker would have to *know* from his own experience that this thing worked.

Fenwick suddenly wanted to get away from Ellerbee as much as he had from Baker a little earlier. There was just so much a man's aging synapses could stand, he told himself. He had to do a bit of thinking by himself. When Ellerbee drove up again, Fenwick told him what he wanted.

Ellerbee looked disappointed but resigned. "I hope this isn't another runaround, Mr. Fenwick. You'll pardon me for being blunt, but I've had some pretty raw treatment from your office since I started writing about my communicator."

"I promise you this isn't a runaround," said Fenwick, "but it's absolutely necessary to get Dr. Baker to view your demonstration. We will want to see your laboratories and your methods of production. I promise you it won't be more than two or three days, depending on Dr. Baker's busy schedule."

"O.K. I'll wait until the end of the week," said Ellerbee. "If I don't hear something by then, I'll go ahead with my plans to market the crystals as a novelty gadget."

"I'll be in touch with you. I promise," said Fenwick. He stood by the curb and watched Ellerbee drive away.

Fenwick moved slowly back to his own car and sat behind the wheel without starting the motor. It seemed a long time since nine-thirty yesterday morning, when he had come in to Baker's office to check on the grant he had known Baker wasn't going to give him. Now, merely by kicking Baker's refuse pile with his toe, so to speak, he had turned up a diamond that Baker was ready to discard.

Fenwick felt a sudden surge of revulsion. How was it possible for such a blind, ignorant fool as Baker to be placed in the position he was in? How could the administrative officers of the United States Government be responsible for such misjudgment? Such maladministration, if performed consciously, would be sheer treason. Yet, unconsciously and ignorantly, Baker's authority was perpetuated, giving him a stranglehold on the creative powers of the nation.

Fenwick tried to recall how he and Baker had become friends—so long ago, in their own college days. It wasn't that there was any closeness or common interest between them, yet they seemed to have drawn together as two opposites might. They were both science majors at the time, but their philosophies were so different that their studies were hardly a common ground.

Fenwick figuratively threw away the textbook the first time the professor's back was turned. Baker, Fenwick thought, never took his eyes from its pages. Fenwick distrusted everything that he could not prove himself. Baker believed nothing that was not solidly fixed in black and white and bound between sturdy cloth covers, and prefaced by the name of a man who boasted at least two graduate degrees.

Fenwick remembered even now his first reaction to Baker. He had never seen his kind before and could not believe that such existed. He supposed Baker felt similarly about him, and, out of the strange contradiction of their worlds, they formed a hesitant friendship. For himself, Fenwick supposed that it was based on a kind of fascination in associating with one who walked so blindly, who was so profoundly incapable of understanding his own blindness and peril.

But never before had he realized

the absolute danger that rested in the hands of Baker. And there must be others like him in high Government scientific circles, Fenwick thought. He had learned long ago that Baker's kind was somewhere in the background in every laboratory and scientific office.

But few of them achieved the strangling power that Baker now possessed.

The Index! Fenwick thought of it and gagged. Wardrobe evaluation! Staff reading index! The reproductive ratio—social activity index—the index of hereditary accomplishment—multiply your ancestors by the number of technical papers your five-year old children have produced and divide by the number of book reviews you attend weekly—

Fenwick slumped in the seat. We hold these truths to be self-evident—that the ratio of sports coats to tuxedos in a faculty member's closet shall determine whether Clearwater gets to do research in solid state physics, whether George Durrant gives his genius to the nation or whether it gets buried in Dr. William Baker's refuse pile.

But not only George Durrant. Jim Ellerbee, too. And how many others?

Something had to be done.

Fenwick hadn't realized it before, but this was the thought that had been churning in his cortex for the last hour. Something had to be done about Bill Baker.

But, short of murder, what?

Getting rid of Baker physically was not the answer, of course. If he



were gone, a hundred others like him would fight for his place.

Baker had to be shown. He had to be shown that high-grading was costing him the very thing he was trying to find. It must be proven to him that flotation methods work as well in mining human resources as in mining metal. That the extra trouble paid off.

This was known—a long time ago—Baker thought. Somewhere along the way things got changed. He glanced toward the Jefferson Memorial. Tom Jefferson knew how it should be, Tom Jefferson, statesman, farmer, writer, and amateur mechanic and inventor. It was not only every gentleman's privilege, it was also his duty to be a tinkerer and amateur scientist, no matter what else he might be.

Fenwick glanced in the distance toward the Lincoln Memorial. Abe had done his share of tinkering. His weird boot-strap system for hoisting river boats off shoals and bars hadn't amounted to much, but Abe knew the principle that every man has the right to be his own scientist.

And then there was Ben Franklin, the noblest amateur of them all! He had roamed these parts, too.

Somewhere it had been lost. The Bill Bakers would have laughed out of existence the great tinkerers like Franklin and Lincoln and Jefferson. And the Pasteurs and the Mendels—and the George Durrants and the Jim Ellerbees, too.

Fenwick started the car. Something had to be done about Bill Baker.

Baker leaned back in his chair and laughed heartily. "So it worked, did it? He showed you something that made you think he had a real working device."

"There was no 'think' about it," said Fenwick. "I saw it with my own eyes. That boy's got something terrific!"

Baker sobered and thumbed through the Ellerbee file again. "Any freshman math major could poke holes all through this mathematical explanation he offers. Right? Secondly, a device such as he claims to have produced violates all the basic laws of science. Why, it's even against the Second Law of Thermodynamics!"

"I don't care what it's against," said Fenwick. "It works. I want you to come with me to Ellerbee's and see for yourself. His device will revolutionize communications."

Baker shook his head sadly. "It's always tougher when they show you something that seems to work. Then you've got to waste a lot of time looking for the gimmick if you're going to follow it through. I just haven't got the time—"

"You've got to, Bill!"

"I'll tell you what I'll do. You go out there and look over his setup. If you can't find his gimmick in half a day, I'll come out and show it to you. But I warn you, some of these things are very tricky—like the old perpetual motion machines. You've got to have your wits about you. Is that fair enough?"

"Fair enough," Fenwick agreed.

Baker smiled broadly. "I'll do even more. If this Ellerbee device should prove to be on the level, I'll give you the research grant you want for Clearwater."

"I'm not so sure I want it on those terms," said Fenwick.

"Well, it's a purely academic matter. You won't have to worry about it. But, on the other hand, I'll expect you to agree that when Ellerbee is exposed you'll not persist in your request to this office."

"Well, now—"

"That's a fair offer. I'm giving you a chance to prove I'm wrong in setting up the Index to screen out people like Ellerbee—"

"—And institutions like Clearwater."

"And institutions like Clearwater," Baker agreed.

"All right," said Fenwick. "I'll gamble with you—for one more stake: If Ellerbee's device is on the level, you'll make a grant to Clearwater *and* other institutions of like qualifications, and you'll scrap that insane Index—"

Baker tapped the desk placatingly. "The grant to Clearwater, yes. As for the Index, if it should fail in its applicability to this clear-cut Ellerbee case I would be the first to want to know why. But I assure you there is no flaw in the Index. It has been tried too many thousands of times."

Ellerbee's place was in Virginia, in a dairying area in the hills. The last ten miles of the road were not the kind to attract visitors. The road was steep and narrow in places that turned sharply around the hillsides. No guardrails blocked the descent into the steep gullies. It was definitely a region for people who liked solitude. The farms that lay in the valleys of the hills were neat and well-cared for, however. The people Fenwick passed on the road didn't look like the recluse type.

Ellerbee's farm was one of the best looking in the vicinity. It had the look of being cared for by a man who could do everything. The huge barn and the corrals were as neat as a garden, and the large white frame farmhouse stood out like a monument against the green pasture.

A woman and two children were in the garden beside the house as Fenwick drove up. "May I help you? I'm Mrs. Ellerbee," the woman said.

Fenwick explained who he was and his purpose in coming. "Jim's been expecting you," the woman said. "His laboratory is the long white building back of the house. He's out there now."

Jim Ellerbee met him at the door. "You didn't bring Dr. Baker," he said almost accusingly.

"Later," said Fenwick. "I came, as I promised. Dr. Baker wants my report on your facilities and production methods. Then he will come up to make his own inspection."

There was doubt in Ellerbee's eyes, as if he was used to such stories. "Maybe it would be best if I marketed the crystals in any form I can," he said.



He led Fenwick through a number of rooms of expensive, precision electronic equipment. Then they passed through a set of double doors, which Fenwick observed acted as a thermal lock between the crystal growing room and the rest of the building. It reminded him of George Durrant's laboratory at Clearwater.

"This is where the crystals are grown," said Ellerbee. "I suppose you're familiar with such processes. Here we must use a very precisely controlled sequence of co-crystallization to get layers of desired thickness—"

Fenwick wasn't listening. He had suddenly observed the second man in the room, a rather small, swarthy man, who moved with quiet precision among a row of tanks on the far side of the room. There was a startling quality about the man that Fenwick was unable to define, a strangeness.

Ellerbee caught the direction of his glance. "Oh," he said. "You must meet my neighbor, Sam Atkins. Sam is in this as deep or even deeper than I am. I think perhaps he's more responsible for the communicator crystals."

The man turned as his name was mentioned, and came toward them. "You were the one who developed the crystals," he said in a soft, persuasive voice, to Jim Ellerbee.

"This is my setup," Ellerbee explained with a wave of his hand to indicate the laboratory surroundings. "But Sam has been working with me for about a year on this thing. When Sam moved in, we found we were both radio hams and electronic bugs. I'd been fooling around with crystal growing, trying to design some new type transistors. Then Sam suggested some experiments in co-crystallization —using different chemicals that will crystallize in successive layers in one crystal.

"We stumbled on one combination that made a terrific amplifier. Then we found it would actually radiate to a distant point all by itself. Finally, we discovered that its radiation was completely nonelectromagnetic. There is no way we have yet found of detecting the radiation from the crystal—except by means of another piece of the same crystal.

"I know it's against all the rules in the books. It just doesn't make sense. But there it is. It works."

Sam Atkins had turned away for a moment to attend to one of the tanks, but Fenwick found himself intensely aware of the man's presence. There was nothing he could put his finger on. He just knew, with such intense certainty, that Sam Atkins was *there.*

"What does Mr. Atkins do?" Fenwick asked. "Does he have a dairy farm, too?"

Ellerbee nodded. "His place is right next to mine. Since we started this project Sam has practically lived here, however. He's a bachelor, and so he takes most of his meals with us."

"Seems strange—" Fenwick mused, "two men like you, way out here in the country, doing work on a level with that of the best crystal labs in the country. I should think you'd

both rather be in academic or industrial work."

Ellerbee smiled and looked up through the windows to the meadows beyond. "We're *free* out here," he said.

Fenwick thought of Baker. "You are that," he said.

"You said you wanted to investigate the whole production process. We'll start here, if you like, and I'll show you every step in our process. This tank contains an ordinary alum solution. We start building on a seed crystal of alum and continue until we reach a precise thickness. Here is a solution of chrome alum. You'll note the insulated tanks. Room temperature is maintained within half a degree. The solutions are held to within one-tenth of a degree. Crystal dimensions must be held to tolerances of little more than the thickness of a molecule—"

The gimmick to fool him and cheat him. Where was it? Fenwick asked himself. Baker was sure it was here. If so, where could it be? There was no trickery in the crystal laboratory—unless it was the trickery of precision refinement of methods. Only men of great mechanical skill could accomplish what Ellerbee and his friend were doing. Genius behind the milking machine! Fenwick could almost sympathize with Baker in his hiding behind the ridiculous Index. Without some such protection a man could encounter shocks.

The crackpot fringe.

Where else would credence have been given to the phenomenon of a crystal that seemed to radiate in a nonelectromagnetic way?

But, of course, it couldn't actually be doing that. All the books, all the authorities, and the known scientific principles said it couldn't happen. Therefore, it wouldn't have happened—outside the crackpot fringe.

If Ellerbee and Atkins weren't trying to foist a deliberate deception, where were they mistaken? It was possible for such men as these to make an honest mistake. That would more than likely turn out to be the case here. But how could there be a mistake in the production of a phenomenon such as Fenwick had witnessed? How could that be produced through some error when it couldn't even be done by known electronic methods—not just as Fenwick had seen it.

Throughout the morning Ellerbee led him down the rows of tanks, explaining at each step what was happening. Sometimes Sam Atkins offered a word of explanation also, but always he stayed in the background. The two farmers showed Fenwick how they measured crystal size down to the thickness of a molecule while the crystals were growing.

A sudden suspicion crossed Fenwick's mind. "If those dimensions are so critical, how did you determine them in the first place?"

"Initially, it was a lucky accident," said Sam Atkins.

"Very lucky," said Fenwick, "if you were able to accidentally obtain a crystal of fifteen layers or so and have each layer even approximately correct."

Sam smiled blandly. "Our first crystals were not so complex, you understand. Only three layers. We thought we were building transistors, then. Later, our mathematics showed us the advantage of additional layers and gave us the dimensions."

The mathematics that Baker said a kid could poke holes in. Fenwick didn't know. He hadn't checked the math.

Where was the gimmick?

In the afternoon they took him out for field tests again. A rise behind the barn was about a mile from a similar rise on Sam Atkins' place. They communicated across that distance in all the ways, including various kinds of codes, that Fenwick could think of to find some evidence of hoax. Afterwards, they returned to the laboratory and sawed in two the crystals they had just used. Then they showed him the tests they had devised to determine the nature of the radiation between the crystals.

He did not find the gimmick.

By the end of the day Ellerbee seemed beat, as if he'd been under a heavy strain all day long. And then Fenwick realized that was actually the case. Ellerbee wanted desperately to have someone believe in him, believe in his communication device. Not only had he used all the reasoning power at his command, he had been straining physically to induce Fenwick to believe.

Through it all, however, Sam Atkins seemed to remain bland and utterly at ease, as if it made absolutely no difference to him, whatever.

"I guess we've just about shot our wad," said Ellerbee. "That's about all we've got to show you. If we haven't convinced you by now that our communicator works, I don't know how we can accomplish it."

Had they convinced him? Fenwick asked himself. Did he believe what he had seen or didn't he? He had been smug in front of Baker after the first demonstration, but now he wondered how much he had been covered by the same brush that had tarred Baker.

It wasn't easy for him to admit the possibility of nonelectromagnetic radiation from these strange crystals, radiation which could carry sight and sound from one point to another without any transducers but the crystals themselves.

"You have to step out of the world you've grown accustomed to," said Sam Atkins very quietly. "This is what we have had to do. It's not hard now to comprehend that telepathic forces of the mind can be directed by this means. This is a new pattern. Think of it as such. Don't try to cram it into the old pattern. Then it's easy."

A new pattern. That was the trouble, Fenwick thought. There couldn't really be any new patterns, could there? There was only one basic pattern, in which all the phenomena of the universe fit. He readily admitted that very little was known about that pattern, and many things believed true were false. But the Second Law of Thermodynamics. *That* had to be

true—invariably true—didn't it?

If there was a hoax, Baker would have to find it.

"I'll be back with Dr. Baker in a couple of days," Fenwick said. "After that, the one final evidence we'll need will be to construct these crystals in our own laboratories, entirely on our own, based on your instructions."

Ellerbee nodded agreement. "That would suit us just fine."

Hypnotism," said Baker. "It sounds like some form of hypnotism, and I don't like that kind of thing. It could merit criminal prosecution."

"There's no possible way I could have been hypnotized," said Fenwick.

"These crystals—obviously it has something to do with them. But I wonder what their game is, anyway? It's hard to see where they can think they're headed."

"I don't know," said Fenwick. "But you promised to show me the gimmick if I couldn't find it in half a day. I spent a whole day out there without finding anything."

Baker slapped the desk in exasperation. "You're not really going to make me go out there and look at this fool thing, are you? I know I made a crazy promise, but I was sure you could find where they were hoaxing you if you took one look at their setup. It's probably so obvious you just stumbled right over it without even seeing it was there."

"Possibly. But you're going to have to show me."

"John, look—"

"Or, I *might* be willing to take that Clearwater research grant without any more questions on either side."

Baker thought of the repercussions that would occur in his own office, let alone outside it, if he ever approved such a grant. "All right," he sighed. "You've got me over a barrel. I'll drive my car. I may have to stop at some offices on the other side of town."

"I might be going on, rather than coming back to town," said Fenwick. "I ought to have my car, too. Suppose I meet you out there?"

"Good enough. Say one o'clock. I'm sure that will give us more time than we need."

Baker was prompt. He arrived with an air of let's-get-this-over-as-quick-as-possible. He nodded perfunctorily as Ellerbee introduced his wife. He scarcely looked at Sam Atkins.

"I hope you've got your demonstration all set up," he said. He glanced at the darkening sky. "It looks like we might get some heavy rain this afternoon."

"We're all ready," said Ellerbee. "Sam will drive over to that little hill on his farm, and we'll go out behind the barn."

On the knoll, Baker accepted the crystal cube without looking at it. Clenching it in his fist, he put his hand in his pocket. Fenwick guessed he was trying to avoid any direct view and thus avoid the possibility of hypnotic effects. This seemed pretty farfetched to Fenwick.

Through field glasses Sam Atkins was seen to get out of his car and walk to the top of the knoll. He stood a moment, then waved to signal his readiness.

"Press the crystal in your hand," Ellerbee said to Baker. "Direct your attention toward Sam Atkins."

Each of them had a cube of the same crystal. It was like a party line. Fenwick pressed his only slightly. He had learned it didn't take much. He saw Baker hesitate, then purse his lips as if in utter disgust, and follow instructions.

In a moment the image of Sam Atkins appeared before them. Regardless of their position, the image gave the illusion of standing about four feet in front of them.

"Good afternoon, Dr. Baker," Sam Atkins said.

Fenwick thought Baker was going to collapse.

The director just stood for a moment, like a creature that had been pole-axed. Then his color began to deepen and he turned with robot stiffness. "Did you men hear anything? Fenwick . . . did you hear . . . did you see?"

"Sure," said Fenwick, grinning broadly. "Sam Atkins said good afternoon to you. It would be polite if you answered him back."

The image of Sam Atkins was still before them. He, too, was grinning broadly. The grins infuriated Baker.

"Mr. Atkins," said Baker.

"Yes, Dr. Baker," said Sam Atkins.

"If you hear me, wave your hands. I will observe you through the field glasses."

"The field glasses won't be necessary."

Both the image before them, and the distant figure on the knoll were seen to wave arms and gyrate simultaneously. For good measure, Sam Atkins turned a cartwheel.

Baker seemed to have partly recovered. "There seems to be a very remarkable effect present here," he said cautiously.

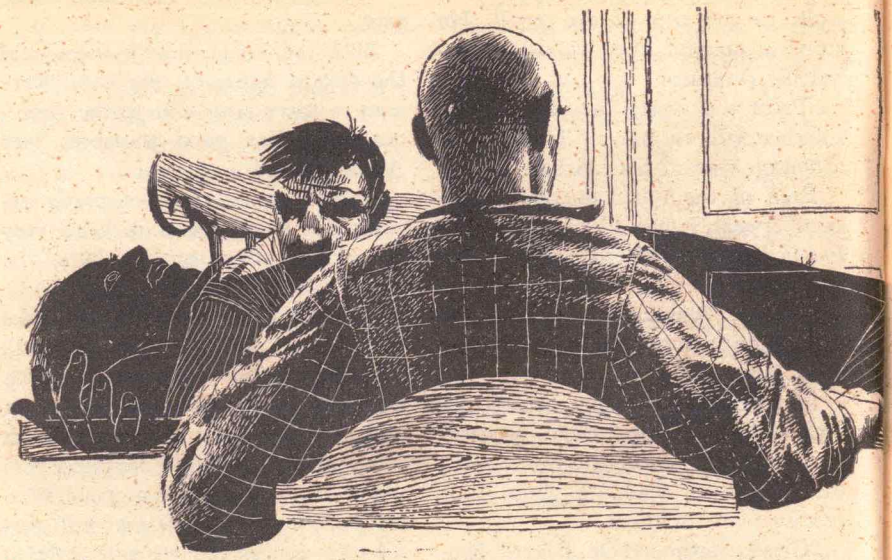
"Dr. Baker," Jim Ellerbee spoke earnestly, "I know you're skeptical. You don't think the crystals do what I say they do. Even though you see it with your own eyes you doubt that it is happening. I will do anything possible to test this device to your satisfaction. Name the test that will dispel your doubts and we will perform it!"

"It's not entirely a question of demonstration, Mr. Ellerbee," said Baker. "There are the theoretical considerations as well. The mathematics you have submitted in support of your claim are not, to put it mildly, sound."

"I know. Sam keeps telling me that. He says we need an entirely new math to handle it. Maybe we'll get around to that. But the important thing is that we've got a working device."

"Your mathematical basis *must* be sound!" Baker's fervor returned. Fenwick felt a sudden surge of pity for the director.

The demonstration was repeated a dozen times more. Fenwick went over on Sam Atkins' hill. He and Baker conversed privately.



"Do you see it yet?" Fenwick asked.

"No, I'm afraid I don't!" Baker was snappish. "This is one of the most devilish things I've ever come across!"

"You don't think it's working the way Jim and Sam say it is?"

"Of course not. The thing is utterly impossible. I am convinced a hypnotic condition is involved, but I must admit I don't see how."

"You may figure it out when you go through Ellerbee's lab."

Baker was obviously shaken. He spoke in subdued tones as Ellerbee started the tour of the crystal lab again. Baker's eyes took in everything. As the tour progressed he seemed to devour each new item with frenzied intensity. He inspected the crystals through a microscope. He checked the measurements of the thickness of the growing crystal layers.

The rain began while they were in the crystal lab. It beat furiously on the roof of the laboratory building, but Baker seemed scarcely aware that it was taking place. His eyes sought out every minute feature of the building. Fenwick was sure he was finding nothing to confirm his belief that the communicator crystals were a hoax.

Fenwick hadn't realized it before, but he recognized now that it would be a terrific blow to Baker if he couldn't prove the existence of a hoax.

Proof that the communicator crystals were all they were supposed to be would be a direct frontal attack on the sacred Index. It would blast a



*. . . "Presence," with the crystals, was not a physical thing . . .*

hole in Baker's conviction that nothing of value could come from the crackpot fringe. And, not least of all, it would require Baker to issue a research grant to Clearwater College.

What else it might do to Baker, Fenwick could only guess, but he felt certain Bill Baker would never be the same man again.

As it grew darker, Baker looked up from the microscope through which he had been peering. He glanced at the windows and the drenched countryside beyond. "It's been raining," he said.

Mary Ellerbee had already anticipated that the visitors would be staying the night. She had the spare room ready for Baker and Fenwick before dinner. While they ate in the big farmhouse kitchen, Ellerbee explained, "It would be crazy to try to get down to the highway tonight. The county's been promising us a new road for five years, but you see what we've got. Even the oldest citizen wouldn't tackle it in weather like this, unless it was an emergency. You put up for the night with us. You'll get home just as fast by leaving in the morning, after the storm clears. And it will be a lot more pleasant than spending the night stuck in the mud somewhere—or worse."

Baker seemed to accept the invitation as he ate without comment. To Fenwick he appeared stunned by the events of the day, by his inability to find a hoax in connection with the communicator crystals.

It was only when Baker and Fen-

wick were alone in the upstairs bedroom that Baker seemed to stir out of his state of shock.

"This is ridiculous, Fenwick!" he said. "I don't know what I'm doing here. I can't possibly stay in this place tonight. I've got people to see this evening, and appointments early in the morning."

"It's coming down like cats and dogs again," said Fenwick. "You saw the road coming in. It's a hog wallow by now. Your chance of getting through would be almost zero."

"It's a chance I have to take," Baker insisted. He started for the door. "*You* don't have to take it, of course."

"I'm not going to!" said Fenwick.

"But I must!"

Fenwick followed him downstairs, still trying to persuade him of the foolishness of driving back tonight. When Ellerbee heard of it he seemed appalled.

"It's impossible, Dr. Baker! I wouldn't have suggested your not returning if there were any chance of getting through. I assure you there isn't."

"Nevertheless I must try. Dr. Fenwick will remain, and I will come back tomorrow afternoon to complete our investigation. There are important things I must attend to before then, however."

Fenwick had the sudden feeling that Baker was in a flight of panic. His words had an aimless stream-of-consciousness quality that contrasted sharply with his usually precise speech. Fenwick was certain there was nothing sufficiently important that it demanded his attention on a night like this. He could have telephoned his family and had his wife cancel any appointments.

No, Fenwick thought, there was nothing Baker had to go *to*; rather, he was running *from*. He was running in panicky fear from his failure to pin down the hoax in the crystals. He was running, Fenwick thought, from the fear that there might be no hoax.

It seemed incredible that such an experience could trigger so strong a reaction. Yet Fenwick was aware that Baker's attitude toward Ellerbee and his device was not merely one aspect of Baker's character. His attitude in these things *was* his character.

Fenwick dared not challenge Baker with these thoughts. He knew it would be like probing Baker's flesh with a hot wire. There was nothing at all that he could do to stop Baker's flight.

Ellerbee insisted on loaning him a powerful flashlight and a hand lantern, which Baker ridiculed but accepted. It was only after Baker's taillight had disappeared in the thick mist that Fenwick remembered he still had the crystal cube in his coat pocket.

"He's bound to get stuck and spend the night on the road," said Ellerbee. "He'll be so upset he'll never come back to finish his investigation."

Fenwick suspected this was true. Baker would seal off every association and reminder of the communicator crystals as if they were some infection that would not heal. "There's no use beating your brains out trying to get the NBSD to pay attention," Fenwick told Ellerbee. "You've got a patent. Figure out some gadgety use and start selling the things. You'll get all the attention you want."

"I wanted to do it in a dignified way," said Ellerbee regretfully.

*You, too,* Fenwick thought as he moved back up the stairs to the spare bedroom.

Fenwick undressed and got into bed. He tried to read a book he had borrowed from Ellerbee, but it held no interest for him. He kept thinking about Baker. What produced a man like Baker? What made him tick, anyway?

Fenwick had practically abandoned his earlier determination that something had to be done about Baker. There was really nothing that could be done about Baker, Bill Baker in particular—and the host of assorted Bakers scattered throughout the world in positions of power and importance, in general.

They stretched on and on, back through the pages of history and time. Jim Ellerbee understood the breed. He had quite rightly tagged Baker in addressing him as "Dear Urban." Pope Urban, who persecuted the great Galileo, had certainly been one of them.

It wasn't that Baker was ignorant or stupid. He was neither. Fenwick gave reluctant respect to his intelligence and his education. Baker was quick-witted. His head was stuffed full of accurate scientific information from diversified fields.

But he refused to be jarred loose from his fixed position that scientific breakthroughs could come from any source but the Established Authority. The possibility that the crackpot fringe could produce such a breakthrough panicked him. It *had* panicked him. He was fleeing dangerously now through the night, driven by a fear he did not know was in him.

Inflexibility. This seemed to be the characteristic that marked Baker and his kind. Defender of the Fixed Position might well have been his title. With all his might and power, Bill Baker defended the Fixed Position he had chosen, the Fixed Position behind the wall of Established Authority.

A blind spot, perhaps? But it seemed more than mere blindness that kept Baker so hotly defending his Fixed Position. It seemed as if, somehow, he was aware of its vulnerability and was determined to fight off any and all attacks, regardless of consequences.

Fenwick didn't know. He felt as if it was less than hopeless, however, to attempt to change Bill Baker. Any change would have to be brought about by Baker himself. And that, at the moment, seemed far less likely than the well-known snowball in Hades.

Fenwick knew he must have dozed off to sleep with the light still on in the room and Ellerbee's unread book opened over his chest. He did not know what time it was when he

awoke. He was aware only of a suffocating sensation as if some ghostly aura were within the room, filling it, pressing down upon him. A wailing of agony and despair seemed to scratch at his senses although he was certain there was no audible sound. And a depression clutched at his soul as if death itself had suddenly walked unseen through the closed door.

Fenwick sat up, shivering in the sudden coolness of the room, but clammy with sweat over his whole body. He had never experienced such sensations before in his life. His stomach turned to a hard ball under the flow of panic that surged through all his nerves.

He forced himself to sit quietly for a moment, trying to release his fear-tightened muscles. He relaxed the panic in his stomach and looked slowly about the room. He could recall no stimulus in his sleep that had produced such a reaction. He hadn't even been dreaming, as far as he could tell. There was no recollection of any sound or movement within the house or outside.

He was calmer after a moment, but that sensation of death close at hand would not go away. He would have been unable to describe it if asked, but it was there. It filled the atmosphere of the room. It seemed to emanate from—

Fenwick turned his head about. It was almost as if there was some definite source from which the ghastly sensation was pouring over him. The walls—the air of the room—

His eyes caught the crystal on the table by the bed.

He could feel the force of death pouring from it.

His first impulse was to pick up the thing and hurl it as far as he could. Then in saner desperation he leaped from the bed and threw on his clothes. He grabbed the crystal in his hand and ran out through the door and down the stairs.

Jim Ellerbee was already there in the living room. He was seated by the old-fashioned library table, his hand outstretched upon it. In his hand lay the counterpart of the crystal Fenwick carried.

"Ellerbee!" Fenwick cried. "What's going on? What in Heaven's name is coming out of these things?"

"Baker," said Ellerbee. "He smashed up on the road somewhere. He's out there dying."

"Can you be sure? Then don't sit there, man! Let's get on our way!"

Ellerbee shook his head. "He'll be dead before we can get there."

"How do you know he cracked up, anyway? Can you read that out of the crystal?"

Ellerbee nodded. "He kept it in his pocket. It's close enough to him to transmit the frantic messages of his dying mind."

"Then we've got to go! No matter if we get there in time or not."

Ellerbee shook his head again. "Sam is on his way over here. He's in touch with Baker. He says he thinks he can talk Baker back."

"*Talk* him back? What do you mean by that?"



Ellerbee hesitated. "I'm not sure. In some ways Sam understands a lot more about these things than I do. He can do things with the crystals that I don't understand. If he says he can talk Dr. Baker back, I think maybe he can."

"But we can't depend on that!" Fenwick said frantically. "Can't we get on our way in the car and let Sam do what he thinks he can while we drive? Maybe he can get Baker to hold on until we get him to a doctor."

"You don't understand," said Ellerbee. "Dr. Baker has gone over the edge. He's *dying*. I know what it's like. I looked into a dying mind once before. There is nothing whatever that a doctor can do after an organism starts dying. It's a definite process. Once started, it's irreversible."

"Then what does Sam—?"

"Sam thinks he knows how to reverse it."

There wasn't much pain. Not as much as he would have supposed. He felt sure there was terrible damage inside. He could feel the warmth of blood welling up inside his throat. But the pain was not there. That was good.

In place of pain, there was a kind of infinite satisfaction and a growing peace. The ultimate magnitude of this peace, which he could sense, was so great that it loomed like some blinding glory.

This was death. The commitment and the decision had been made. But this was better than any alternative. He could not see how there could have been any question about it.

He was lying on his back in the wet clay of a bank below the road. It was raining, softly now, and he rather liked the gentle drop of it on his face. Somewhere below him the hulk of his wrecked car lay on its side. He could smell the unpleasant odor of gasoline. But all of this was less than nothing in importance to him now. Somewhere in the back of his mind was a remnant of memory of what he had been doing this day. He remembered the name of John Fenwick, and the memory brought a faint amusement to his bloody lips. There had been some differences between him and John Fenwick. Those differences were also less than nothing, now. All differences were wiped out. He gave himself up to the pleasure of being borne along on that great current that seemed to be carrying him swiftly to a quiet place.

After a time, he remembered two other names, also. James Ellerbee and Sam Atkins. He remembered a crystal, and it meant nothing. He remembered that it was in his pocket and that for some time he had felt a warmth from it, that was both pleasant and unpleasant. It was of no importance. He might have reached for it and thrown it farther from him, but his arm on that side was broken.

He was glad that there was nothing—nothing whatever—that had any magnitude of importance. Even his family—they were like fragments of a long-ago dream.

He lay waiting quietly and patiently for the swiftly approaching destination of ultimate peace. He did not know how long it would take, but he knew it could not be long, and even the journey was sweet.

It was while he waited, letting his mind drift, that he became aware of the intruder. In that moment, the pain boiled up in shrieking agony.

He had thought himself alone. He wanted above all else to be alone. But there was someone with him. He wasn't sure how he knew. He could simply *feel* the unwanted presence. He strained to see in the wet darkness. He listened for muted sounds. There was nothing. Only the presence.

"Go away!" he whispered hoarsely. "Go away, and leave me alone—whoever you are."

"No. Let me take you by the hand, William Baker. I have come to show you the way back. I have come to lead you back."

"Leave me alone! Whoever you are, leave me alone!" Baker was conscious of his own voice screaming in the black night. And it was not only terror of the unknown presence that made him scream, but the physical pain of crushed bones and torn flesh was sweeping like a torrent through him.

"Don't be afraid of me. You know me. You remember, we met this afternoon. Sam Atkins. You remember, Dr. Baker?"

"I remember." Baker's voice was a painful gasp. "I remember. Now go away and leave me alone. You can do nothing for me. I don't want you to do anything for me."

Sam Atkins. The crystal. Baker wished he could reach the cursed thing and hurl it away from him. That must be how Atkins was communicating with him. Yes, somehow it was possible. He had found no trick, no gimmick. Somehow, the miserable things worked.

But what did Sam Atkins want? He had broken in on a moment that was as private as a dream. There was nothing he could do. Baker was dying. He knew he was dying. There was no medicine that could heal the battering his body had taken. He had been slipping away into peace and release of pain. He had no desire to have it interrupted.

There was no more evidence of Sam Atkins' presence. It was there—and Baker wished furiously that Atkins would let his death be a private thing—but he was not interfering now.

There was the faint suggestion of other presences, too. Baker thought he could pick them out, Fenwick and Ellerbee. They were all gathered to watch him die through the crystals. It was unkind of them to so intrude—but it didn't really matter very much. He began drifting pleasantly again.

"William Baker." The soft voice of Sam Atkins shattered the peaceable realm once more. "We must do some healing before we start back, Dr. Baker. Give me your hand, and come with me, Dr. Baker, while we touch



these tissues and heal their breaks. Stay close to me and the pain will not be more than you can endure."

The night remained dark and there was no sound, but Baker's body arched and twisted in panic as he fought against invisible hands that seemed to touch with fleeting, exploratory passes over him.

"I don't want to be healed," he whispered. "There is nothing that can be done. I'm dying. I want to die! Can't you understand that? I want to die! I don't want your help!"

He had said it. And the shock of it jolted even him in the depths of his half-conscious mind. Could a man really *want* to die?

Yes.

He had forgotten what terror he had left so far behind. He knew only that he wanted to move forever in the direction of the flowing peace.

Like probing fingers, Sam Atkins' mind continued to touch him. It scanned the broken organs of his body, and, in some kind of detached way, Baker felt that he was accompanying Atkins on that journey of exploration, even as Sam had asked.

They searched the skeleton and found the splintered bones. They examined the muscle structure and found the torn and shattered tissue. They searched the dark recesses of his vital organs and came to injury that Baker knew was hopeless.

"You built this once," Sam Atkins' voice whispered. "You can build it again. The materials are all here. The blood stream is still moving. The nerve tissue will carry your instructions. I'll supply the scaffolding—while you build—"

He remembered. Baker examined the long-untouched record of when he had done this before. He remembered the construction of cells, the building of organs, the interconnection of nerve tissue. He felt an infinite sadness at the present ruin. Yes—he could build again.

Sam Atkins' face was like that of a dead man. Across the table from him, Jim Ellerbee and John Fenwick watched silently. Faintly, between them was the crystal-projected image of Baker's body.

Fenwick felt the cold touch of some mysterious unknown prickle his scalp. Sam Atkins seemed remote and alien, like the practitioner of ancient and forbidden arts. Fenwick found the question tumbling over and over in his mind, who is this man? He felt as if the very life energy of Sam Atkins was somehow flowing out through the crystal, across space, to the distant broken body of Bill Baker and was supporting it while Baker's own feeble energy was consumed in the rebuilding of his shattered organs.

Though Fenwick and Ellerbee held their own crystals, Sam had somehow shut them out. They were in faint contact with Baker, but they could not follow the fierce contact that Sam's mind held with him.

Ellerbee's face showed worry and a trace of panic. He hesitantly reached out to touch the immobile figure of

Sam Atkins, who sat with closed eyes and imperceptible breath. Fenwick sensed disaster. He arrested the motion of Ellerbee's hand.

"I think you could kill them both," he whispered. The life force of one man, divided between two—it was not sufficient to cope with unexpected shocks to either, now.

Ellerbee desisted. "I've never seen anything like this before," he said. "I don't know what Sam's doing—I don't know how he's doing it—"

Fenwick looked sharply at Ellerbee. Ellerbee had discovered the crystals, so he and Sam said. Yet Sam was able to do things with them that Ellerbee could not conceive. Fenwick wondered just who was responsible for the crystals. And he resolved that some day, when and if Baker pulled out of this, he would learn something more about Sam Atkins.

Time moved beyond midnight and into the early morning hours of the day, but this meant nothing to William Baker. He was in the midst of eternity. Because the old pattern was there, and the ancient memories were clear, his reconstruction moved at a pace that was limited only by the materials available. When these grew scarce, Sam Atkins showed him how to break down and utilize other structures that could be rebuilt leisurely at a later time. There was remembered joy in the building and, once started, Baker gave only idle wonder to the question of whether this was more desirable than death. He did not know. This seemed the right thing to do.

In the presence of Sam Atkins everything he was doing seemed right, and a lifetime of doubts, and errors, and fears seemed distant and vague.

But Sam said suddenly, "It is almost finished. Just a little farther and you'll have to go the rest of the way alone."

Terror struck at Baker. He had reached a point where he was absolutely sure he could *not* go on alone without Sam's supporting presence. "You tricked me!" Baker cried. "You tricked me! You didn't tell me I would have to be reborn alone!"

"Doesn't every man?" said Sam. "Is there any way to be born, except alone?"

Slowly, the world closed in about Baker.

Light. Sounds.

Wet. Cold.

The impact of a million idiot minds. The coursing of cosmic-ray particles. The wrenching of Earth's magnetic and gravitational fields. Old and sluggish memories were renewed, memories meant to be buried for all of his life.

Baker felt as if he were suddenly running down a dark and immense corridor. Behind were all the terrors spawned since the beginning of time. Ahead were a thousand openings of light and safety. He raced for the nearest and brightest and most familiar.

"No," said Sam Atkins. "You cannot go that way again. It is the way you went before—and it led to this—to a search for death. For you, it will lead only to the same goal again."

"I can't go on!" Baker cried. The terrors seemed to be swiftly closing in.

"Take my hand a moment longer," said Sam. "Inspect these more distant paths. There are many of them that will be agreeable to you."

Baker felt calmer now in the renewed presence of Sam Atkins. He passed the branching pathway that Sam had forbidden, that had seemed so bright. He sensed now why Sam had cautioned him against it. Far down, in the depths of it, he glimpsed faintly a dark ugliness that he had not seen before. He shuddered.

Directly ahead there seemed to be the opening of a corridor of blazing brightness. Baker's calmness increased as he approached. "This one," he said.

He heard nothing, but he sensed Sam Atkins' smile and nod of approval.

He remembered now for the first time why he had wanted to die. It was to avoid the very terrors by which he had been pursued through the dark corridor. All this had happened before, and he had gone down the pathway Sam had forbidden. Somehow, like a circle, it had come back to this very point, to this forgotten experience for which he had been willing to die rather than endure again.

It was very bewildering. He did not understand the meaning of it. But he knew he had corrected a former error. He was back in the world. He was alive again.

Sam Atkins looked up at his companions through eyes that seemed all but dead. "He's going to make it," he said. "We can get the car out and pick up Baker now."

They used Sam's panel truck, which had a four-wheel drive and mud tires. Nothing else could possibly get through. Fenwick left his own car at Ellerbee's.

It was still raining lightly as the truck sloshed and slewed through the muck that was hardly recognizable now as a road. For an hour Sam fought the wheel to hold the car approximately in the middle of the brownish ooze that led them through the night. The three men sat in the cab. Behind them, a litter and first-aid equipment had been rigged for Baker. Sam told them nothing would be needed except soap and water, but Fenwick and Ellerbee felt it impossible to go off without some other emergency equipment.

After an hour, Sam said, "He's close. Just around the next bend. That's where his car went off."

Baker loomed suddenly in the lights of the car. He was standing at the edge of the road. He waved an arm wearily.

Fenwick would not have recognized him. And for some seconds after the car had come to a halt, and Baker stood weaving uncertainly in the beam of the lights, Fenwick was not sure it was Baker at all.

He looked like something out of

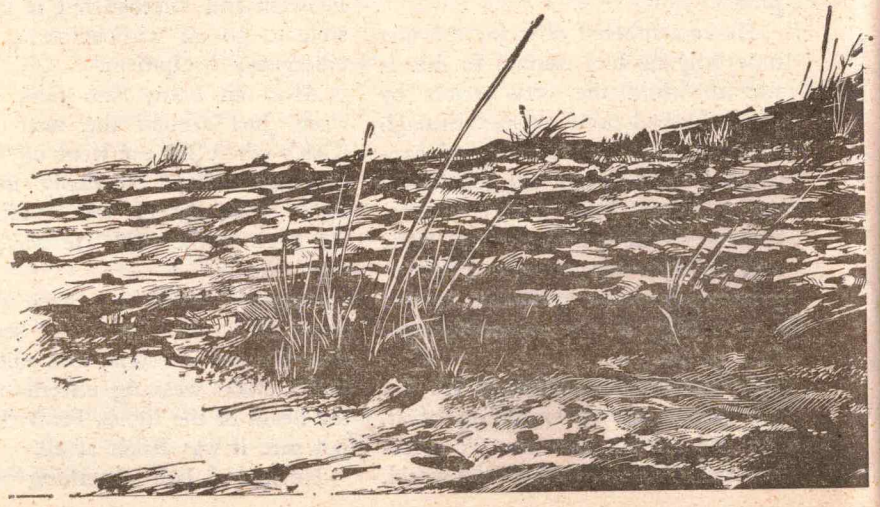
an old Frankenstein movie. His clothes were ripped almost completely away. Those remaining were stained with blood and red clay, and soaked with rain. Baker's face was laced with a network of scars as if he had been slashed with a shower of glass not too long ago and the wounds were freshly healed. Blood was caked and cracked on his face and was matted in his hair.

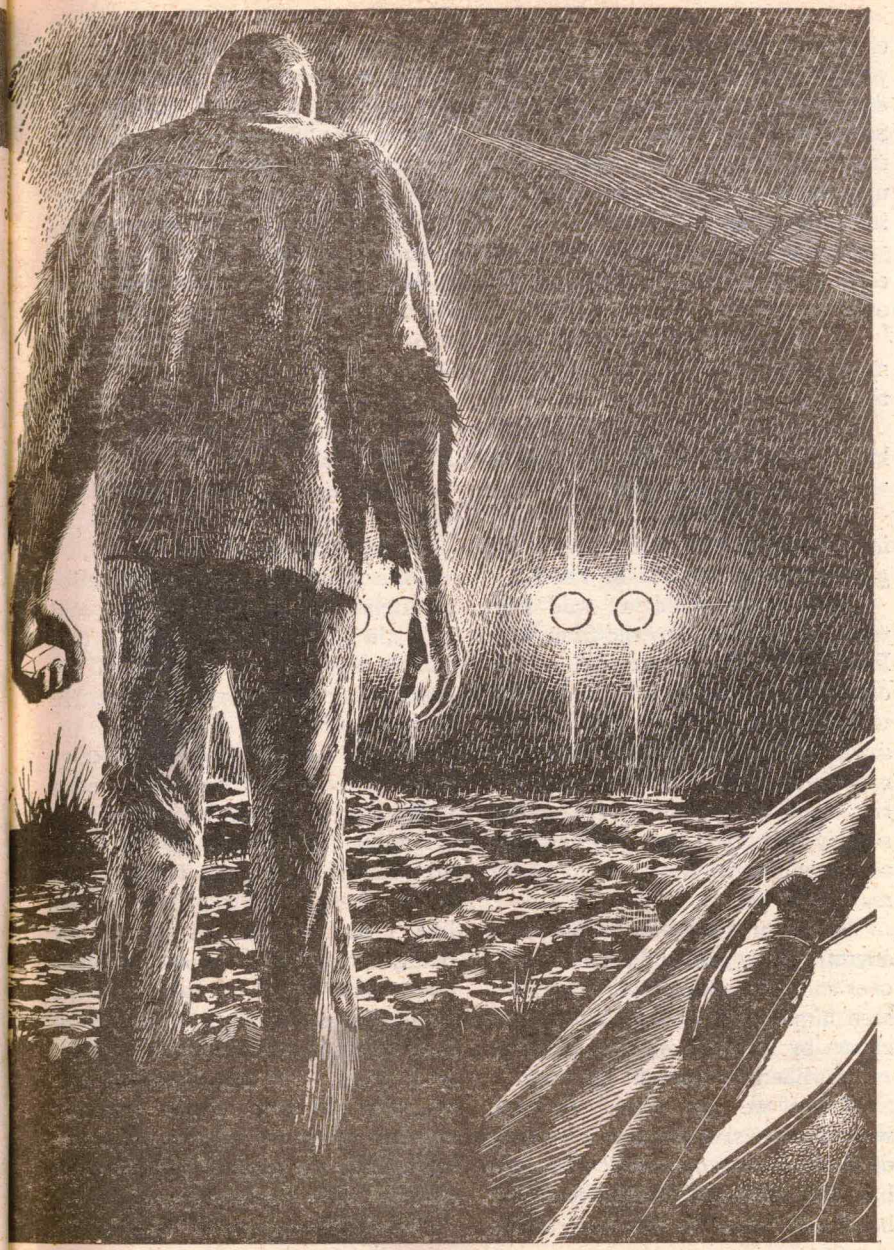
He smiled grotesquely as he staggered toward the car door. "About time you got here," he said. "A man could catch his death of cold standing out here in this weather."

Dr. William Baker was quite sure he had no need of hospitalization, but he let them settle him in a hospital bed anyway. He had some thinking to do, and he didn't know of a better place to get it done.

There was a good deal of medical speculation about the vast network of very fresh scars on his body, the bones which X rays showed to have been only very recently knit, and the violent internal injuries which gave some evidence of their recent healing. Baker allowed the speculation to go on without offering explanations. He let them tap and measure and apply electrical gadgets to their heart's content. It didn't bother the thinking he had to get done.

Fenwick and Ellerbee came back the next day to see him. The two approached the bed so warily that Ba-





ker burst out laughing. "Pull up chairs!" he exclaimed. "Just because you saw me looking a shade less than dead doesn't mean I'm a ghost now. Sit down. And where's Sam? Not that I don't appreciate seeing your ugly faces, but Sam and I have got some things to talk about."

Ellerbee and Fenwick looked at each other as if each expected the other to speak.

"Well, what's the matter?" demanded Baker. "Nothing's happened to Sam, I hope!"

Fenwick spoke finally. "We don't know where Sam is. We don't think we'll be seeing him again."

"Why not?" Baker demanded. But in the back of his mind was the growing suspicion that he knew.

"After your—accident," said Fenwick, "I went back to the farm with Ellerbee and Sam because I'd left my car there. I went back to bed to try to get some more shut-eye, but the storm had started up again and kept me awake. Just before dawn a terrific bolt of lightning seemed to strike Sam's silo. Later, Jim went out to check on his cows and help his man finish up the milking.

"By mid-morning we hadn't heard anything from Sam and decided to go over and talk to him about what we'd seen him do for you. I guess it was eleven by the time we got there."

Jim Ellerbee nodded agreement.

"When we got there," Fenwick went on, "we saw that the front door of the house was open as if the storm had blown it in. We called Sam, but he didn't answer, so we went on in. Things were a mess. We thought it was because of the storm, but then we saw that drawers and shelves seemed to have been opened hastily and cleaned out. Some things had been dropped on the floor, but most of the stuff was just gone.

"It was that way all through the house. Sam's bed hadn't been disturbed. He had either not slept in it, or had gone to the trouble of making it up even though he left the rest of the house in a mess."

"Sounds like the place might have been broken into," said Baker. "Didn't you notify the sheriff?

"Not after we'd seen what was outside, in back."

"What was that?"

"We wanted to see the silo after the lightning had struck it. Jim said he'd always been curious about that silo. It was one of the best in the county, but Sam never used it. He used a pit.

"When we went out, all the cows were bellowing. They hadn't been milked. Sam did all his own work. Jim called his own man to come and take care of Sam's cows. Then we had a close look at the silo. It had split like a banana peel opening up. It hardly seemed as if a bolt of lightning could have caused it. We climbed over the broken pieces to look inside. It was still warm in there. At least six hours after lightning—or whatever had struck it, the concrete was still warm. The bottom and several feet of the sides of the silo were covered with a glassy glaze."

"No lightning bolt did that."



"We know that now," said Fenwick. "But I had seen the flash of it myself. Then I remembered that in my groggy condition that morning something had seemed wrong about that flash of lightning. Instead of a jagged tree of lightning that formed instantly, it had seemed like a thin thread of light striking *upward*. I thought I must be getting bleary-eyed and tried to forget it. In the silo, I remembered. I told Jim.

"We went back through the house once more. In Sam's bedroom, as if accidently dropped and kicked partway under the bed, I found this. Take a look!"

Fenwick held out a small book. It had covers and pages as did any ordinary book. But when Baker's fingers touched the book, something chilled his backbone.

The material had the feel and appearance of white leather—yet Baker had the insane impression that the cells of that leather still formed a living substance. He opened the pages. Their substance was as foreign as that of the cover. The message—printing, or whatever it might be called—consisted of patterned rows of dots, pin-head size, in color. It reminded him of computer tape cut to some character code. He had the impression that an eye might scan those pages and react as swiftly as a tape-fed computer.

Baker closed the book. "Nothing more?" he asked Fenwick.

"Nothing. We thought maybe you had found out something else when he worked to save your life."

Baker kept his eyes on the ceiling. "I found out a few things," he said. "I could scarcely believe they were true. I have to believe after hearing your story."

"What did you find?"

"Sam Atkins came from—somewhere else. He went back in the ship he had hidden in the silo."

"Where did he come from? What was he doing here?"

"I don't know the name of the world he was from or where it is located. Somewhere in this galaxy, is about all I can deduce from my impressions. He was here on a scientific mission, a sociological study. He was responsible for the crystals. I suppose you know that by now?" Baker glanced at Ellerbee.

Jim Ellerbee nodded. "I suspected for a long time that I was being led, but I couldn't understand it. I thought I was doing the research that produced the crystals, but Sam would drop a hint or a suggestion every once in a while, that would lead off on the right track and produce something fantastic. He knew where we were going, ahead of time. He led me to believe that we were exploring together. Do you know why he did this?"

"Yes," said Baker. "It was part of his project. The project consisted of a study of human reaction to scientific processes which our scientific culture considered impossible. He was interested in measuring our flexibility and reaction to such introductions."

Baker smiled grimly. "We sure gave him his money's worth, didn't we! We really reacted when he brought out his little cubes. I'd like to read the report he writes up!"

"Why did he leave so suddenly?" asked Fenwick. "Was he through?"

"No, that's the bad part of it. My reaction to the crystals was a shock that sent me into a suicidal action—"

Fenwick stared at him, shocked. "You didn't—"

"But I did," said Baker calmly. "All very subconsciously, of course, but I did try to commit suicide. The crystals triggered it. I'll explain how in a minute, but since Sam Atkins was an ethical being he felt the responsibility for what had happened to me. He had to reveal himself to the extent of saving my life—and helping me to change so that the suicidal drive would not appear again. He did this, but it revealed too much of himself and destroyed the chance of completing his program. When he gets back home, he's really going to catch hell for lousing up the works. It's too bad."

Jim Ellerbee let out a long breath. "Sam Atkins—somebody from another world—it doesn't seem possible. What things he could have taught us if he'd stayed!"

Fenwick wondered why it had to have been Baker to receive this knowledge. Baker, the High Priest of the Fixed Position, the ambassador of Established Authority. Why couldn't Sam Atkins—or whatever his real name might be—have whispered just a few words of light to a man willing to listen and profit? His bowels felt sick with the impact of opportunity forever lost.

How did the crystals trigger a suicidal reaction?" asked Fenwick finally, as if to make conversation more than anything else.

Baker's face seemed to glow. "That's the really important thing I learned from Sam. I learned that about me—about all of us. It's hard to explain. I experienced it—but you can only hear about it."

"We're listening," said Fenwick dully.

"I saw a picture of a lathe in a magazine a few months ago," said Baker slowly. "You can buy one of these lathes for $174,000, if you want one. It's a pretty fancy job. The lathe remembers what it does once, and afterwards can do it again without any instructions.

"The lathe has a magnetic tape memory. The operator cuts the first piece on the lathe, and the tape records all the operations necessary for that production. After that, the operator needs only to insert the metal stock and press the start button.

"There could be a million memories in storage, and the lathe could draw on any one of them to repeat what it had done before at any time in its history."

"I don't see what this has got to do with Sam and you," said Fenwick.

Baker ignored him. "A long time ago a bit of life came into existence. It had no memory, because it was the first But it faced the universe and mad decisions. That's the difference between life and nonlife. Did you know that, Fenwick? The capacity to make decisions without pre-programming. The lathe is not alive because it must be pre-programmed by the operator. We used to say that reproduction was the criterion of life, but the lathe could be pre-programmed to build a duplicate of itself, complete with existing memories, if that were desired, but that would not make it a living thing.

"Spontaneous decision. A single cell can make a simple binary choice. Maybe nothing more complex than to be or not to be. The decision may be conditioned by lethal circumstances that permit only a 'not' decision. Nevertheless, a decision *is* made, and the cell shuts down its life processes in the very instant of death. They are not shut down for it.

"In the beginning, the first bit of life faced the world and made decisions, and memory came into being. The structures of giant protein molecules shifted slightly in those first cells and became a memory of decisions and encounters. The cells split and became new pairs carrying in each part giant patterned molecules of the same structure. These were memory tapes that grew and divided and spread among all life until they carried un-numbered billions of memories.

"Molecular tapes. Genes. The memory of life on earth, since the beginning. Each new piece of life that springs from parent life comes equipped with vast libraries of molecular tapes recording the experiences of life since the beginning.

"Life forms as complex as mammals could not exist without this tape library to draw upon. The bodily mechanisms could not function if they came into existence without the taped memories out of the ages, explaining why each organ was developed and how it should function. Sometimes, part of the tapes *are* missing, and the organism, if it endures, must live without instructions for some function. One human lifetime is too infinitesimally small to relearn procedures that have taken aeons to develop.

Just as the lathe operator has a choice of tapes which will cause the lathe to function in different ways, so does new life have a choice. The accumulated instructions and wisdom of the whole race may be available, except for those tapes which have been lost or destroyed through the ages. New life has a choice from that vast library of tapes. In its inexperience, it relies on the parentage for the selection of many proven combinations, and so we conclude certain characteristics are 'dominant' or 'inherited,' but we haven't been able to discover the slightest reason why this is so.

"A selection of things other than color of eyes, the height of growth to be attained, the shape of the body must also be made. A choice of modes of facing the exterior world, a choice

of stratagems to be used in attaining survival and security in that world, must be made.

"And there is one other important factor: Mammalian life is created in a universe where only life exists. The mammal in the womb does not know of the existence of the external universe. Somewhere, sometime, the first awareness of this external universe arises. In the womb. Outside the womb. Early in fetal life, or late. When and where this awareness comes is an individual matter. But when it comes, it arrives with lethal impact.

"Awareness brings a million sensory invasions—chemical, physical, extrasensory—none of them understood, all of them terrifying.

"This terrible fear that arises in this moment of awareness and nonunderstanding is almost sufficient to cause a choice of death rather than life at this point. Only because of the developed toughness, acquired through the aeons, does the majority of mammalian life choose to continue.

"In this moment, choices must be made as to how to cope with the external world, how to understand it so as to diminish the fear it inspires. The library of genetic tapes is full of possible solutions. Parental experience is examined, too, and the very sensory impacts that are the source of the terror are inspected to a greater or lesser extent to see how they align with taped information.

"A very basic choice is then made. It may not be a single decision, but, rather, a system of decisions all based on some fundamental underlying principle. And the choice may not be made in an instant. How long a time it may occupy I do not know.

"When the decision has been made, reaction between the individual and the external universe begins, and understanding begins to flow into the data storage banks. As data are stored, and successful solutions found in the encounter with the world, fear diminishes. Some kind of equilibrium is eventually reached, in which the organism decides how much fear it is willing to tolerate to venture farther into areas of the unknown, and how much it is willing to limit its experience because of this fear.

"When the decision has been made, and the point of equilibrium chosen, a personality exists. The individual has shaped himself to face the world.

"And nothing short of a Heavenly miracle will ever change that shape!"

"You have said nothing about how the crystal caused you to attempt suicide," said Fenwick.

"The crystal invalidated the molecular tape I had chosen to provide my foundation program for living. The tape was completely shattered, brought to an end. There was nothing left for me to go on."

"Wait a minute!" said Fenwick. "Even supposing this could happen as you describe it, other programs could be selected out of the great number you have described."

"Quite true. But do you know what happens to an adult human being when the program on which his entire life is patterned is destroyed?"

Fenwick shook his head. "What is it like?"

"It's like it was in the beginning, in that moment of first awareness of the external universe. He is aware of the universe, but has no understanding of it. Previous understanding—or what he thought was understanding—has been invalidated, destroyed. The drive to keep living, that was present in that first moment of awareness, has weakened. The strongest impulse is to escape the terror that follows awareness without understanding. Death is the quickest escape.

"This is why men are inflexible. This is why the Urbans cannot endure the Galileos. This is why the Bill Bakers cannot face the Jim Ellerbees. That was what Sam Atkins wanted to find out.

"If a man should decide his basic program is invalid and decide to choose another, he would have to face again the terror of awareness of a world in which understanding does not exist. He would have to return to that moment of first awareness and select a new program in that moment of overwhelming fear. Men are not willing to do this. They prefer a program—a personality—that is defective, that functions with only a fraction of the efficiency it might have. They prefer this to a basic change of programs. Only when a program is rendered absolutely invalid—as mine was by the crystal communicator—is the program abandoned. When that happens, the average man drives his car into a telephone pole or a bridge abutment, or he steps in front of a truck at a street intersection. I drove into a gully in a storm."

"All this would imply that the tape library is loaded with genetic programs that contain basic defects!" said Fenwick.

Baker hesitated. "That's not quite true," he said finally. "The library of molecular tapes does contain a great many false solutions. But they are false not so much because they are defective as because they are obsolete. All of them worked at one time, under some set of circumstances, however briefly. Those times and circumstances may have vanished long since."

"Then why are they chosen? Why aren't they simply passed over?"

"Because the individual organism lacks adequate data for evaluating the available programs. In addition, information may be presented to him which says these obsolete programs are just the ones to use."

Fenwick leaned against the bed and shook his head. "How could a crazy thing like that come about?"

"Cultures become diseased," said Baker. "Sparta was such a one in ancient times. A more psychotic culture has scarcely existed anywhere, yet Sparta prevailed for generations. Ancient Rome is another example. The Age of Chivalry. Each of these

cultures was afflicted with a different disease.

"These diseases are epidemic. Individuals are infected before they emerge from the womb. In the Age of Chivalry this cultural disease held out the data that the best life program was based on the concept of Honor. Honor that could be challenged by a mistaken glance, an accidental touch in a crowd. Honor that had to be defended at the expense of life itself.

"Pure insanity. Yet how long did it persist?"

"And our culture?" said Fenwick. "There is such a sickness in our times?"

Baker nodded. "There's a disease in our times. A cultural disease you might call the Great Gray Plague. It is a disease which premises that safety, security, and effectiveness in dealing with the world may be obtained by agreement with the highest existing Authority.

"This premise was valid in the days when disobedience to the Head Man meant getting lost in a bog or eaten by a saber-toothed tiger. Today it is more than obsolete. It is among the most vicious sicknesses that have ever infected any culture."

"And you were sick with it."

"I was sick with it. You remember I said a molecular program is chosen partly on the basis of data presented by parental sources and the spears of invasion from the external world. This data that came to me from both sources said that I could deal with the world by yielding to Authority, by surrounding myself with it as with a shell. It would protect me. I would have stature. My world-problems would be solved if I chose this pattern.

"I chose it well. In our culture there are two areas of Authority, one in government, one in science. I covered myself both ways. I became a Government Science Administrator. You just don't get any more authoritative than that in our day and time!"

"But not everyone employs this as a basic premise!" exclaimed Fenwick.

"No—not everyone, fortunately. In that, may be our salvation. In all times there have been a few infected individuals—Pope Urban, for example. But in his time the culture was throwing off such ills and was surging forward under the impetus of men like Galileo.

"In our own time we are on the other end of the stick. We are just beginning to sink into this plague; it has existed in epidemic form only a few short decades. But look how it has spread! Our civil institutions, always weak to such infection, have almost completely succumbed. Our educational centers are equally sick. Approach them with a new idea and no Ph.D. and see what happens. Remember the Greek elevator engineer who did that a few years ago? He battered his way in by sheer force. It was the only way. He became a nuclear scientist. But for every one of his kind a thousand others are defeated by the Plague."



Fenwick was grinning broadly. He suddenly laughed aloud. "You must be crazy in the head, Bill. You sound just like me!"

Baker smiled faintly. "You are one of the lucky ones. You and Jim. It hasn't hit you. And there are plenty of others like you. But they are defeated by the powerful ones in authority, who have been infected.

"It's less than fifty years since it hit us. It may have five hundred years to run. I think we'll be wiped out by it before then. There must be something that can be done, some way to stamp it out."

"Well," said Fenwick. "You could give Clearwater enough to get us on our feet and running. That would be a start in the right direction."

"An excellent start," said Baker. "The only trouble is you asked for less than half of what you need. As soon as I get back to the office a grant for what you need will be on its way."

William Baker stayed in the hospital two more days. Apart from his family, he asked that no visitors be admitted. He felt as if he were a new-born infant, facing the world with the knowledge of a man—but innocent of experience.

He remembered the days before the accident. He remembered how he dealt with the world in those days. But the methods used then were as impossible to him now as if he were paralyzed. The new methods, found in that bright portal to which Sam Atkins had helped guide him, were untried. He knew they were right. But he had never used them.

He found it difficult to define the postulates he had chosen. The more he struggled to identify them, the more elusive they seemed to become. When he gave up the struggle he found the answer. He had chosen a program that held no fixed postulates. It was based on a decision to face the world as it came.

He was not entirely sure what this meant. The age-old genetic wisdom was still available to guide him. But he was committed to no set path. Fresh decisions would be required at every turn.

A single shot of vaccine could not stem an epidemic. His immunity to the sickness of his culture could not immunize the entire populace. Yet, he felt there was something he could do. He was just not sure what it was.

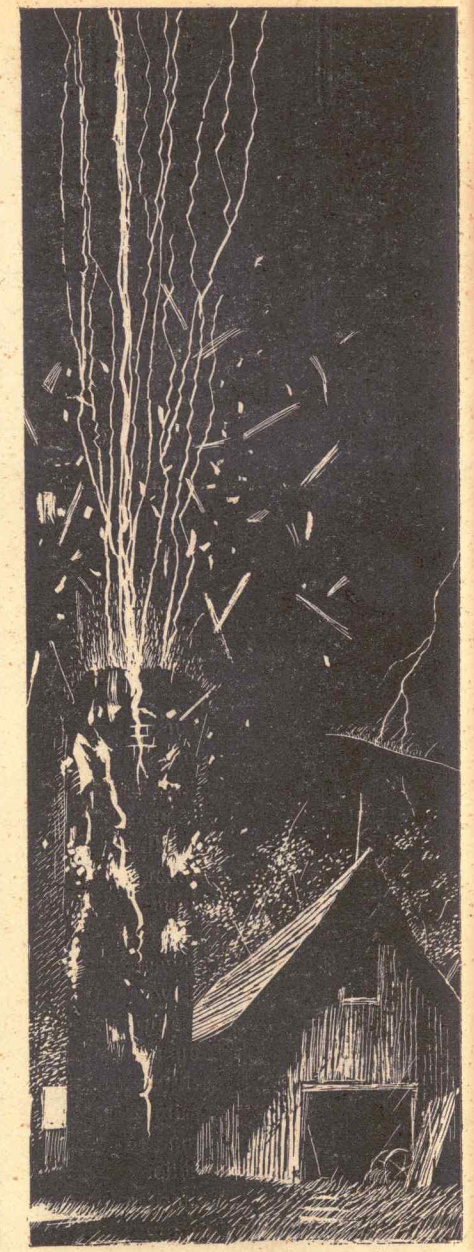
What could a single man do? In other times, a lone man had been enough to overturn an age. But William Baker did not feel such heroic confidence in his own capacity.

He was not alone, however. There were the John Fenwicks and the Jim Ellerbees who were immune to the great Plague. It was just that William Baker was probably the only man in the world who had ever been infected so completely and then rendered immune. That gave him a look at both sides of the fence, which was an advantage no one else shared.

There was something that stuck in his mind, something that Sam Atkins had said that night when Baker had been reborn. He couldn't understand

it. Sam Atkins had said of the molecular program tape that had been broken: When you cease to be fearful of Authority, you become Authority.

The last thing in the whole world William Baker wanted now was to be Authority. But the thought would not leave his mind. Sam Atkins did not say things that had no meaning.



Baker's return to the office of NBSD was an occasion for outpouring of the professional affection which his staff had always tendered him. He knew that there had been a time when this had given him a great deal of satisfaction. He remembered that fiftieth birthday party.

Looking back, it seemed as if all that must have happened to some other man. He felt like a double of himself, taking over positions and

*. . . Lightning doesn't strike up from inside a silo! That's something else . . .*

prerogatives in which he was a complete impostor.

This was going to be harder than he had anticipated, he thought.

Pehrson especially, it appeared, was going to be difficult. The administrative assistant came into the office almost as soon as Baker was seated at his desk. "It's very good to have you back," said Pehrson. "I think we've managed to keep things running while you've been gone, however. We have rejected approximately one hundred applications during the past week."

Baker grunted. "And how many have you approved?"

"Approval would have had to await your signature, of course."

"O.K., how many are awaiting my signature?"

"It has been impossible to find a single one which had a high enough Index to warrant your consideration."

"I see," said Baker. "So you've taken care of the usual routine without any help from me?"

"Yes," said Pehrson.

"There's one grant left over from before I was absent. We must get that out of the way as quickly as possible."

"I don't recall any that were pending—" said Pehrson in apology.

"Clearwater College. Get me the file, will you?"

Pehrson didn't know for sure whether the chief was joking or not. He looked completely serious. Pehrson felt sick at the sudden thought that the accident may have so injured the chief's mind that he was actually serious.

He sparred. "The Clearwater College file?"

"That's what I said. Bring a set of approval forms, too."

Pehrson managed to get out with a placid mask on his face, but it broke as soon as he reached the safety of his own office. It wasn't possible that Baker was serious! The check that went out that afternoon convinced him it was so.

When Pehrson left the office, Baker got up and sauntered to the window, looking out over the smoke-gray buildings of Washington. The Index. He smiled, remembering it. Five years he and Pehrson had worked on that. It had seemed like quite a monumental achievement when they considered it finished. It had never been really finished, of course. Continuous additions and modifications were being made. But they had been very proud of it.

Baker wondered now, however, if they had not been very shortsighted in their application of the Index. He sensed, stirring in the back of his mind, not fully defined, possibilities that had never appeared to him before.

His speculations were interrupted by Doris. She spoke on the interphone, still in the sweetly sympathetic tone she had adopted for her greetings that morning. Baker suspected this would last at least a full week.

Dr. Wily is on the phone. He would like to know if you'd mind his coming in this afternoon. Shall I make an appointment or would you rather postpone these interviews for a few days. Dr. Wily would understand, of course."

"Tell him to come on up whenever he's ready," said Baker. "I'm not doing much today."

President George H. Wily, Ph. D.,

D.Sc., of Great Eastern University. Wily was one of his best customers.

Baker guessed that he had given Wily somewhere around twelve or thirteen million dollars over the past decade. He didn't know exactly what Wily had done with all of it, but one didn't question Great Eastern's use of its funds. Certainly only the most benevolent use would be made of the money.

Baker reflected on his associations with Wily. His satisfaction had been unmeasurable in those exquisite moments when he had had the pleasure of handing Wily a check for two or three million dollars at a time. In turn, Wily had invited him to the great, commemorative banquets of Great Eastern. He had presented Baker to the Alumni and extolled the magnificent work Baker was doing in the advancement of the cause of Science. It had been a very pleasant association for both of them.

The door opened and Doris ushered Wily into the room. He came forward with outstretched hands. "My dear Baker! Your secretary said you had no objection to my coming up immediately, so I took advantage of it. I didn't hear about your terrible accident until yesterday. It's so good to know that you were not more seriously hurt."

"Thanks," said Baker. "It wasn't very bad. Come and sit down."

Wily was a rather large, beetle-shaped man. He affected a small, graying beard that sometimes had tobacco ashes in it.

"Terrible loss to the cause of Science if your accident had been more serious," Wily was saying. "I don't know of anyone who occupies a more critical position in our nation's scientific advance than you do."

This was what had made him feel safe, secure, able to cope with the problems of the world, Baker reflected. Wily represented Authority, the highest possible Authority in the existing scientific culture.

But it had worked both ways, too. Baker had supplied a similar counterpart for Wily. His degrees matched Wily's own. He represented both Science and Government. The gift of a million dollars expressed confidence on the part of the Government that Wily was on the right track, that his activity was approved.

A sort of mutual admiration society, Baker thought.

"I suppose you are interested in the progress on your application for renewal of Great Eastern's grants," said Baker.

Wily waved the subject away with an emphatic gesture. "Not business today! I simply dropped in for a friendly chat after learning of your accident. Of course, if there is something to report, I wouldn't mind hearing it. I presume, however, the processing is following the usual routine."

"Not quite," said Baker slowly. "An increasing flood of applications is coming in, and I'm finding it necessary to adopt new processing methods to cope with the problem."

"I can understand that," said Wily. "And one of the things I have always admired most about your office is your ability to prevent wastage of funds by nonqualified people. Qualifications in the scientific world are becoming tighter every day. You have no idea how difficult it is to get people with adequate backgrounds today. Men of stature and authority seem to be getting rarer all the time. At any rate, I'm sure we are agreed that only the intellectual elite must be given access to these funds of your Bureau, which are limited at best."

Baker continued to regard Wily across the desk for a long moment. Wily was one of them, he thought. One of the most heavily infected of all. Surround yourself with Authority. Fold it about you like a shell. Never step beyond the boundaries set by Authority. This was George H. Wily, President of Great Eastern University. This was a man stricken by the Great Gray Plague.

"I need a report," said Baker. "For our new program of screening I need a report of past performance under our grants. The last two years would be sufficient, I think, from Great Eastern."

Wily was disturbed. He frowned and hesitated. "I'm sure we could supply such a report," he said finally. "There's never been any question—"

"No question at all," said Baker. "I just need to tally up the achievements made under recent grants. I shall also require some new information for the Index. I'll send forms as soon as they're ready."

"We'll be more than glad to cooperate," said Wily. "It's just that concrete achievement in a research program is sometimes hard to pin point, you know. So many intangibles."

"I know," said Baker.

When Wily was gone, Baker continued sitting at his desk for a long time. He wished fervently that he could talk with Sam Atkins for just five minutes now. And he hoped Sam hadn't gotten too blistered by his mentors when he returned home after fluffing the inquiry he was sent out on.

There was no chance, of course, that Baker would ever be able to talk with Sam again. That one fortuitous encounter would have to do for a lifetime. But Sam's great cryptic statement was slowly beginning to make sense: When you cease to be fearful of Authority, you become Authority.

Neither Baker or Wily, or any of the members of Wily's lock-step staff were Authority. Rather, they all gave obeisance to the intangible Authority of Science, and stood together as self-appointed vicars of that Authority, demanding penance for the slightest blasphemy against it. And each one stood in living terror of such censure.

The same ghost haunted the halls of Government. The smallest civil servant, in his meanest incivility, could invoke the same reverence for that unseen mantle of Authority that rested, however falsely, on his thin shoulders.

The ghost existed in but one place,

the minds of the victims of the Plague. William Baker had ceased to recognize or give obeisance to it. He was beginning to understand the meaning of Sam Atkins' words.

He was quite sure the grants to Great Eastern were going to diminish severely.

Within six months, the output from Clearwater College was phenomenal. The only string that Baker had attached to his grants was the provision that the National Bureau of Scientific Development be granted the privilege of announcing all new inventions, discoveries, and significant reports. This worked to the advantage of both parties. It gave the college the prestige of association in the press with the powerful Government agency, and it gave Baker the association with a prominent scientific discovery.

During the first month of operation under the grant, Fenwick appointed a half dozen "uneducated" professors to his physical science staff. These were located with Baker's help because they had previously applied to NBSD for assistance.

The announcement of the developments of the projects of these men was a kind of unearned windfall for both Baker and Fenwick because most of the work had already been done in garages and basements. But no one objected that it gave both Clearwater and NBSD a substantial boost in the public consciousness.

During this period, Baker found three other small colleges of almost equal caliber with Clearwater. He made substantial grants to all of them and watched their staffs grow in number and quality of background that would have shocked George Wily into apoplexy. Baker's announcements of substantial scientific gains became the subject of weekly press conferences.

And also, during this time, he lowered the ax on Great Eastern and two other giants whose applications were pending. He cut them to twenty per cent of what they were asking. A dozen of the largest industrial firms were accorded similar treatment.

Through all this, Pehrson moved like a man in a nightmare. His first impulse had been to resign. His second was to report the gross mismanagement of NBSD to some appropriate congressman. Before he did either of these things the reports began to come in from Clearwater and other obscure points.

Pehrson was a man in whom allegiance was easily swayed. His loyalty was only for the top man of any heirarchy, and he suddenly began to regard Baker with an amazed incredulity. It seemed akin to witchcraft to be able to pull out works of near genius from the dross material Baker had been supporting with his grants. Pehrson wasn't quite sure how it had been done although he had been present throughout the whole process. He only knew that Baker had developed a kind of prescience that was nothing short of miraculous, and from now on he was strictly a Baker man.

Baker was happy with this outcome. The problem of Pehrson had been a bothersome one. Civil Service regulations forbade his displacement. Baker had been undecided how to deal with him. With Pehrson's acceptance of the new methods, the entire staff swung behind Baker, and the previous grumblings and complaints finally ceased. He stood on top in his own office, at least, Baker reflected.

George H. Wily was not happy, however. He waited two full days after receiving the announcement of NBSD's grant for the coming year. He consulted with his Board of Regents and then took a night plane down to Washington to see Baker.

He was coldly formal as he entered Baker's office. Baker shook his hand warmly and invited him to sit down.

"I was hoping you'd drop in again when you came to town," said Baker. "I was sorry we had to ask you for so much new information, but I appreciate your prompt response."

Wily's eyes were frosty. "Is that why you gave us only two hundred thousand?" he asked.

Baker spread his hands. "I explained when you were here last that we were getting a flood of applications. We have been forced to distribute the money much more broadly than in other years. There is only so much to go around, you know."

"There is just as much as you've ever had," snapped Wily. "I've checked on your over-all appropriation. And there is no increase in qualified applicants. There is a decrease, if anything.

"I've done a little checking on the grants you've made, Baker. I'd like to see you defend your appropriation for that miserable little school called Clearwater College. I made a detailed study of their staff. They haven't a single qualified man. Not one with a background any better than that of your elevator operator!"

Baker looked up at the ceiling. "I remember an elevator man who became quite a first rate scientist."

Wily glared, waiting for explanation, then snorted. "Oh, *him*—"

"Yes, *him*," said Baker.

"That doesn't explain your wasting of Government funds on such an institution as Clearwater. It doesn't explain your grants to—"

"Let me show you what does explain my grants," said Baker. "I have what I call the Index—with a capital I, you know—"

"I don't care anything about your explanations or your Index!" Wily exclaimed. "I'm here to serve notice that I represent the nation's interest as well as that of Great Eastern. And I am not going to stand by silently while you mismanage these sacred funds the way you have chosen to do in recent months. I don't know what's happened to you, Baker. You were never guilty of such mistakes before. But unless you can assure me that the full normal grant can be restored to Great Eastern, I'm going to see that your office is turned inside

out by the Senate Committee on Scientific Development, and that you, personally, are thrown out."

Wily glared and breathed heavily after his speech. He sat waiting for Baker's answer.

Baker gave it when Wily had stopped panting and turned to drumming his fingers on the desk. "Unless your record of achievement is better this year than it has been in recent years, Great Eastern may not get any allotment at all next year," he said quietly.

Wily shaded toward deep red, verging on purple, as he rose. "You'll regret this, Baker! This office belongs to American Science. I refuse to see it desecrated by your gross mismanagement! Good day!"

Baker smiled grimly as Wily stormed out. Then he picked up the phone and asked Doris to get Fenwick at Clearwater. When Fenwick finally came on, Baker said, "Wily was just here. I expected he would be the one. This is going to be it. Send me everything you've got for release. We're going to find out how right Sam Atkins was!"

He called the other maverick schools he'd given grants, and the penny ante commercial organizations he'd set on their feet. He gave them the same message.

It wasn't going to be easy or pleasant, he reflected. The biggest guns of Scientific Authority would be trained on him before this was over.

Drew Pearson had the word even before it reached Baker. Baker read it at breakfast a week after Wily's visit. The columnist said, "The next big spending agency to come under the fire of Congressional Investigation is none other than the high-echelon National Bureau of Scientific Development. Dr. William Baker, head of the Agency, has been accused of indiscriminate spending policies wholly unrelated to the national interest. The accusers are a group of elite universities and top manufacturing organizations that have benefited greatly from Baker's handouts in years past. This year, Baker is accused of giving upwards of five million dollars to crackpot groups and individuals who have no standing in the scientific community whatever.

"If these charges are true, it is difficult to see what Dr. Baker is up to. For many years he has had an enviable record as a tight-fisted, hard-headed administrator of these important funds. Congress intends to find out what's going on. The watchdog committee of Senator Landrus is expected to call an investigation early next week."

Baker was notified that same afternoon.

Senator Landrus was a big, florid man, who moved about a committee hearing chamber with the ponderous smoothness of a luxury liner. He was never visited by a single doubt about the rightness of his chosen course—no matter how erratic it might appear to an onlooker. His faith in his established legislative procedures and in the established tenets of Science was complete. Since he wore the shield of both camps, his confidence in the path of Senator Robert Landrus was also unmarred by questions.





Baker had faced him many times, but always as an ally. Now, recognizing him as the enemy, Baker felt some small qualms, not because he feared Landrus, but because so much was at stake in this hearing. So much depended on his ability to guide the whims and uncertainties of this mammoth vessel of Authority.

There was an unusual amount of press interest in what might have seemed a routine and unspectacular hearing. No one could recall a previous occasion when the recipients had challenged a Government handout agency regarding the size of the handouts. While Landrus made his opening statement several of the reporters fiddled with the idea of a headline that said something about biting the hand that feeds. It wouldn't quite come off.

Wily was invited to make his statement next, which he did with icy reserve, never once looking in Baker's direction. He was followed by two other university presidents and a string of laboratory directors. The essence of their remarks was that Russia was going to beat the pants off American researchers, and it was all Baker's fault.

This recital took up all of the morning and half the afternoon of the first day. A dozen or so corporation executives were next on the

docket with complaints that their vast facilities were being hamstrung by Baker's sudden switch of R & D funds to less qualified agents. Baker observed that the ones complaining were some of those who had never spent a nickel on genuine research until the Government began buying it. He knew that Landrus had not observed this fact. It would have to be called to the senator's attention.

By the end of the day, Landrus looked grave. It was obvious that he could see nothing but villainy in Baker's recent performance. It had been explained to him in careful detail by some of the most powerful men in the nation. Baker was certainly guilty of criminal negligence, if not more, in derailing these funds which Congress had intended should go to the support of the nation's scientific leaders. Landrus felt a weary depression. He hadn't really believed it would turn out this bad for Baker, for whom he had had a considerable regard in times past.

"You have heard the testimony of these witnesses," Landrus said to Baker. "Do you wish to reply or make a statement of your own, Dr. Baker?"

"I most certainly do!" said Baker.

Landrus didn't see what was left for Baker to say. "Testimony will resume tomorrow at nine a.m.," he said. "Dr. Baker will present his statement at that time."

The press thought it looked bad for Baker, too. Some papers accused him openly of attempting to sabotage the nation's research program. Wily and his fellows, and Landrus, were commended for catching this defection before it progressed any further.

Baker was well aware he was in a tight spot, and one which he had deliberately created. But as far as he could see, it was the only chance of utilizing the gift that Sam Atkins had left him. He felt confident he had a fighting chance.

His battery of supporters had not even been noticed in the glare of Wily's brilliant assembly, but Fenwick was there, and Ellerbee. Fenwick's fair-haired boy, George, and a half dozen of his new recruits were there. Also present were the heads of the other maverick schools like Clearwater, and the presidents—some of whom doubled as janitors—of the minor corporations Baker had sponsored.

Baker took the stand the following morning, armed with his charts and displays. He looked completely confident as he addressed Landrus and the assembly.

"Gentlemen—and ladies—" he said. "The corner grocery store was one of America's most familiar and best loved institutions a generation or two ago. In spite of this, it went out of business because we refused to support it. May I ask why we refused to continue to support the corner grocery?

"The answer is obvious. We began to find better bargains elsewhere, in the supermarket. As much as we regret the passing of the oldtime grocer I'm sure that none of us would seriously suggest we bring him back.

"For the same reason I suggest that the time may have come to reconsider the bargains we have been getting in scientific developments and inventions. Americans have always taken pride in driving a good, hard, fair bargain. I see no reason why we should not do the same when we go into the open market to buy ideas.

"Some months ago I began giving fresh consideration to the product we were buying with the millions of dollars in grants made by NBSD. It was obvious that we were buying an impressive collection of shiny, glass and metal laboratories. We were buying giant pieces of laboratory equipment and monstrous machines of other kinds. We were getting endless quantities of fat reports—they fill thousands of miles of microfilm.

"Then I discovered an old picture of what I am sure all unbiased scientists will recognize as the world's greatest laboratory—greatest in terms of measurable output. I brought this picture with me."

Baker unrolled the first of his exhibits, a large photographic blowup. The single, whitehaired figure seated at a desk was instantly recognized. Wily and his group glanced at the picture and glared at Baker.

"You recognize Dr. Einstein, of course," said Baker. "This is a photograph of him at work in his laboratory at the Institute for Advanced Study at Princeton."

"We are all familiar with the appearance of the great Dr. Einstein," said Landrus. "But you are not showing us anything of his laboratory, as you claimed."

"Ah, but I am!" said Baker. "This is all the laboratory Dr. Einstein ever had. A desk, a chair, some writing paper. You will note that even the bookshelves behind him are bare except for a can of tobacco. The greatest laboratory in the world, a place for a man's mind to work in peace. Nuclear science began here."

Wily jumped to his feet. "This is absurd! No one denies the greatness of Dr. Einstein's work, but where would he have been without billions of dollars spent at Oak Ridge, Hanford, Los Alamos, and other great laboratories. To say that Dr. Einstein did not use laboratory facilities does not imply that vast expenditures for laboratories are not necessary!"

"I should like to reverse your question, Dr. Wily, and then let it rest," said Baker. "What would Oak Ridge, Hanford, and Los Alamos have done without Dr. Einstein?"

Senator Landrus floated up from his chair and raised his hands. "Let us be orderly, gentlemen. Dr. Baker has the floor. I should not like to have him interrupted again, please."

Baker nodded his thanks to the senator. "It has been charged," Baker continued, "that the methods of NBSD in granting funds for research have changed in recent times. This is entirely correct, and I should first like to show the results of this change."

He unrolled a chart and pinned it to the board behind him. "This chart

shows what we have been paying and what we have been getting. The black line on the upper half of the chart shows the number of millions of dollars spent during the past five years. Our budget has had a moderately steady rise. The green line shows the value of laboratories constructed and equipment purchased. The red line shows the measure of new concepts developed by the scientists in these laboratories, the improvement on old concepts, and the invention of devices that are fundamentally new in purpose or function."

The gallery leaned forward to stare at the chart. From press row came the popping of flash cameras. Then a surge of spontaneous comment rolled through the chamber as the audience observed the sharp rise of the red line during the last six months, and the dropping of the green line."

Wily was on his feet again. "An imbecile should be able to see that the trend of the red line is the direct result of the previous satisfactory expenditures for facilities. One follows the other!"

Landrus banged for order.

"That's a very interesting point," said Baker. "I have another chart here"—he unrolled and pinned it—"that shows the output in terms of concepts and inventions, plotted against the size of the grants given to the institution."

The curve went almost straight downhill.

Wily was screaming. "Such data are absolutely meaningless! Who can say what constitutes a new idea, a new invention? The months of groundwork—"

"It will be necessary to remove any further demonstrators from the hearing room," said Landrus. "This will be an orderly hearing if I have to evict everyone but Dr. Baker and myself. Please continue, doctor."

"I am quite willing for my figures and premises to be examined in all detail," said Baker. "I will be glad to supply the necessary information to anyone who desires it at the close of this session. In the meantime, I should like to present a picture of the means which we have devised to determine whether a grant should be made to any given applicant.

"I am sure you will agree, Senator Landrus and Committee members, that it would be criminal to make such choices on any but the most scientific basis. For this reason, we have chosen to eliminate all elements of bias, chance, or outright error. We have developed a highly advanced scientific tool which we know simply as The Index."

Baker posted another long chart on the wall, speaking as he went. "This chart represents the index of an institution which shall remain anonymous as Sample A. However, I would direct Dr. Wily's close attention to this exhibit. The black median line indicates the boundary of characteristics which have been determined as acceptable or nonacceptable for grants. The colored areas on either side of the median line show strength of the various factors represented in any one institution. The Index is very simple. All that is required is that fifty per cent of the area above the line be colored in order to be eligible for a grant. You will note that in the case of Sample A the requirement is not met."

Fenwick couldn't believe his eyes. The chart was almost like the first one he had ever seen, the one prepared for Clearwater College months ago. He hadn't even known that Baker was still using the idiotic Index. Something was wrong, he told himself—all wrong.

"The Index is a composite," Baker was saying, "the final resultant of many individual charts, and it is the individual charts that will show you the factors which are measured. These factors are determined by an analysis of information supplied directly by the institution.

"The first of these factors is admissions. For a college, it is admission as a student. For a corporation, it is admission as an employee. In each case we present the qualifications of the following at college age: Thomas Edison, Michael Faraday, Nicholai Tesla, James Watt, Heinrich Hertz, Kepler, Copernicus, Galileo, and Henry Ford. The admissibility of this group of the world's scientific and the inventive leaders is shown here." Baker pointed to a minute dab of red on the chart.

"Gentlemen of the Committee," he said, "would you advise me to support with a million-dollar grant an institution that would close its doors to minds like those of Edison and Faraday?"

The roar of surf seemed to fill the committee room as Landrus banged in vain on the table. Photographers' flashes lit the scene with spurts of lightning. Wily was on his feet screaming, and Baker thought he heard the word, "Fraud!" repeated numerous times. Landrus was finally heard, "The room will be cleared at the next outburst!"

Baker wondered if he ever did carry out such a threat.

But Wily prevailed. "No such question was ever asked," he cried. My organization was never asked the ridiculous question of whether or not it would admit these men. Of course we would admit them if they were known to us!"

"I should like to answer the gentleman's objection," Baker said to Landrus.

The senator nodded reluctantly.

"We did not, of course, present these men by name. That would have been too obvious. We presented them in terms of their qualifications at the age of college entrance. You see how many would have been turned down. How many, therefore, who are the intellectual equals of these men are also being turned down? Dr. Wily says they would be admitted if they were known. But of course they could not be known at the start of their careers!"

Baker turned the chart and quickly

substituted another. "The second standard is that of creativeness. We simply asked the applicants to describe ten or more new ideas of speculations entertained by each member of the staff during the past year. When we received this information, we did not even read the descriptions; we merely plotted the degree of response. As you see, the institution represented by Sample A does not consider itself long on speculative ideas."

A titter rippled through the audience. Baker saw Wily poised, beetred, to spring up once more; then apparently he thought better of it and slumped in his seat.

"Is this a fair test?" Baker asked rhetorically. "I submit that it is. An institution that is in the business of fostering creativeness ought to be guilty of a few new ideas once in a while!"

He changed charts once more and faced the listeners. "We have more than twenty such factors that go into the composition of the Index. I will not weary you with a recital of all of them, but I will present just one more. We call this the area of communication, and it is plotted here for Sample institution A."

Again, a dismal red smudge showed up at the bottom of the sheet. Fenwick could hardly keep from chuckling aloud as he recalled the first time he had seen such a chart. He hoped Baker was putting it over. If the reaction of the gallery were any indication, he was doing so.

"A major activity of scientists in all ages has been writing reports of their activities. If a man creates something new and talks only to himself about it, the value of the man and his discovery to the world is a big round zero. If a man creates something new and tells the whole world about it, the value is at a maximum. Somewhere in between these extremes lies the communicative activity of the modern scientist.

"There was a time when the scientist was the most literate of men, and the writing of a scientific report was a work of literary art. The lectures of Michael Faraday, Darwin's account of his great research—these are literate reading still.

"There are few such men among us today. The modern scientists seldom speak to you and me, but only to each other. To the extent their circle of communication is limited, so is their value. Shall we support the man who speaks to the world, or the man who speaks only in order to hear his own echo?"

He had them now, Fenwick was convinced. He could quit any time and be ahead. The gallery was smiling approval. The press was nodding and whispering to each other. The senators wouldn't be human if they weren't moved.

Baker swept aside all these charts now and placed another series before the audience. "This is the Index on an institution to whom we have given a sizable grant," he said. "Is there anyone here who would question our decision?

"This institution would have accepted every one of the list of scientists I gave you a moment ago. They would have had their chance here. This institution has men in whom new ideas pop up like cherry blossoms in the spring. I don't know how many of them are good ideas. No one can tell at this stage, but, at least, these men are *thinking*—which is a basic requirement for producing scientific discovery.

"Finally, this institution is staffed by men who can't be shut up. They don't communicate merely with each other. They talk about their ideas to anyone who comes along. They write articles for little publications and for big ones. They are in the home mechanics' journals and on publishers' book lists.

"Most important of all, these are some of the men responsible for the red line on the first curve I showed you. These are the men who have produced the most new developments and inventions with the least amount of money.

"I leave it to you, gentlemen. Has the National Bureau of Scientific Development chosen correctly, or should we return to our former course?"

There were cheers and applause as Baker sat down. Landrus closed the hearing with the announcement that the evidence would be examined at length and a report issued. Wily hurried forward to buttonhole him as the crowd filed out.

"It was a good show," Fenwick said, "but I'm still puzzled by what you've done. This new Index is really just about as phony as your old one."

They were seated in Baker's office once more. Baker smiled and glanced through the window beyond Fenwick. "I suppose so," Baker admitted finally, "but do you think Wily will be able to convince Landrus and his committee of that no matter how big a dinner he buys him tonight?"

"No—I don't think he will."

"Then we've accomplished our purpose. Besides, there's a good deal of truth buried in the Index. It's no lie that we can give them scientific research at a cheaper price than ever before."

"But what was the purpose you were trying to accomplish?"

Baker hesitated. "To establish myself as an Authority," he said, finally. "After today, I will be the recognized Authority on how to manage the nation's greatest research and development program."

Fenwick stared, then gasped. "Authority—you? This is the thing you were trying to fight. This is the great Plague Sam Atkins taught you—"

Baker was shaking his head and laughing. "No. Sam Atkins didn't tell me that one man could become immune and fight the Plague headon all by himself. He taught me something else that I didn't understand for a long time. He told me that he who ceases to fear Authority becomes Authority.

"To become Authority was the last thing in the world I wanted. But finally I recognized what Sam meant; it was the only way I could ever ac-

complish anything in the face of this Plague. You can't tell men of this culture that it is wrong to put themselves in total agreement with Authority. If that's the program on which they've chosen to function, the destruction of the program would destroy them, just as it did me. There had to be another way.

"If men are afraid of lions, you don't teach them it's wrong for men to be afraid of beasts; you teach them how to trap lions.

"If men are afraid of new knowledge-experiences, you don't teach them that new knowledge is not to be feared. There was a time when men got burned at the stake for such efforts. The response today is not entirely different. No—when men are afraid of knowledge you teach them to trap knowledge, just as you might teach them to trap lions.

"I can do this now because I have shown them that I am an Authority. I can lead them and it will not fracture their basic program tapes, which instruct them to be in accord with Authority. I can stop their battle against those who are not possessed of the Plague. It may even be that I can change the course of the Plague. Who knows?"

Fenwick was silent for a long time. Then he spoke again. "I read somewhere about a caterpillar that's called the Processionary Caterpillar. Several of them hook up, nose to fanny, and travel through a forest wherever the whims of the front caterpillar take them.

"A naturalist once took a train of Processionary Caterpillars and placed them on the rim of a flower pot in a continuous chain. They marched for days around the flower pot, each one supposing the caterpillar in front of him knew where he was going. Each was the Authority to the one behind. Food and water were placed nearby, but the caterpillars continued marching until they dropped off from exhaustion."

Baker frowned. "And what's that got to do with—?"

"You," said Fenwick. "You just led the way down off the flower pot. You just got promoted to head caterpillar."

■ ■ ■



# Pandemic

*Generally,*
*human beings don't do*
*totally useless things*
*consistently and widely.*
*So—maybe there is*
*something to it—*

**BY J. F. BONE**

■ "We call it Thurston's Disease for two perfectly good reasons," Dr. Walter Kramer said. "He discovered it—and he was the first to die of it." The doctor fumbled fruitlessly through the pockets of his lab coat. "Now where the devil did I put those matches?"

"Are these what you're looking for?" the trim blonde in the gray seersucker uniform asked. She picked a small box of wooden safety matches from the littered lab table beside her and handed them to him.

"Ah," Kramer said. "Thanks. Things have a habit of getting lost around here."

"I can believe that," she said as she eyed the frenzied disorder around her. Her boss wasn't much better than his laboratory, she decided as she watched him strike a match against the side of the box and apply the flame to the charred bowl of his pipe. His long dark face became half obscured behind a cloud of bluish smoke as he puffed furiously. He looked like a lean untidy devil recently escaped from hell with his thick brows, green eyes and lank black hair highlighted intermittently by the leaping flame of the match. He certainly didn't look like a pathologist. She wondered if she was going to like working with him, and shook her head imperceptibly. Possibly, but not probably. It might be difficult being cooped up here with him day after day. Well, she could always quit if things got too tough. At least there was that consolation.

He draped his lean body across a

ILLUSTRATED BY BARBERIS



lab stool and leaned his elbows on its back. There was a faint smile on his face as he eyed her quizzically. "You're new," he said. "Not just to this lab but to the Institute."

She nodded. "I am, but how did you know?"

"Thurston's Disease. Everyone in the Institute knows that name for the plague, but few outsiders do." He smiled sardonically. "Virus pneumonic plague—that's a better term for public use. After all, what good does it do to advertise a doctor's stupidity?"

She eyed him curiously. *"De mortuis?"* she asked.

He nodded. "That's about it. We may condemn our own, but we don't like laymen doing it. And besides, Thurston had good intentions. He never dreamed this would happen."

"The road to hell, so I hear, is paved with good intentions."

"Undoubtedly," Kramer said dryly. "Incidentally, did you apply for this job or were you assigned?"

"I applied."

"Someone should have warned you I dislike clichés," he said. He paused a moment and eyed her curiously. "Just why did you apply?" he asked. "Why are you imprisoning yourself in a sealed laboratory which you won't leave as long as you work here. You know, of course, what the conditions are. Unless you resign or are carried out feet first you will remain here . . . have you considered what such an imprisonment means?"

"I considered it," she said, "and it doesn't make any difference. I have no ties outside and I thought I could help. I've had training. I was a nurse before I was married."

"Divorced?"

"Widowed."

Kramer nodded. There were plenty of widows and widowers outside. Too many. But it wasn't much worse than in the Institute where, despite precautions, Thurston's disease took its toll of life.

"Did they tell you this place is called the suicide section?" he asked.

She nodded.

"Weren't you frightened?"

"Of dying? Hardly. Too many people are doing it nowadays."

He grimaced, looking more satanic than ever. "You have a point," he admitted, "but it isn't a good one. Young people should be afraid of dying."

"You're not."

"I'm not young. I'm thirty-five, and besides, this is my business. I've been looking at death for eleven years. I'm immune."

"I haven't your experience," she admitted, "but I have your attitude."

"What's your name?" Kramer said.

"Barton, Mary Barton."

"Hm-m-m. Well, Mary—I can't turn you down. I need you. But I could wish you had taken some other job."

"I'll survive."

He looked at her with faint admiration in his greenish eyes. "Perhaps you will," he said. "All right. As to your duties—you will be my assistant, which means you'll be a dishwasher, laboratory technician,

secretary, junior pathologist, and coffee maker. I'll help you with all the jobs except the last one. I make lousy coffee." Kramer grinned, his teeth a white flash across the darkness of his face. "You'll be on call twenty-four hours a day, underpaid, overworked, and in constant danger until we lick Thurston's virus. You'll be expected to handle the jobs of three people unless I can get more help—and I doubt that I can. People stay away from here in droves. There's no future in it."

Mary smiled wryly. "Literally or figuratively?" she asked.

He chuckled. "You have a nice sense of graveyard humor," he said. "It'll help. But don't get careless. Assistants are hard to find."

She shook her head. "I won't. While I'm not afraid of dying I don't want to do it. And I have no illusions about the danger. I was briefed quite thoroughly."

"They wanted you to work upstairs?"

She nodded.

I suppose they need help, too. Thurston's Disease has riddled the medical profession. Just don't forget that this place can be a death trap. One mistake and you've had it. Naturally, we take every precaution, but with a virus no protection is absolute. If you're careless and make errors in procedure, sooner or later one of those submicroscopic protein molecules will get into your system."

"You're still alive."

"So I am," Kramer said, "but I don't take chances. My predecessor, my secretary, my lab technician, my junior pathologist, and my dishwasher all died of Thurston's Disease." He eyed her grimly. "Still want the job?" he asked.

"I lost a husband and a three-year old son," Mary said with equal grimness. "That's why I'm here. I want to destroy the thing that killed my family. I want to do something. I want to be useful."

He nodded. "I think you can be," he said quietly.

"Mind if I smoke?" she asked. "I need some defense against that pipe of yours."

"No—go ahead. Out here it's all right, but not in the security section."

Mary took a package of cigarettes from her pocket, lit one and blew a cloud of gray smoke to mingle with the blue haze from Kramer's pipe.

"Comfortable?" Kramer asked.

She nodded.

He looked at his wrist watch. "We have half an hour before the roll tube cultures are ready for examination. That should be enough to tell you about the modern Pasteur and his mutant virus. Since your duties will primarily involve Thurston's Disease, you'd better know something about it." He settled himself more comfortably across the lab bench and went on talking in a dry schoolmasterish voice. "Alan Thurston was an immunologist at Midwestern University Medical School. Like most men in the teaching trade, he also had a research project. If it worked out, he'd be one of the great names in medicine, like Jenner, Pasteur, and Salk. The result was that he pushed it and wasn't too careful. He wanted to be famous."

"He's well known now," Mary said. "at least within the profession."

"Quite," Kramer said dryly. "He was working with gamma radiations on microorganisms, trying to produce a mutated strain of *Micrococcus pyogenes* that would have enhanced antigenic properties."

"Wait a minute, doctor. It's been four years since I was active in nursing. Translation, please."

Kramer chuckled. "He was trying to make a vaccine out of a common infectious organism. You may know it better as *Staphylococcus.* As you know, it's a pus former that's made hospital life more dangerous than it should be because it develops resistance to antibiotics. What Thurston wanted to do was to produce a strain that would stimulate resistance in the patient without causing disease—something that would help patients protect themselves rather than rely upon doubtfully effective antibiotics."

That wasn't a bad idea."

"There was nothing wrong with it. The only trouble was that he wound up with something else entirely. He was like the man who wanted to make a plastic suitable for children's toys and ended up with a new explosive. You see, what Thurston didn't realize was that his cultures were contaminated. He'd secured them from the University Clinic and had, so he thought, isolated them. But somehow he'd brought a virus along—probably one of the orphan group or possibly a phage."

"Orphan?"

"Yes—one that was not a normal inhabitant of human tissues. At any rate there was a virus—and he mutated it rather than the bacteria. Actually, it was simple enough, relatively speaking, since a virus is infinitely simpler in structure than a bacterium, and hence much easier to modify with ionizing radiation. So he didn't produce an antigen—he produced a disease instead. Naturally, he contacted it, and during the period between his infection and death he managed to infect the entire hospital. Before anyone realized what they were dealing with, the disease jumped from the hospital to the college, and from the college to the city, and from the city to—"

"Yes, I know that part of it. It's all over the world now—killing people by the millions."

Well," Kramer said, "at least it's solved the population explosion." He blew a cloud of blue smoke in Mary's direction. "And it did make Thurston famous. His name won't be quickly forgotten."

She coughed. "I doubt if it ever will be," she said, "but it won't be remembered the way he intended."

He looked at her suspiciously. "That cough—"

"No, it's not Thurston's Disease. It's that pipe. It's rancid."

"It helps me think," Kramer said.

"You could try cigarettes—or candy," she suggested.

"I'd rather smoke a pipe."

"There's cancer of the lip and tongue," she said helpfully.

"Don't quote Ochsner. I don't agree with him. And besides, you smoke cigarettes, which are infinitely worse."

"Only four or five a day. I don't saturate my system with nicotine."

"In another generation," Kramer observed, "you'd have run through the streets of the city brandishing an ax smashing saloons. You're a lineal descendent of Carrie Nation." He puffed quietly until his head was surrounded by a nimbus of smoke. "Stop trying to reform me," he added. "You haven't been here long enough."

"Not even God could do that, according to the reports I've heard," she said.

He laughed. "I suppose my reputation gets around."

"It does. You're an opinionated slave driver, a bully, an intellectual tyrant, and the best pathologist in this center."

"The last part of that sentence makes up for unflattering honesty of the first," Kramer said. "At any rate, once we realized the situation we went to work to correct it. Institutes like this were established everywhere the disease appeared for the sole purpose of examining, treating, and experimenting with the hope of finding a cure. This section exists for the evaluation of treatment. We check the human cases, and the primates in the experimental laboratories. It is our duty to find out if anything the boys upstairs try shows any promise. We were a pretty big section once, but Thurston's virus has whittled us down. Right now there is just you and me. But there's still enough work to keep us busy. The experiments are still going on, and there are still human cases, even though the virus has killed off most of the susceptibles. We've evaluated over a thousand different drugs and treatments in this Institute alone.

"And none of them have worked?"

"No—but that doesn't mean the work's been useless. The research has saved others thousands of man hours chasing false leads. In this business negative results are almost as important as positive ones. We may never discover the solution, but our work will keep others from making the same mistakes."

"I never thought of it that way."

"People seldom do. But if you realize that this is international, that every worker on Thurston's Disease has a niche to fill, the picture will be clearer. We're doing our part inside the plan. Others are, too. And there are thousands of labs involved. Somewhere, someone will find the answer. It probably won't be us, but we'll help get the problem solved as quickly as possible. That's the important thing. It's the biggest challenge the race has ever faced—and the most important. It's a question of survival." Kramer's voice was sober. "We have to solve this. If Thurston's Disease isn't checked, the human race will become extinct. As a result, for the first time in history all mankind is working together."

"All? You mean the Communists are, too?"

"Of course. What's an ideology if there are no people to follow it?" Kramer knocked the ashes out of his pipe, looked at the laboratory clock and shrugged. "Ten minutes more," he said, "and these tubes will be ready. Keep an eye on that clock and let me know. Meantime you can straighten up this lab and find out where things are. I'll be in the office checking the progress reports." He turned abruptly away, leaving her standing in the middle of the cluttered laboratory.

"Now what am I supposed to do here?" Mary wondered aloud. "Clean up, he says. Find out where things are, he says. Get acquainted with the place, he says. I could spend a month doing that." She looked at the littered bench, the wall cabinets with sliding doors half open, the jars of reagents sitting on the sink, the drainboard, on top of the refrigerator and on the floor. The disorder was appalling. "How he ever manages to work in here is beyond me. I suppose that I'd better start somewhere—perhaps I can get these bottles in some sort of order first." She sighed and moved toward the wall cabinets. "Oh well," she mused, "I asked for this."

Didn't you hear that buzzer?" Kramer asked.

"Was that for me?" Mary said, looking up from a pile of bottles and glassware she was sorting.

"Partly. It means they've sent us another post-mortem from upstairs."

"What is it?"

"I don't know—man or monkey, it makes no difference. Whatever it is, it's Thurston's Disease. Come along. You might as well see what goes on in our ultra modern necropsy suite."

"I'd like to." She put down the bottle she was holding and followed him to a green door at the rear of the laboratory.

"Inside," Kramer said, "you will find a small anteroom, a shower, and a dressing room. Strip, shower, and put on a clean set of lab coveralls and slippers which you will find in the dressing room. You'll find surgical masks in the wall cabinet beside the lockers. Go through the door beyond the dressing room and wait for me there. I'll give you ten minutes."

"We do this both ways," Kramer said as he joined her in the narrow hall beyond the dressing room. "We'll reverse the process going out."

"You certainly carry security to a maximum," she said through the mask that covered the lower part of her face.

"You haven't seen anything yet," he said as he opened a door in the hall. "Note the positive air pressure," he said. "Theoretically nothing can get in here except what we bring with us. And we try not to bring anything." He stood aside to show her the glassed-in cubicle overhanging a

bare room dominated by a polished steel post-mortem table that glittered in the harsh fluorescent lighting. Above the table a number of jointed rods and clamps hung from the ceiling. A low metal door and series of racks containing instruments and glassware were set into the opposite wall together with the gaping circular orifice of an open autoclave.

"We work by remote control, just like they do at the AEC. See those handlers?" He pointed to the control console set into a small stainless steel table standing beside the sheet of glass at the far end of the cubicle. "They're connected to those gadgets up there." He indicated the jointed arms hanging over the autopsy table in the room beyond. "I could perform a major operation from here and never touch the patient. Using these I can do anything I could in person with the difference that there's a quarter inch of glass between me and my work. I have controls that let me use magnifiers, and even do microdissection, if necessary."

"Where's the cadaver?" Mary asked.

"Across the room, behind that door," he said, waving at the low, sliding metal partition behind the table. "It's been prepped, decontaminated and ready to go."

"What happens when you're through?"

"Watch." Dr. Kramer pressed a button on the console in front of him. A section of flooring slid aside and the table tipped. "The cadaver slides off that table and through that hole. Down below is a highly efficient crematorium."

Mary shivered. "Neat and effective," she said shakily.

"After that the whole room is sprayed with germicide and sterilized with live steam. The instruments go into the autoclave, and thirty minutes later we're ready for another post-mortem."

"We use the handlers to put specimens into those jars," he said, pointing to a row of capped glass jars of assorted sizes on a wall rack behind the table. "After they're capped, the jars go onto that carrier beside the table. From here they pass through a decontamination chamber and into the remote-control laboratory across the hall where we can run biochemical and histological techniques. Finished slides and mounted specimens then go through another decontamination process to the outside lab. Theoretically, this place is proof against anything."

"It seems to be," Mary said, obviously impressed. "I've never seen anything so elegant."

"Neither did I until Thurston's Disease became a problem." Kramer shrugged and sat down behind the controls. "Watch, now," he said as he pressed a button. "Let's see what's on deck—man or monkey. Want to make a bet? I'll give you two to one it's a monkey."

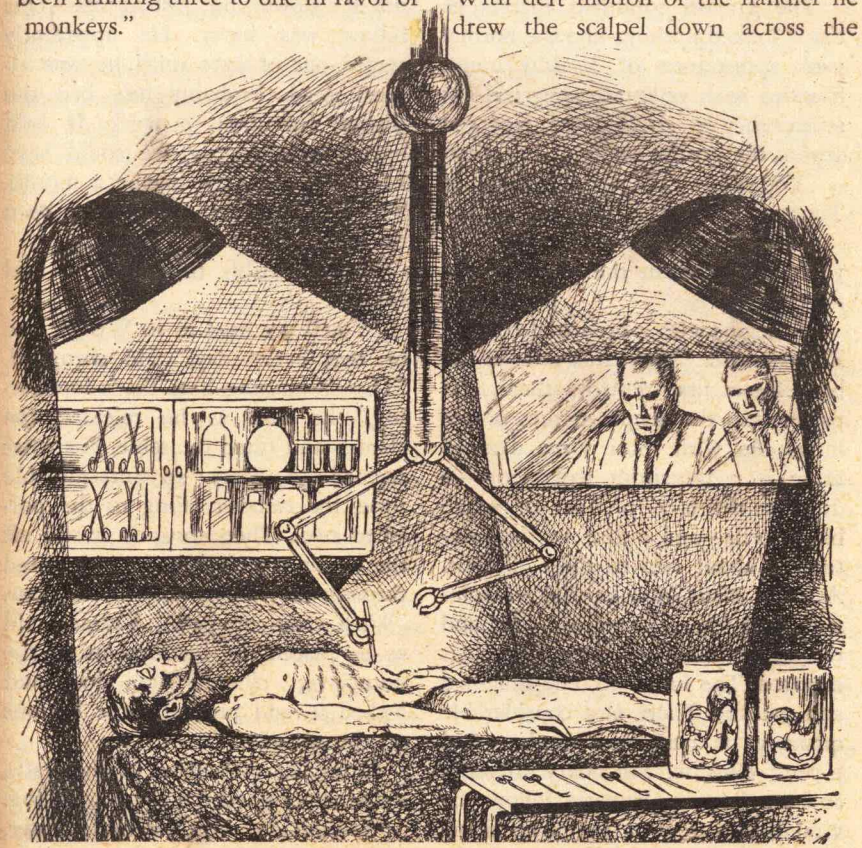
She shook her head.

The low door slid aside and a steel carriage emerged into the necropsy room bearing the nude body of a man. The corpse gleamed pallidly under the harsh shadowless glare of the fluorescents in the ceiling as Kramer, using the handlers, rolled it onto the post-mortem table and clamped it in place on its back. He pushed another button and the carriage moved back into the wall and the steel door slid shut. "That'll be decontaminated," he said, "and sent back upstairs for another body. I'd have lost," he remarked idly. "Lately the posts have been running three to one in favor of monkeys."

He moved a handler and picked up a heavy scalpel from the instrument rack. "There's a certain advantage to this," he said as he moved the handler delicately. "These gadgets give a tremendous mechanical advantage. I can cut right through small bones and cartilage without using a saw."

"How nice," Mary said. "I expect you enjoy yourself."

"I couldn't ask for better equipment," he replied noncommittally. With deft motion of the handler he drew the scalpel down across the



chest and along the costal margins in the classic inverted "Y" incision. "We'll take a look at the thorax first," he said, as he used the handlers to pry open the rib cage and expose the thoracic viscera. "Ah! Thought so! See that?" He pointed with a small handler that carried a probe. "Look at those lungs." He swung a viewer into place so Mary could see better. "Look at those abscesses and necrosis. It's Thurston's Disease, all right, with secondary bacterial invasion."

The grayish solidified masses of tissue looked nothing like the normal pink appearance of healthy lungs. Studded with yellowish spherical abscesses they lay swollen and engorged within the gaping cavity of the chest.

"You know the pathogenesis of Thurston's Disease?" Kramer asked.

Mary shook her head, her face yellowish-white in the glare of the fluorescents.

"It begins with a bronchial cough," Kramer said. "The virus attacks the bronchioles first, destroys them, and passes into the deeper tissues of the lungs. As with most virus diseases there is a transitory leukopenia—a drop in the total number of white blood cells—and a rise in temperature of about two or three degrees. As the virus attacks the alveolar structures, the temperature rises and the white blood cell count becomes elevated. The lungs become inflamed and painful. There is a considerable quantity of lymphoid exudate and pleural effusion. Secondary invaders and pus-forming bacteria follow the viral destruction of the lung tissue and form abscesses. Breathing becomes progressively more difficult as more lung tissue is destroyed. Hepatization and necrosis inactivate more lung tissue as the bacteria get in their dirty work, and finally the patient suffocates."

"But what if the bacteria are controlled by antibiotics?"

"Then the virus does the job. It produces atelectasis followed by progressive necrosis of lung tissue with gradual liquefaction of the parenchyma. It's slower, but just as fatal. This fellow was lucky. He apparently stayed out of here until he was almost dead. Probably he's had the disease for about a week. If he'd have come in early, we could have kept him alive for maybe a month. The end, however, would have been the same."

"It's a terrible thing," Mary said faintly.

"You'll get used to it. We get one or two every day." He shrugged. "There's nothing here that's interesting," he said as he released the clamps and tilted the table. For what seemed to Mary an interminable time, the cadaver clung to the polished steel. Then abruptly it slid off the shining surface and disappeared through the square hole in the floor. "We'll clean up now," Kramer said as he placed the instruments in the autoclave, closed the door and locked it, and pressed three buttons on the console.

From jets embedded in the walls, a fine spray filled the room with fog.

"Germicide," Kramer said. "Later, there'll be steam. That's all for now. Do you want to go?"

Mary nodded.

"If you feel a little rocky there's a bottle of Scotch in my desk. I'll split a drink with you when we get out of here."

"Thanks," Mary said. "I think I could use one."

Barton! Where is the MacNeal stain!" Kramer's voice came from the lab. "I left it on the sink and it's gone!"

"It's with the other blood stains and reagents. Second drawer from the right in the big cabinet. There's a label on the drawer." Mary called from the office. "If you can wait until I finish filing these papers, I'll come in and help you."

"I wish you would," Kramer's voice was faintly exasperated. "Ever since you've organized my lab I can't find anything."

"You just have a disorderly mind," Mary said, as she slipped the last paper into its proper folder and closed the file. "I'll be with you in a minute."

"I don't dare lose you," Kramer said as Mary came into the lab. "You've made yourself indispensable. It'd take me six months to undo what you've done in one. Not that I mind," he amended, "but I was used to things the way they were." He looked around the orderly laboratory with a mixture of pride and annoyance. "Things are so neat they're almost painful."

"You look more like a pathologist should," Mary said as she deftly removed the tray of blood slides from in front of him and began to run the stains. "It's my job to keep you free to think."

"Whose brilliant idea is that? Yours?"

"No—the Director's. He told me what my duties were when I came here. And I think he's right. You should be using your brain rather than fooling around with blood stains and sectioning tissues."

"But I like to do things like that," Kramer protested. "It's relaxing."

"What right have you to relax," Mary said. "Outside, people are dying by the thousands and you want to relax. Have you looked at the latest mortality reports?"

"No—"

"You should. The WHO estimates that nearly two billion people have died since Thurston's Disease first appeared in epidemic proportions. That's two out of three. And more are dying every day. Yet you want to relax."

"I know," Kramer said, "but what can we do about it. We're working but we're getting no results."

"You might use that brain of yours," Mary said bitterly. "You're supposed to be a scientist. You have facts. Can't you put them together?"

"I don't know." He shrugged. "I've been working on this problem longer than you think. I come down here at night—"

"I know. I clean up after you."

"I haven't gotten anywhere. Sure,

we can isolate the virus. It grows nicely on monkey lung cells. But that doesn't help. The thing has no apparent antigenicity. It parasitizes, but it doesn't trigger any immune reaction. We can kill it, but the strength of the germicide is too great for living tissue to tolerate."

"Some people seem to be immune."

"Sure they do—but why?"

"Don't ask me. I'm not the scientist."

"Play like one," Kramer growled. "Here are the facts. The disease attacks people of all races and ages. So far every one who is attacked dies. Adult Europeans and Americans appear to be somewhat more resistant than others on a population basis. Somewhere around sixty per cent of them are still alive, but it's wiped out better than eighty per cent of some groups. Children get it worse. Right now I doubt if one per cent of the children born during the past ten years are still alive."

"It's awful!" Mary said.

"It's worse than that. It's extinction. Without kids the race will die out." Kramer rubbed his forehead.

"Have you any ideas?"

"Children have less resistance," Kramer replied. "An adult gets exposed to a number of diseases to which he builds an immunity. Possibly one of these has a cross immunity against Thurston's virus."

"Then why don't you work on that line?" Mary asked.

"Just what do you think I've been doing? That idea was put out months ago, and everyone has been taking a crack at it. There are twenty-four laboratories working full time on that facet and God knows how many more working part time like we are. I've screened a dozen common diseases, including the six varieties of the common cold virus. All, incidentally, were negative."

"Well—are you going to keep on with it?"

"I have to." Kramer rubbed his eyes. "It won't let me sleep. I'm sure we're on the right track. Something an adult gets gives him resistance or immunity." He shrugged. "Tell you what. You run those bloods out and I'll go take another look at the data." He reached into his lab coat and produced a pipe. "I'll give it another try."

"Sometimes I wish you'd read without puffing on that thing," Mary said.

"Your delicate nose will be the death of me yet—" Kramer said.

"It's my lungs I'm worried about," Mary said. "They'l probably look like two pieces of well-tanned leather if I associate with you for another year."

"Stop complaining. You've gotten me to wear clean lab coats. Be satisfied with a limited victory," Kramer said absently, his eyes staring unseeingly at a row of reagent bottles on the bench. Abruptly he nodded. "Fantastic," he muttered, "but it's worth a check." He left the room, slamming the door behind him in his hurry.

That man!" Mary murmured. "He'd drive a saint out of his mind. If I wasn't so fond of him I'd quit. If anyone told me I'd fall in love with a pathologist, I'd have said they were crazy. I wish—" Whatever the wish was, it wasn't uttered. Mary gasped and coughed rackingly. Carefully she moved back from the bench, opened a drawer and found a thermometer. She put it in her mouth. Then she drew a drop of blood from her forefinger and filled a red and white cell pipette, and made a smear of the remainder.

She was interrupted by another spasm of coughing, but she waited until the paroxysm passed and went methodically back to her self-appointed task. She had done this many times before. It was routine procedure to check on anything that might be Thurston's Disease. A cold, a sore throat, a slight difficulty in breathing —all demanded the diagnostic check. It was as much a habit as breathing. This was probably the result of that cold she'd gotten last week, but there was nothing like being sure. Now let's see—temperature 99.5 degrees, red cell count 4½ million. White cell count . . . oh! 2500 . . . leukopenia! The differential showed a virtual absence of polymorphs, lymphocytes and monocytes. The whole slide didn't have two hundred. Eosinophils and basophils way up—twenty and fifteen per cent respectively—a relative rise rather than an absolute one —leukopenia, no doubt about it.

She shrugged. There wasn't much question. She had Thurston's Disease. It was the beginning stages, the harsh cough, the slight temperature, the leukopenia. Pretty soon her white cell count would begin to rise, but it would rise too late. In fact, it was already too late. It's funny, she thought. I'm going to die, but it doesn't frighten me. In fact, the only thing that bothers me is that poor Walter is going to have a terrible time finding things. But I can't put this place the way it was. I couldn't hope to.

She shook her head, slid gingerly off the lab stool and went to the hall door. She'd better check in at the clinic, she thought. There was bed space in the hospital now. Plenty of it. That hadn't been true a few months ago but the only ones who were dying now were the newborn and an occasional adult like herself. The epidemic had died out not because of lack of virulence but because of lack of victims. The city outside, one of the first affected, now had less than forty per cent of its people left alive. It was a hollow shell of its former self. People walked its streets and went through the motions of life. But they were not really alive. The vital criteria were as necessary for a race as for an individual. Growth, reproduction, irritability, metabolism—Mary smiled wryly. Whoever had authored that hackneyed mnemonic that life was a "grim" proposition never knew how right he was, particularly when one of the criteria was missing.

The race couldn't reproduce. That was the true horror of Thurston's Disease—not how it killed, but who it killed. No children played in the parks and playgrounds. The schools were empty. No babies were pushed in carriages or taken on tours through

the supermarkets in shopping carts. No advertisements of motherhood, or children, or children's things were in the newspapers or magazines. They were forbidden subjects—too dangerously emotional to touch. Laughter and shrill young voices had vanished from the earth to be replaced by the drab grayness of silence and waiting. Death had laid cold hands upon the hearts of mankind and the survivors were frozen to numbness.

It was odd, she thought, how wrong the prophets were. When Thurston's Disease broke into the news there were frightened predictions of the end of civilization. But they had not materialized. There were no mass insurrections, no rioting, no organized violence. Individual excesses, yes—but nothing of a group nature. What little panic there was at the beginning disappeared once people realized that there was no place to go. And a grim passivity had settled upon the survivors. Civilization did not break down. It endured. The mechanics remained intact. People had to do something even if it was only routine counterfeit of normal life—the stiff upper lip in the face of disaster.

It would have been far more odd, Mary decided, if mankind had given way to panic. Humanity had survived other plagues nearly as terrible as this—and racial memory is long. The same grim patience of the past was here in the present. Man would somehow survive, and civilization go on.

It was inconceivable that mankind would become extinct. The whole vast resources and pooled intelligence of surviving humanity were focused upon Thurston's Disease. And the disease would yield. Humanity waited with childlike confidence for the miracle that would save it. And the miracle would happen. Mary knew it with a calm certainty as she stood in the cross corridor at the end of the hall, looking down the thirty yards of tile that separated her from the elevator that would carry her up to the clinic and oblivion. It might be too late for her, but not for the race. Nature had tried unaided to destroy man before—and had failed. And her unholy alliance with man's genius would also fail.

She wondered as she walked down the corridor if the others who had sickened and died felt as she did. She speculated with grim amusement whether Walter Kramer would be as impersonal as he was with the others when he performed the post-mortem on her body. She shivered at the thought of that bare sterile room and the shining table. Death was not a pretty thing. But she could meet it with resignation if not with courage. She had already seen too much for it to have any meaning. She did not falter as she placed a finger on the elevator button.

Poor Walter—she sighed. Sometimes it was harder to be among the living. It was good that she didn't let him know how she felt. She had sensed a change in him recently. His friendly impersonality had become merely friendly. It could, with a little encouragement, have developed into something else. But it wouldn't now. She sighed again. His hardness had been a tower of strength. And his bitter gallows humor had furnished a wry relief to grim reality. It had been nice to work with him. She wondered if he would miss her. Her lips curled in a faint smile. He would, if only for the trouble he would have in making chaos out of the order she had created. Why couldn't that elevator hurry?

Mary! Where are you going?" Kramer's voice was in her ears, and his hand was on her shoulder.

"Don't touch me!"

"Why not?" His voice was curiously different. Younger, excited.

"I have Thurston's Disease," she said.

He didn't let go. "Are you sure?"

"The presumptive tests were positive."

"Initial stages?"

She nodded. "I had the first coughing attack a few minutes ago."

He pulled her away from the elevator door that suddenly slid open. "You were going to that death trap upstairs," he said.

"Where else can I go?"

"With me," he said. "I think I can help you."

"How? Have you found a cure for the virus?"

"I think so. At least it's a better possibility than the things they're using up there." His voice was urgent. "And to think I might never have seen it if you hadn't put me on the track."

"Are you sure you're right?"

"Not absolutely, but the facts fit. The theory's good."

"Then I'm going to the clinic. I can't risk infecting you. I'm a carrier now. I can kill you, and you're too important to die."

"You don't know how wrong you are," Kramer said.

"Let go of me!"

"No—you're coming back!"

She twisted in his grasp. "Let me go!" she sobbed and broke into a fit of coughing worse then before.

"What I was trying to say," Dr. Kramer said into the silence that followed, "is that if you have Thurston's Disease, you've been a carrier for at least two weeks. If I am going to get it, your going away can't help. And if I'm not, I'm not."

"Do you come willingly or shall I knock you unconscious and drag you back?" Kramer asked.

She looked at his face. It was grimmer than she had ever seen it before. Numbly she let him lead her back to the laboratory.

But, Walter—I can't. That's sixty in the past ten hours!" she protested.

"Take it," he said grimly, "then take another. And inhale. Deeply."

"But they make me dizzy."

"Better dizzy than dead. And, by the way—how's your chest?"

"Better. There's no pain now. But the cough is worse."

"It should be."

"Why?"

"You've never smoked enough to get a cigarette cough," he said.

She shook her head dizzily. "You're so right," she said.

"And that's what nearly killed you," he finished triumphantly.

"Are you sure?"

"I'm certain. Naturally, I can't prove it—yet. But that's just a matter of time. Your response just about clinches it. Take a look at the records. Who gets this disease? Youngsters—with nearly one hundred per cent morbidity and one hundred per cent mortality. Adults—less than fifty per cent morbidity—and again one hundred per cent mortality. What makes the other fifty per cent immune? Your crack about leather lungs started me thinking—so I fed the data cards into the computer and keyed them for smoking versus incidence. And I found that not one heavy smoker had died of Thurston's Disease. Light smokers and nonsmokers—plenty of them—but not one single nicotine addict. And there were over ten thousand randomized cards in that spot check. And there's the exact reverse of that classic experiment the lung cancer boys used to sell their case. Among certain religious groups which prohibit smoking there was nearly one hundred per cent mortality of all ages!

"And so I thought since the disease was just starting in you, perhaps I could stop it if I loaded you with tobacco smoke. And it works!"

"You're not certain yet," Mary said. "I might not have had the disease."

"You had the symptoms. And there's virus in your sputum."

"Yes, but—"

"But, nothing! I've passed the word—and the boys in the other labs figure that there's merit in it. We're going to call it Barton's Therapy in your honor. It's going to cause a minor social revolution. A lot of laws are going to have to be rewritten. I can see where it's going to be illegal for children not to smoke. Funny, isn't it?

"I've contacted the maternity ward. They have three babies still alive upstairs. We get all the newborn in this town, or didn't you know. Funny, isn't it, how we still try to reproduce. They're rigging a smoke chamber for the kids. The head nurse is screaming like a wounded tiger, but she'll feel better with live babies to care for. The only bad thing I can see is that it may cut down on her chain smoking. She's been worried a lot about infant mortality.

"And speaking of nurseries—that reminds me. I wanted to ask you something."

"Yes?"

"Will you marry me? I've wanted to ask you before, but I didn't dare. Now I think you owe me something—your life. And I'd like to take care of it from now on."

"Of course I will," Mary said. "And I have reasons, too. If I marry you, you can't possibly do that silly thing you plan."

"What thing?"

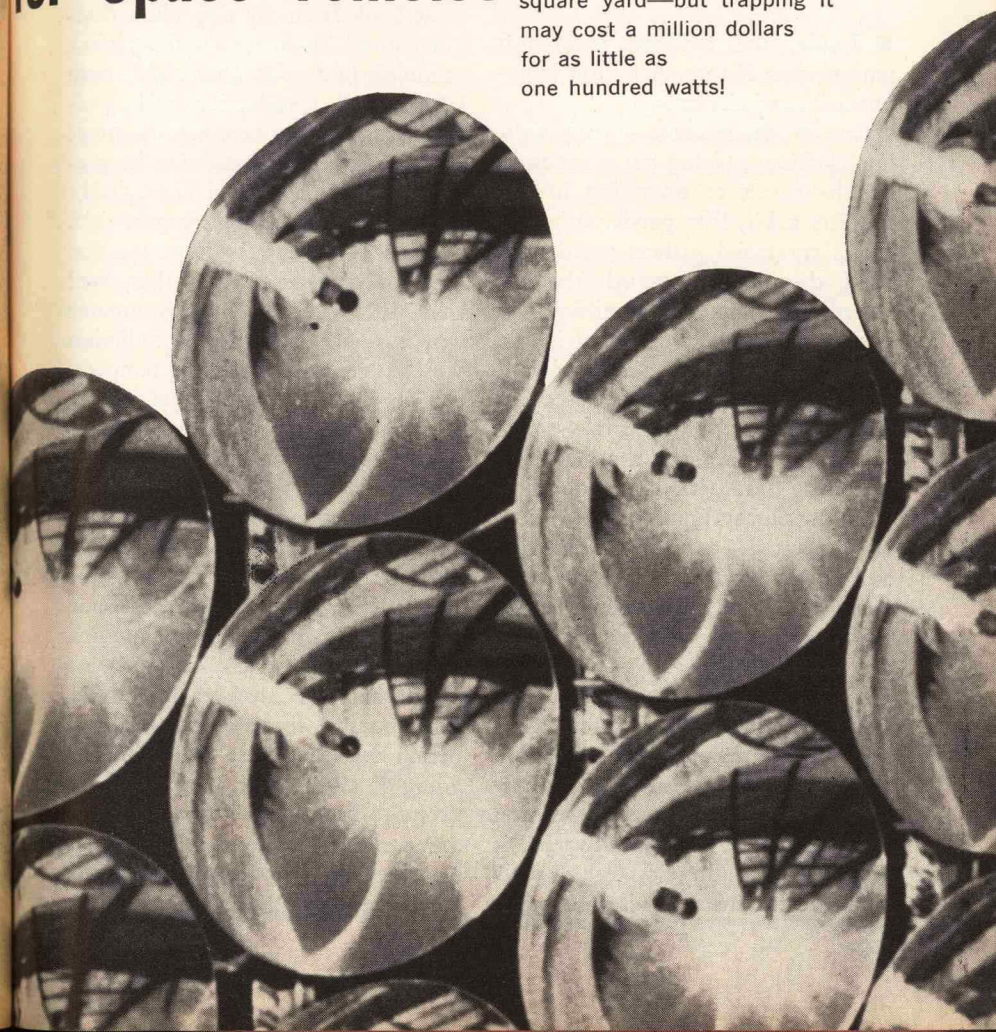
"Naming the treatment Barton's. It'll have to be Kramer's." ■



# Power Supplies for Space Vehicles

BY J. B. FRIEDENBERG

It takes multi-millions of horsepower to launch a space vehicle—but once in space, a few watts of electric power becomes enormously expensive. Sure, there's one horsepower of solar energy falling on every square yard—but trapping it may cost a million dollars for as little as one hundred watts!



## PART 1: NO MOVING PARTS

■ Inside, the strident, medium-fi tone reaches X-zero. A button is depressed; a switch closes.

Outside, the monster—gently sighing, clicking, gasping out a vaporous breath—comes to shattering life. It staggers a bit, lifts ponderously, becomes surer and gathers speed unto itself, then hurtles toward "that inverted bowl," the sky. A million feet later, it shakes loose a part of it that has by then become nothing but a nuisance, and—in a silence as shattering as the concert at liftoff—coasts up and up in a gentle arc.

During this period, no longer is the beast clumsy, bumbling. Now it is alive, sentient, palpably feeling for and eagerly awaiting a word of command from the planetmaster below, or from the tiny, whirring programmer in its gut.

This time of silent coasting is spent in a somewhat leisurely manner, and is a period of contemplation on the part of the beast: exactly how does my centerline point in relation to the planet below? Exactly what is my velocity at any instant? Exactly what are the instant-to-instant co-ordinates of my path? Exactly what parts of the earth's horizon am I seeing with my so-sensitive IR optic? Exactly what nose down-or-up push must I ask from my tiny pitch reaction control jets to assume the perfect attitude? Ditto for nose right, nose left, and roll. (Aside: it must be perfect, for otherwise how can the beast align itself perfectly and thus be prepared to fire its second-stage rocket at the one holy location in space-time which will allow it to leave the one orbit and transfer to the other, final orbit?) How are all my instruments working—accelerometers, radiation sensors, vibration pickups, temperature probes, potentiometers, gyros, pressure probes, troubleshooting instruments of all types. How is the pressure in my tanks? If it isn't just so, my propellant pumps will cavitate. How is the pressure in my high pressure helium spheres? What is the speed of my turbine? All these, and many more hypochondriacal queries.

Notice—these questions are being asked, and the answers monitored, continuously; there is no real rest period for the beast—something is going on all the time. Nothing glamorous, to be sure. The big glamour of a space shot—at least as far as lay observers are concerned—occurs at launch, when all the flame and fury is unleashed, and the vehicle "disappears in the clouds high above"—this is the part that can be seen. And there's lots of glamour in "striking in the target area, only 1.6 miles from the target," or in "the finest orbit to date, almost perfectly circular and only 7.4 miles short of the specified altitude," or "hurtling silently about our planet, watching and sending information, unseen and unheard. The next six orbits will be over Soviet territory." And so on.

Good. Let there be glamour! Glamour has a habit of begetting dollars, a very useful commodity in this business.

But what is it that permits such things as standing balanced on a thin plume of orange fire, striking in the target area, assuming and maintaining hairline attitude and altitude, watching, receiving information and sending same, continuously controlling attitude, accepting commands and acting upon them—in short, the performance of the vast multitude of small, unglamorous tasks that all sophisticated exoatmospheric vehicles must perform in the discharge of their divers duties?

Sound and fury are obviously a must; without a huge push, the beast cannot leave the ground to begin its odyssey. But this is far from enough to satisfy the intricate and far-reaching objectives presently before us, and which will become more sophisticated by several orders of magnitude in the somewhat near future.

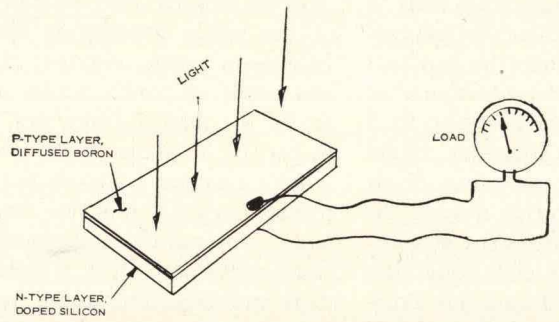



*Fig I: Solar Cell*

In order to satisfy these objectives, we must have available at our fingertips, pinpoint, hairline control. Control on timing, on flight path, on rocket engine start, stop, and restart, on autopilot functions, on telemetering functions, on camera functions, on IR seeker functions, on rocket engine gimballing—both first- and second-stage—on stage separation, on reaction controls, on retro rockets, and you name it. From the moment of liftoff—no, from prior to that moment—these control efforts are in process, some intermittently, some continuously.

The basic, fundamental requirement lying at the bottom of all the activity described above is symbolized by the small word "Power." This manuscript, being interested mainly in the electrical power requirements of space missions, accordingly will present the problems and solutions from the electrical point of view.

The electrical power required to perform the hundreds of long and short term jobs during a space mission is measured, for each discrete job, in fractions of a horsepower for the most part, and occasionally a horsepower or two. Not very glamorous, and a far cry from the hundreds of kilos of horsepower represented by the awesome diamonds blasting from the rocket nozzles. Quiet little chunks of power, unobtrusively but firmly going about the job of making the mission a success, from the very beginning to the very end. Long after Big Glamour has halted his bombast, long after all the air in the world is far away, the steady, everlasting requirements for power remain, and must be satisfied. And the nasty part of the whole situation is that any failure—or even intermittency—in the supply of power, results in failure of the mission objectives, either in part or in whole.

Let's examine a hypothetical, reasonably typical mission, and see where the power requirements lie, and—a question which is taking up more and more time in the world of space science—how is this power developed? A representative state-of-the-art mission—which can be defined as the Best of Now—serving as a good vehicle for defining those periods wherein power requirements exist, is the overall mission of an active communication satellite. Examining the mission, we find that it breaks down into rather definite regimes, thus making somewhat disciplined the study of power requirements. In our example, we'll assume that the complete vehicle consists of an Atlas booster, on top of which is installed an upper stage of the Agena family, containing the satellite payload in its protective shroud. The Atlas is really a stage-and-a-half vehicle, consisting of a big collar holding two large thrust chambers of 150,000 pounds apiece, plus the central tankbody that holds the single sustainer chamber of 60,000 pounds thrust. The collar and its two chambers are jettisoned after about 140 seconds, and the sustainer, which has fired right along with the other two motors, continues firing for about 160

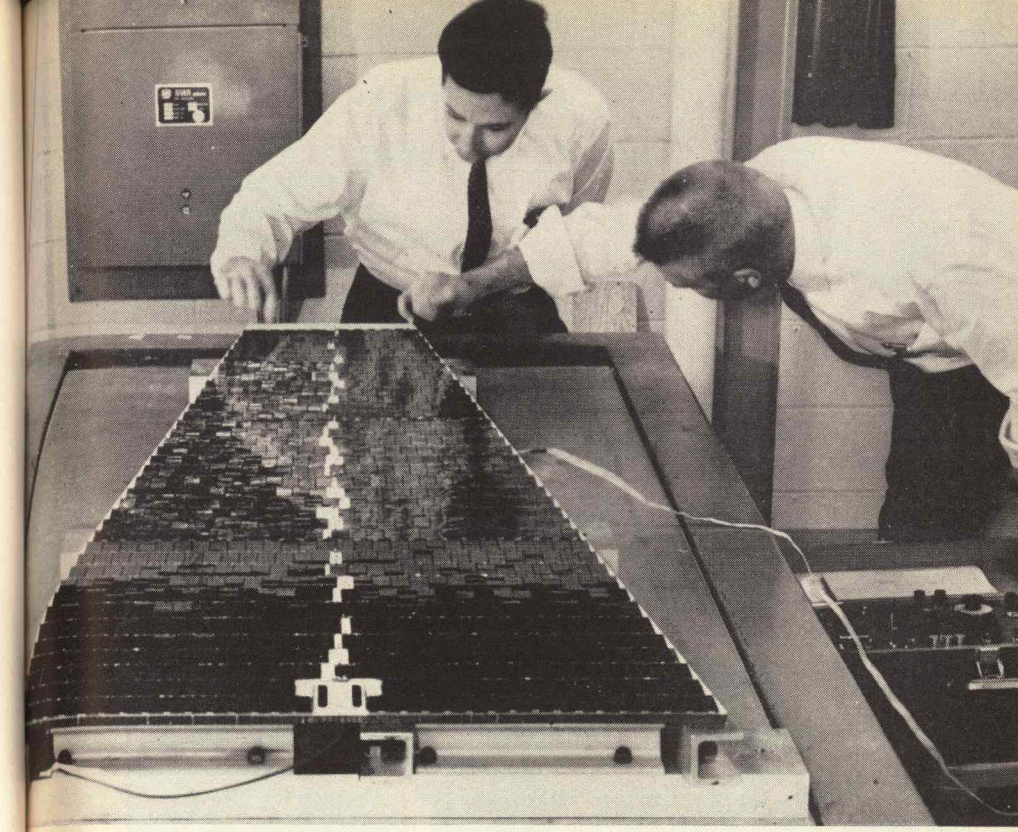
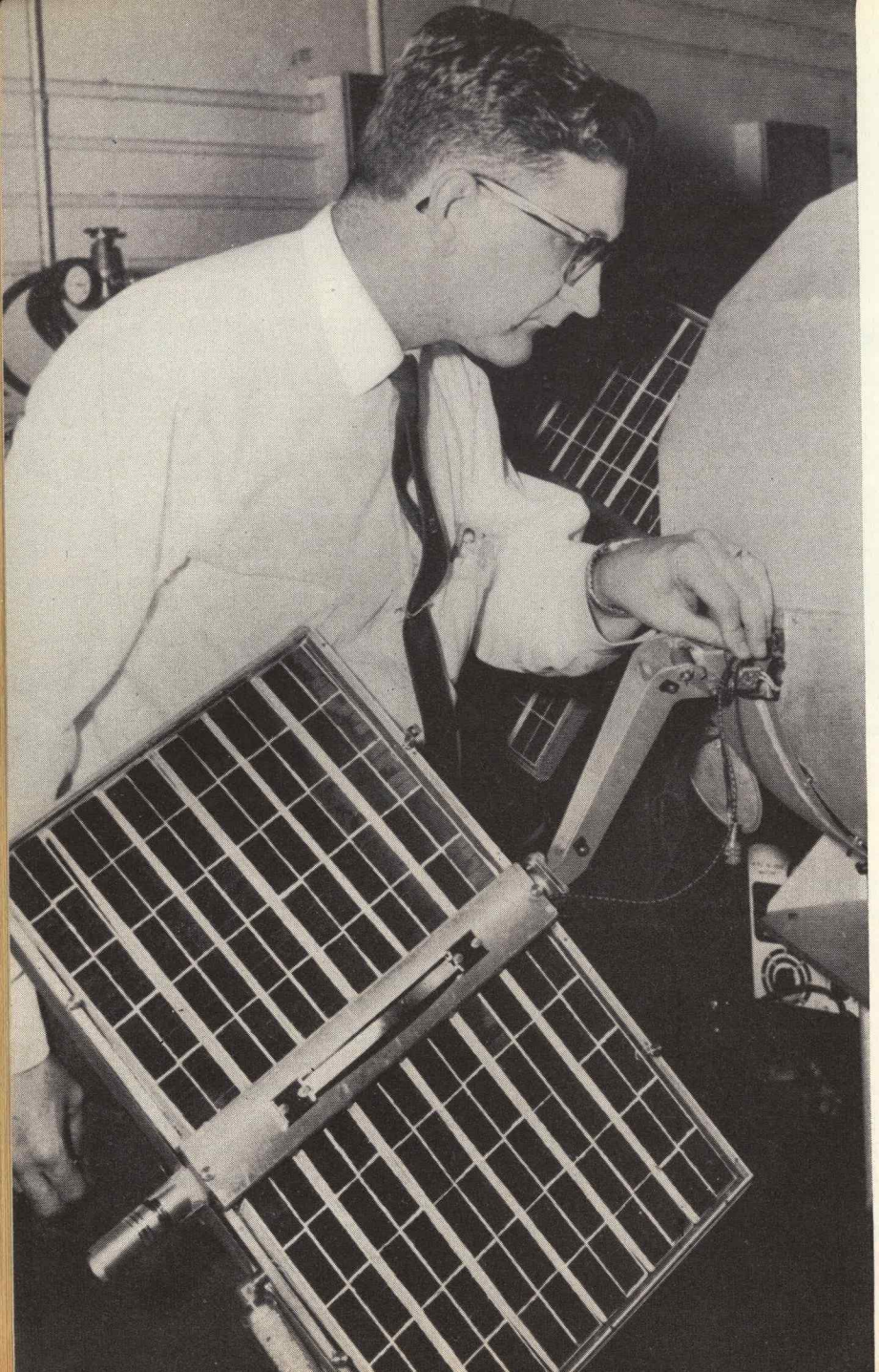


*Fig. II: Checking out a solar power converter panel built for the JPL Ranger RA-1 Space Probe. The panel will provide about 90 watts of continuous electrical power, contains 4,340 individual silicon solar cells, and weighs 19 pounds. Panel was built by the Semiconductor Division of Hoffman Electronics Corporation.*



more seconds before it separates from the Agena vehicle. The Agena contains a single chamber of 16,000 pounds thrust, and in our example is an advanced type which can be re-started in deep space.

Now we're ready to break the mission down into the aforementioned flight regimes:

1. *Launch.* The launch phase lasts for about 5 minutes—the 140 plus 160 seconds mentioned above. At first boost cutoff, acceleration is about 5.6 gees, and at sustainer cutoff, about 3.1 gees. Atlas separates and falls to earth. Agena ignites, fires for 40 seconds, kicking the vehicle into coast orbit, then shuts down.

2. *Coast.* Directly after cutoff of the sustainer, the horizon sensor and a directional gyro in the Agena vehicle are actuated by an accelerometer which sensed the abrupt change from 3.1 gees to zero gees. The gyro is brought up to speed, and the horizon sensor begins to search for the preselected segments of the earth's horizon, so that when the Agena Engine does fire, the vehicle's directional reference will be aligned just so. In our case, the coast period will be scheduled as a parking orbit of perhaps six hours, to await the proper time for orbit exchange. During this period, the vehicle aligns its centerline with the programmed gyro reference, via use of its small reaction jets, and thus automatically aligns the Agena engine so that, at the proper moment, in response to either a signal from the tracking station on the ground, or from a timer-programmer in the vehicle, the Agena engine is re-ignited.

3. *Transfer Ellipse.* Under this rocket thrust, the Agena vehicle, with its satellite payload, accelerates and slides outward towards its desired final communication orbit. Now, a preset programmer, working with the axial accelerometer, tells the Agena engine when to cut off. In this case, cutoff occurs 220 seconds after restart, and the vehicle then falls into orbit. Just prior to cutoff, the acceleration is 3.75 gees. Immediately after cutoff, two actions take place: the protective nose shroud is split like an orange peel and is jettisoned by explosive bolts and/or springs, and the Agena vehicle, consisting of propellant tanks, gas bottles, structure, and rocket engine, is separated by a system of explosive bolts and is cast off by means of a small retro-rocket which gives it a backward push. Now the satellite, naked, starts its indefinitely long journey around the earth.

*Fig. III: Close-up of a "paddle" on the Pioneer V satellite, showing the Hoffman silicon solar cells which convert sunlight into electricity to power the radio communications equipment on the satellite. Orbited March 11, 1960, the Pioneer V is now using solar power to send information to earth from many millions of miles out in space.*

4. *Communication Orbit.* The satellite is now positioned thousands of miles away from the earth, and is rotating about earth in a nearly circular orbit, in some definite period depending on the pre-arranged orbital diameter. From here on, it must maintain definite attitudes, so that its receiving and transmitting antennas are oriented properly at the correct times in each circuit. The various attitudes required during mission life are maintained through the actions of the horizon sensors, the gyros, autopilot system, and the attitude control system, which may be a set of tiny gas jets, a set of inertia wheels driven by small electric motors, or an ingenious combination of both. The satellite's primary mission, that of receiving a message from earth and relaying it to another spot on earth, or to an aircraft flying at a certain latitude and longitude, is henceforward its only activity.

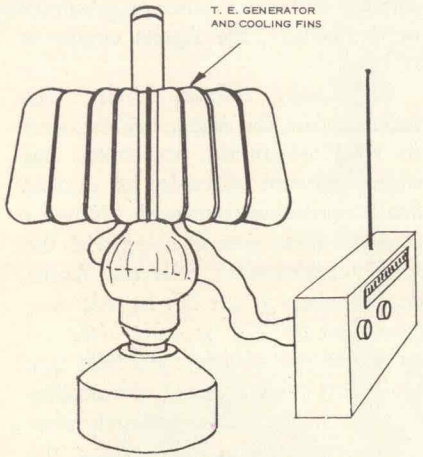
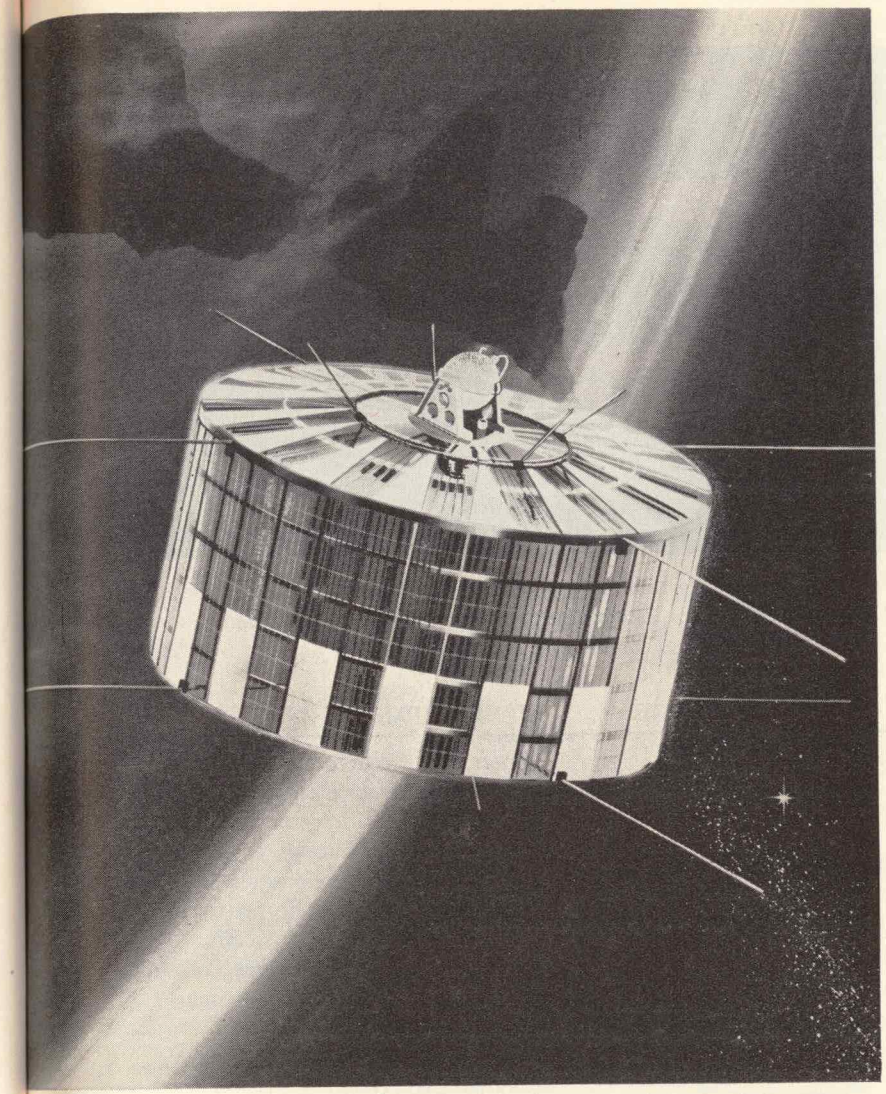



*Fig. IV: Russian thermoelectric generator using heat from kerosene lamp chimney.*

At present, these missions are being planned to take anywhere from a few days to over a year, by both military and commercial groups. Once again, we must point out that not one tiny portion of the mission, from launch to completion, is possible without electrical power. And this power must come from some mechanism which is part and parcel of the vehicle. How do we get the power? Where does it come from? Remember, the communication satellite may be called upon to operate for a year or more, during which time the electrical power demands of the satellite's communication apparatus are, when averaged out, relatively high. Typical power profiles for the orbital portion of the mission run from a steady minimum of perhaps thirty watts, to peaks of twelve hundred watts, with the cycle occurring many times each day.

Now let's examine the various activities going on during the flight regimes outlined previously. This will give a general picture of the myriad of jobs continually in process, that require electrical power for successful prosecution of a communication satellite mission.





The Martin Company

*Fig. V: Two for the price of one. The main power supply for this Transit satellite is a silicon solar-cell array on its drum-shaped sides, essentially similar to that on the Tiros satellites. But riding on top is a small white sphere, containing a thermoelectric generator, powered by the heat from the spontaneous decay of plutonium-238 which is being space-tested as a passenger on the main instrument-package.*

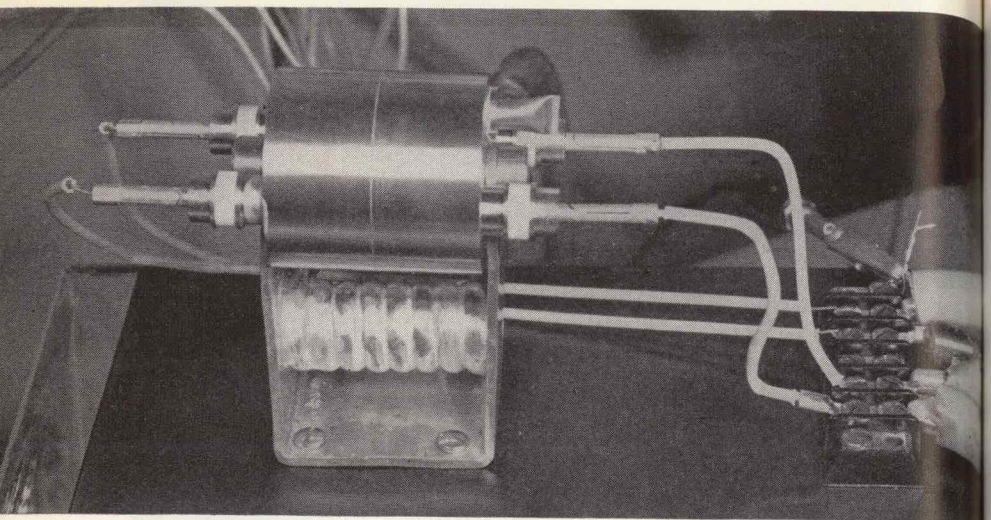


*Fig. VI: Electrically simulated isotopic thermionic converter developed by Thermo Electron for the Atomic Energy Commission under a subcontract with the Martin Company.*

| FLIGHT REGIME | EQUIPMENT USING POWER |
|---|---|
| 1. Launch. | Timers and programmers.<br>Platform gyros, torquers, potentiometers, etc.<br>Rate gyros.<br>Autopilot feedback loops, amplifiers, relays.<br>Inertial guidance accelerometers, integrators.<br>Flight path computers. Propellant valving.<br>Rocket engine start-stop circuits.<br>Rocket engine gimballing mechanisms.<br>Tracking and range safety beacons.<br>Telemetry and instrumentation.<br>Interstage separation system.<br>Command receiver. |
| 2. Coast—Parking Orbit. | Horizon IR sensors.<br>Directional and rate gyros, etc.<br>Accelerometers and potentiometers.<br>Autopilot functions, circuitry.<br>Inertial guidance system.<br>Command receiver.<br>Telemetry and instrumentation.<br>Flight path computer. Reaction control system.<br>Timers and programmers.<br>Beacons. |
| 3. Transfer Ellipse. Including rocket engine start, stop, and orbit injection. | Rocket engine arm and fire circuits.<br>Propellant valving and sequence circuits.<br>Command receiver. Reaction controls.<br>Autopilot functions.<br>Inertial guidance system.<br>Gyros, potentiometers, accelerometers.<br>Beacon.<br>Telemetry and instrumentation.<br>Flight path computer. Programmer, timers.<br>Flight control system, rocket gimballing. |
| 4. Final Orbit. | Stage separation pyrotechnics.<br>Retro rocket ignition, arm circuitry.<br>Protective shroud pyrotechnics.<br>Satellite reaction jets.<br>Antenna, paddlewheel erection systems.<br>Inertia wheel motors.<br>IR Sensors, gyro motors.<br>Telemetry and instrumentation.<br>Beacon.<br>Temperature control system.<br>Receivers and transmitters. |



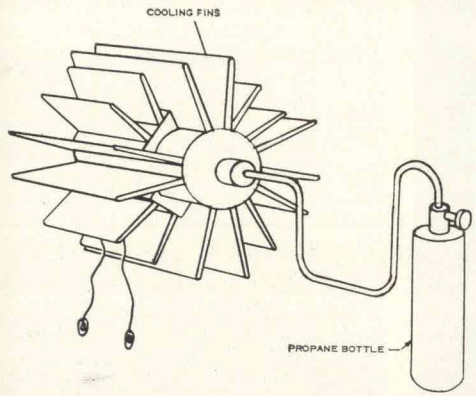



*Fig. VII: General Instruments Corporation. T.E. Generator.*

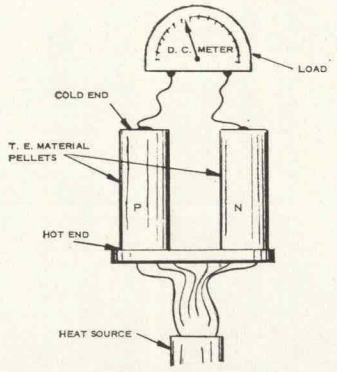
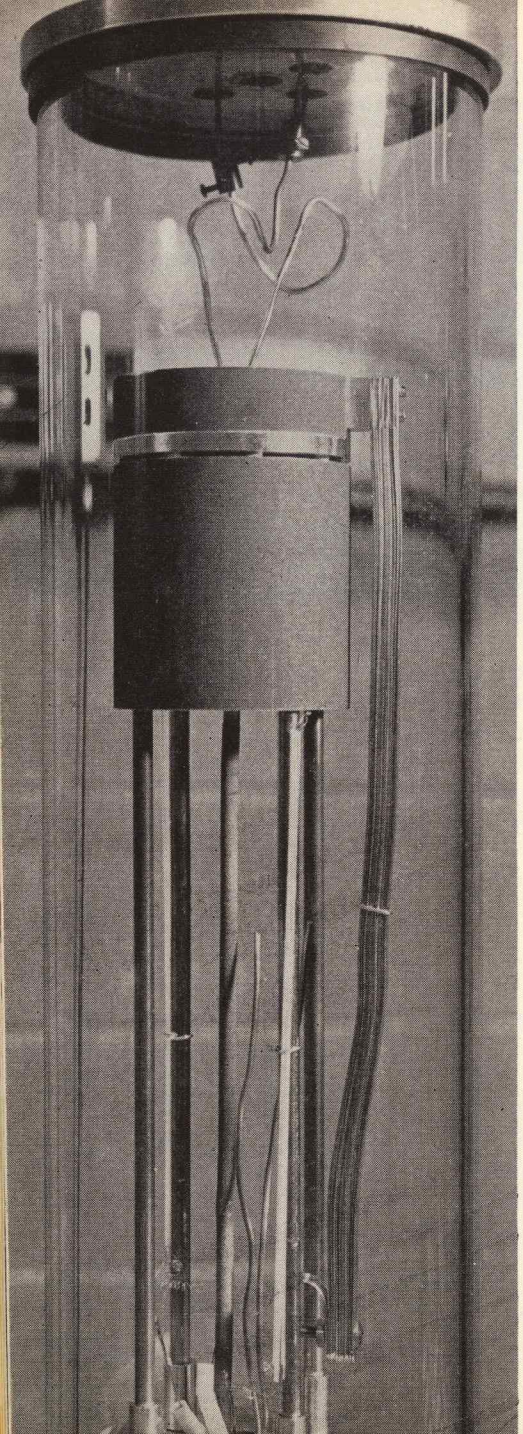



*Fig. VIII: Basics of T.E. Generator, showing one junction.*



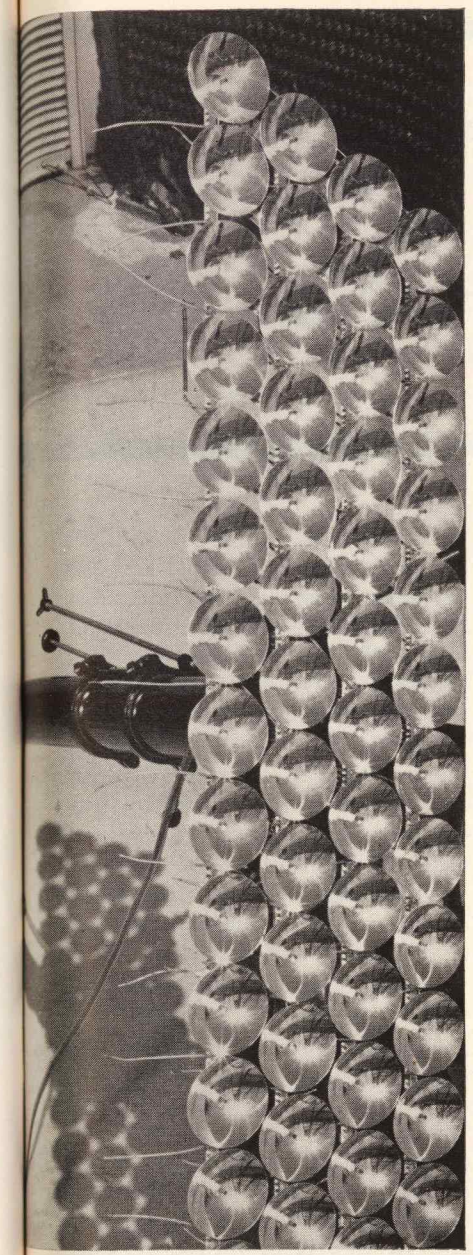
Up to now, we have cast a cursory glance at a typical communication satellite mission. This glance has told us something about the various flight phases, and some of the operations, function, and equipment that require electrical power. Once again, now, comes the pressing question: how do we supply this power, and how do we keep it in good supply for periods of a year, untended in the abysmal cold, blazing hot, pitch black, stark white fastnesses of outer space?

During certain phases of the flight, it is "easier" to supply power to the vehicle than during other phases. The "easy" phases—quotes used advisedly —start on the ground and continue throughout launch, coast, transfer ellipse, and up to the point of Agena stage and shroud jettison. For instance, during the launch phase, the big Atlas booster's large battery pack assumes the chore of providing all electrical power even before liftoff, and does all the required jobs until Agena stage separation. From this point to the disgorging of the satellite, the big Agena battery package takes over, continuing the good work.

But now things change radically. No longer is a battery pack of any use alone; the length of time in the communication orbit precludes this. Now we have to become really ingenious; we've got to fight Nature tooth and nail, and at the same time woo her passiontely, in order to keep the spark of life in our tiny machine. There we are, far from Mother Earth, and not an electrical socket or generator in sight.

*Left. Fig. IX: 200 watt 13% efficient solar thermionic converter developed by Thermo Electron for the Aeronautical Systems Division at Wright-Patterson Air Base, Ohio, under a subcontract with Thompson, Ramo, Wooldridge, Inc.*

*Right. Fig. X: T.E. Generator developed by Hamilton Standard.*



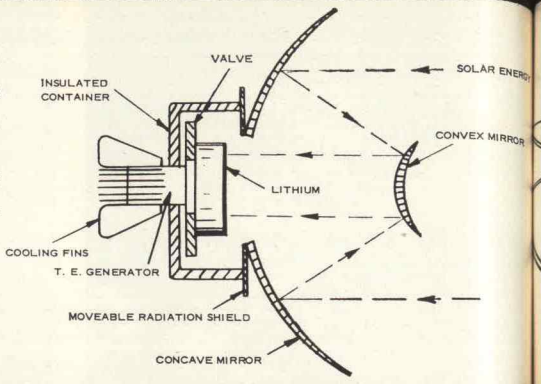
A moment! There may be no socket, but there sure is one whale of a generator! The same generator that sparks you and me and every other living thing in the solar system. There's a key phrase: solar system, with a key word, "solar," which translates in our case into "Good Old Sol."

Let's take a look at electrical power generation.

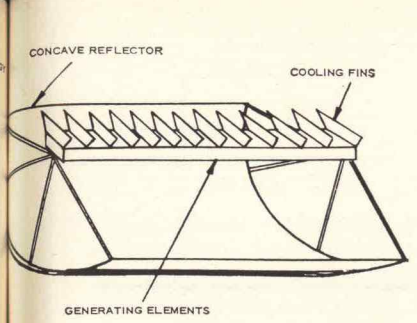
We are all familiar with the methods used to generate electrical power on the ground. These methods are all an outgrowth of Maxwell's development of the principle that a current is built up in a conductor when said conductor traverses a magnetic field in a specific manner. Really, the main differences between the various methods of present-day power generation lie not in the generators themselves, but in the prime movers.

Prime moving energy, with the exception of a few relatively unimportant methods used here and there, comes from two main sources: the combustion of fossil fuels, and the kinetics of flowing water. Oil and coal, combined with oxygen at high temperature, provide the energy for boiling fluids, or for generating gases

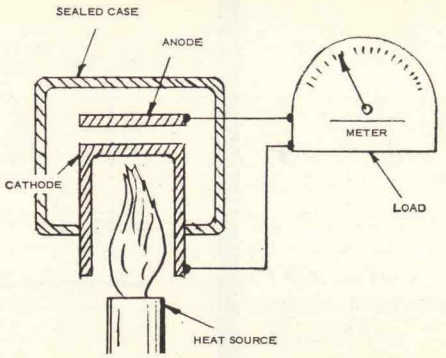
*Right. Fig. XI: T.E. Generator using lithium for heat storage.*




*Center. Fig. XII: T.E. Generator—simple reflector.*




*Left. Fig. XIII: Thermionic Generator—basic elements.*




directly, which are then used to turn turbine wheels which in turn rotate generator rotors. Burning gasoline provides the energy for all sorts of small generating plants, even in moving vehicles. The flow of water is directed through turbines to turn generator armatures in large stationary generating plants. In a few localities, some slightly more exotic methods are used. There are a number of large aerodynamic generating stations—to be pedestrian, call them windmills—situated in areas where there are strong and prevailing winds, but these are mostly trial facilities and cannot compete economically with the highly developed steam, Diesel, and water-generating units. In some other particularly fortunate areas, subterranean or volcanic steam is being used to run turbine generators; the area that comes immediately to mind is New Zealand. Other methods that have been proposed were to use the motion of the tides, the temperature differential between the ocean bottom and surface, and to cover acres of southwest wasteland with surfaces that collect sun heat and reflect same onto steam boilers.

The generating methods presented above are, to be sure, good, solid, highly developed, and quite efficient. However, when we try to apply them to operations in space, we immediately run into a hitch or two that very effectively blocks us. These hitches are very simple and elemental: no oxygen and no water!

In discussing auxilliary power supplies for space vehicle application, it seems fairly safe to discard such energy sources as flowing water, volcanic steam, and prevailing breezes. Which brings us to the point of choosing a logical source of energy for use in a very strange environment. What are these energy sources, how are they being used at present, and how are they being proposed for use in the future?

First off, let's examine, in a very unspecific manner, general methods that can be used to generate power in a space vehicle. Quite simply, energy is available from two locations: external to the vehicle, or from inside it. Pressing the examination a little farther, the single major source of energy external to the vehicle is the Sun; internal energy sources are either chemistry based or nuclear. The following table gives a breakdown of these major categories into system types:

| *General Energy Source.* | *Energy Conversion System.* |
|---|---|
| External—Solar. | Photovoltaic—Solar Cells.<br>Thermoelectric.<br>Thermionic.<br>Turbine/Alternator.<br>Stirling Engine. |
| Internal—Chemical or Nuclear. | Batteries.<br>Fuel Cells.<br>Thermoelectric.<br>Thermionic.<br>Gas Generator/Turbine.<br>Magnetohydrodynamic. |

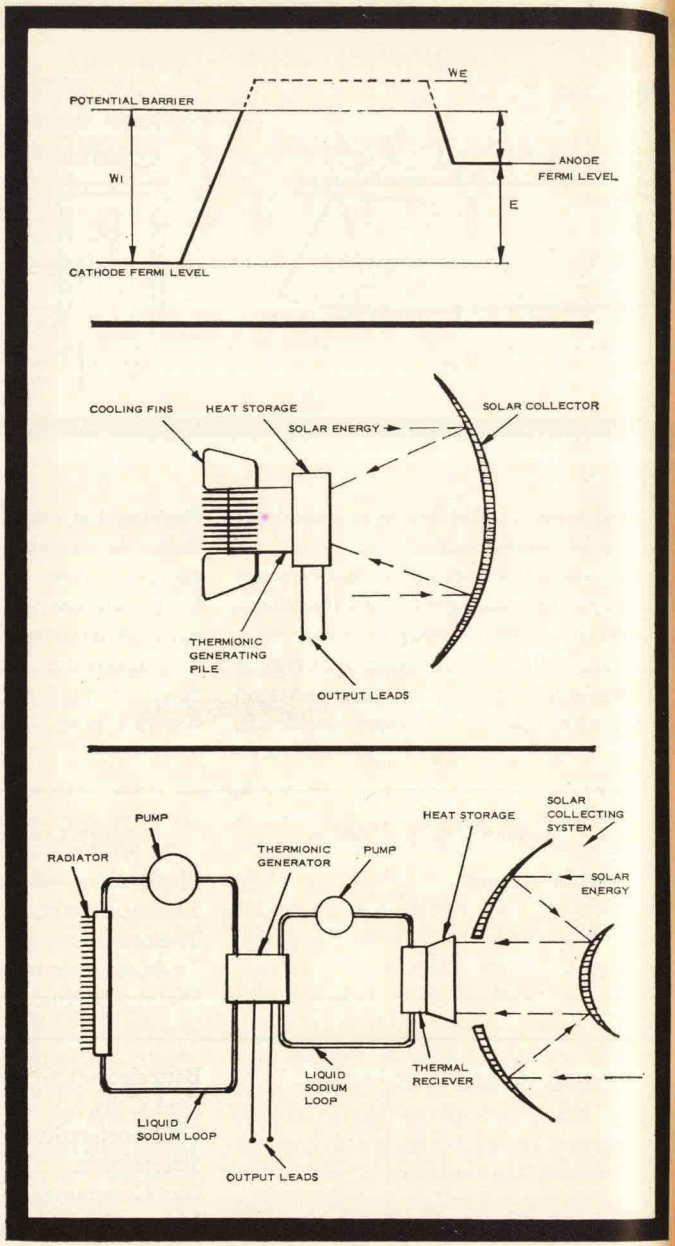



*Fig. XIV: Potential energy diagram of electron moving from heated cathode to cool anode.*

*Fig. XV: Simple thermionic systems, designed for low power output.*

*Fig. XVI: Sophisticated thermionic system, designed for high power output.*



This paper will not attempt to describe chemical or nuclear systems, but will only cover the solar-powered systems, as categorized in the table above.

*Photovoltaic—Solar Cells:* Sometime during the early nineteen hundreds, it was discovered that a plate of metal covered with copper oxide would generate an electric current when illuminated. This discovery started a very desultory quest for a device that would deliver copious quantities of electrical power from direct illumination by sunlight. The search idled along, with the technique being mistily lost and rediscovered, until in very recent years the circumstances surrounding impending flight into space lit a big fire under it, and now the solar photovoltaic power device is the basis for a full-fledged effort in many laboratories and plants around the globe. The attractions of the solar cell are numerous: they are simple, containing no moving parts; for the same reason, they provide at least an approach to being foolproof, and with reliability of space devices carrying the importance that it does, this is no mean factor; they are easily manufactured after the initial setup, and lend well to high reproducible production rates; they are easy to package and install, and are fairly rugged; they are beginning to show reasonable efficiencies; they fit into the space environment very well.

The solar cell, as presently developed, is essentially an application of semiconductor technology. In its most common form, the solar cell is formed of a thin film of semiconductor material cemented to a wafer of metal. Semiconductor materials such as selenium, and a metal such as iron, comprise one of the standard commercial material combinations used in the "light" cells that go into the makeup of such items as photograhic light meters and some door-opening systems. These cells, when illuminated, develop enough of a signal to use in applications where tiny amounts of power are required, or where amplification is simple. In the case of a selenium cell, under the most advantageously filtered light conditions, the power efficiency is about 1.4%, the output may reach a level between 3 and 20 milli-volts.

Note usage of the term "most advantageously filtered". This is due to the fact that the efficiency of solar cells—and it depends upon the material combinations—reaches a peak at different Angstrom levels; selenium's peak is at 5461 A. However, when we apply the illumination of full sunlight, accepting the great Angstrom spread of the spectrum, the efficiency of the selenium cell drops to 0.2%, and the power output falls accordingly. It is obvious that the selenium cell will not fill the bill for a space power supply. The requirements of a space-travelling vehicle such as the Communication Satellite are relatively high, reaching a thousand watts or more. At the present time, the best material available for easily produced, reliable, high-power-output solar cells is silicon.

Silicon solar cells are being used in all space vehicles whose missions call for this general type of power supply. Available in production quantities, these cells are now giving upwards of 10% conversion efficiency, with some claims running as high as 15%, and over 20% predicted for the near future. Hundreds and thousands of them are used in each vehicle, and with mission complexities rising and power requirements going up, the few companies producing the cells have a waiting market. However, it is not all beer and skittles in the solar cell business. For instance, only about half of the cells manufactured will satisfy the applicable specifications, and this is a vast improvement over the figure of one-tenth which prevailed about three years ago! Naturally, this is a factor in the high cost of the cells; a few years ago, they were priced at somewhere between $300 and $400 per cell—yes, you read correctly, per cell! When you figure that a vehicle such as Tiros I uses 9200 cells, it becomes a bit shocking to realize the price being paid for a power supply that reaches a peak of the same order of magnitude as two of your car batteries! Total cost—$40. At the present time, due to vast improvements in production methods, things are a lot better; the cost of a high-efficiency solar cell is now in the general range of $25 to $50.

The prevailing concept of the inner workings of a solar cell is in line with present semiconductor theory. Of all the variables that affect the operation of the solar cell, those with the greatest impact pertain to the physical properties of the cell structure. Silicon in its pure state is a pretty good insulator, but fortunately can be transformed into a pretty good semiconductor by a process known as "doping." Doping is the addition of tiny quantities of impurities to the pure material; judicious selection of the impurity material and its quantity then controls the polarity, and even the "strength" of the polarity, of the resulting semiconductor crystal. Depending upon the objectives you have in mind, the doping process used to transform the pure silicon into a polarized crystal requires somewhere between one part of impurity per hundred million, and one part per billion! The process results in a crystal that has a disordered lattice structure, in which free electrons or positive-site holes can be moved about under some outside influence.

In order to manufacture a silicon solar cell, the silicon, which has a valence of 4, is initially doped with a 5-valence element, such as arsenic or antimony. This may be done in the original manufacture of the silicon crystal by adding the proper microscopic amount of the desired impurity to the melt. The resulting crystal then contains an extra electron wherever there is a finite junction between the silicon and the impurity. In the case of silicon doped with antimony, the crystal becomes a negative (n) type semiconductor. It is then sliced into wafers of about a square inch in area, and .016 inch thick. The next step in forming the wafers into solar cells is to expose one surface of the wafers to boron vapor, which diffuses into the n-type silicon. The process of diffusion is allowed to proceed until the thickness of the diffused layer is about .0001 inch. Because boron is a 3-valence element, its junction with the silicon produces the opposite effect from the antimony doping; that is, it results in electron shortages, or the formation of holes which represent positive charge sites. Now we have the complete generating unit, consisting of a positive-on-negative semiconductor wafer.

Briefly, the solar cell wafer functions like this. The doped n-type silicon surface has the characteristic of a high density of free electrons. On the other hand, the boron diffused surface is a positive (p) type semiconductor, having a deficit of free electrons, but a high density of electron vacancies, or holes, which are positive charge sites. Thus, in the p-type surface, electric current consists of an activity called a migration of holes. The vague region between the p and n type materials is called the barrier region.

Exposure of the boron-diffused surface to light results in light absorption to a depth of about one-ten-thousandth of a millimeter. Each photon absorbed displaces an electron, thus producing both a free electron at a certain energy level, and an electron vacancy or hole. Remember that the original p surface had a dearth of free electrons compared to the hole density. The effect of the photon absorption, therefore, is to increase the ratio of free electron density to hole density by a very large factor. Under these conditions, that portion of the free electrons whose energy has been raised sufficiently by collision with the photons, will move across the barrier region into the n-type material, creating an overcrowded condition, and essentially squeezing out a number of the free electrons already present in that material. These are then available to move into an external circuit and do work. Incidentally, temperature has quite an effect on the cell output; a rise in temperature results in a considerable lowering of output. At room temperature, a silicon solar cell of standard 10% efficiency will generate about .017 watts.

A simple line drawing of a solar cell is shown in Fig. I.

At the present level of space vehicle development, power supplies based upon solar cells are the only practical systems available for long duration missions. In fact, for any orbital mission lasting more than a week, this type of system is at present far and away the best from every point of view, especially if the power level requirements remain below a steady load of 200 watts, with peak loads of about 1200 watts. Of course, with the major effort presently being placed upon solar cell development, we can expect rather startling output and efficiency jumps, and in fact mili-

tary people are projecting this type of system as being competitive up to power levels as high as 50 kilowatts.

One of the nasty problems with which this system must contend is the complex one of orienting the cell array. The array panels must be oriented within about plus or minus 10 degrees of perpendicularity with the sun for optimum results. This rather large tolerance on angularity before the output drops alarmingly off the top of the curve is accounted for by the fact that power output drops as the cosine of the angle of incidence. Much development is now going into the orientation problem, and the solar cell arrays will do even better than they are presently doing as soon as a reliable, accurate closed-loop orientation system, that can be easily packaged, is developed. At present, paddlewheel designs provide enough cell area to take care of non-optimum conditions. This sort of problem also occurs on the solar cell arrays used on satellites such as Tiros, in which the array covers most of the surface of the satellite itself. Tiros I rode in its orbit in a spin stabilized condition, with its spin axis fixed inertially, and as a consequence, only a small part of its array could feel direct sunlight at any instant. It is pretty obvious that a nonoriented system requires many cells than does an oriented system. Nevertheless, it certainly is a simple way to do the job, and right now is probably the most reliable cell configuration.

Orientation is only one of many problems. For instance, what do we do when the satellite is traveling, during its orbital period, in the earth's shadow? This is a problem that is relatively simple of solution: we install chemical batteries, and we charge the batteries from the solar cells during that period of the orbit when sunlight is plentiful. Now we have a well regulated system which can operate for long periods at a high level of reliability. And system reliability is not harmed one whit by the fact that the prime source of energy is good old evershining Sol. The batteries in this system are very special silver-zinc or cadmium-zinc units, designed so that hundreds of current drains and recharges will not harm them. The development of these batteries is another story.

There is a universal problem that besets any mechanism that lifts from the earth: everything, but everything, weighs too much. In the case of solar cells, this is just as acute as in any other flight system. Weight must be kept at a very minimum; at first glance, the paddlewheel array doesn't look too bad from this point of view. Flat solar arrays can be designed and fabricated to weigh about a half a pound per square foot, including cells and structure. However, this is not the full story. The very radiation energy field that provides the energy for electrical power generation also contains other types of radiation which are destructive to the solar cells, and must be protected against. At the same time, the extremely active Van Allen belts create similar radiation hazards. Remember, all types of radiation except light in specific spectral bands are harmful—infra red, ultra violet, cosmic rays, Xrays, et cetera—even stray micrometeorites which happen along. Much work is being performed to develop protective coatings which are feather light, but for the present generation of solar panels, the method used is to cover each cell with a thin cemented wafer of glass about .05 inch thick, including a 15-layer interference film. Paddlewheel panels must be covered both front and back; integral arrays only on the front.

Recently, a big advance in overcoming the radiation problem has been scored by the Army Signal Corps, through their development of a new cell that resists four times more radiation than the standard silicon-boron cell, for ten times longer periods, and still exhibits the same or slightly better efficiency. The new cells do not use boron, but instead diffuse phosphorus into the surface of silicon which has been doped so that it exhibits p-type semiconductor characteristics. We have here, then, a negative-on-positive cell, which is the reverse of the standard cell configuration. Work is in process now to uncover the reasons for the remarkable radiation resistance of this new solar cell, which will soon be in quantity production for space vehicle use.

Now we are confronted with the usual system-type problems that occur when a new element is injected into a design situation. The radiation protection raises the weight of the cells, which automatically creates a requirement for heavier structure, until the panel weight finally stabilizes at about two pounds per square foot. At present, solar cell powered systems run about 1200 pounds per kilowatt, an admittedly unhappy figure. However, all is not lost, as higher power solar cell systems, using reflectors to concentrate the light, now point the way to system weights of perhaps 300 pounds per kilowatt.

At present, solar arrays are costly. A glance at two typical satellite arrays will give a picture of approximate costs. Tiros I, the meteorological satellite that uses two TV cameras and a picture transmitting system, is shaped like a squat cylinder. The top and sides are covered with silicon cells—only the bottom is not. Total number of cells is 9200. We can assume a cost per cell, at the time of development of the Tiros system, of $100 per cell, and not be too far off. This results in a cost somewhere around $900,000 for a system that delivers a steady output of less than 100 watts!

The active repeater communication satellite that the American Telephone and Telegraph Company has proposed as part of their commercial communications network will also be powered by a solar cell array. One design is spherical in configuration, and its surface is virtually covered with 11,552 cells. At the current going price of about $25, the cost of the cells for this array comes to a spanking $288,800! The price of wattage

out there is high! And this does not take into account such items as wiring, installation, test, breakage/replacement, and the batteries and charging circuits. Figures II and III show solar cell arrays built by the Hoffman Electronics Corporation for our satellite programs.

Also on order by the military is a huge array of twelve panels, totaling 50,000 cells of a slightly newer design and higher efficiency; the cost of this little item is estimated at $600,000. The latter two cost estimates are based upon the latest production prices; obviously, production methods have come a long way since the time when each cell cost $400!

Despite the problems and expense, solar cells are now, and are destined to remain for a long time, the number one conversion method for use in space vehicles. Interestingly enough, the U.S.S.R. seems to be in about the same situation as we are—perhaps a little more advanced in their orientation techniques, although this is very debatable. Actually, we don't know many details about their power supplies—only a few generalities. The following is a quote from Pravda of February 26, 1961, in an article about the Russian Venus probe, named by them AIS, or Automatic Interplanetary Station: "Two panels of solar batteries, constantly oriented on the Sun, ensure the uninterrupted charging of the chemical sources of current over the entire trajectory of the AIS; ensuring power supplies to all systems and equipment."

Now let's go on to the next type of power conversion system.

*Solar Thermoelectric Generator.* In 1821, about a year after the discovery of the electromagnetic effect, Thomas Johann Seebeck stumbled across a very interesting phenomenon. He discovered that a magnetic needle held near any leg of a circuit made up of two different conductor materials, will deflect when any part of the circuit is heated. Naturally, he got excited, and started a lifetime of investigation which led him down a wrong road, and set back the science of energy conversion by about a century! Seebeck unfortunately decided that what he had discovered was a method of generating magnetism via establishment of a temperature differential, and he used up the rest of his life in trying to prove this fact alone, in a bitter fight with the scientists who believed that the magnetic effect was secondary, and that the temperature differential actually created an electrical current flow in the circuit. However, even though Seebeck was to a large extent mistaken, he certainly was a painstaking investigator, and left very few stones unturned in his studies. In fact, he not only investigated metals, but wound up actually creating some semiconductor materials which show an electrical conversion efficiency of over 3%. At that time, this was directly comparable to the efficiency of existing steam-powered engines. The unfortunate aspect of Seebeck's interpretation is emphasized when we realize that successful generation of electricity, through use of a steam engine and wire-wound generating coils, was not established until the 1870s, about half a century after Seebeck's discovery! Then, development of the rotary generator provided the final impetus that put thermoelectricity into a state of suspended animation.

The kiss that aroused this sleeping beauty into a state of wakefulness, and probably a long life of usefulness, was the USSR's requirement in the 1930s for the capability of developing electrical power in the many small communities lying undeveloped in the hinterland. During this period, scientists all over the world were attracted by the electrical properties of the class of materials called semiconductors. Investigation showed that some of these materials acted in a similar manner to unlike metals when heated, but produced a much greater voltage. In the late Thirties, Westinghouse's Dr. Maria Telkes developed and patented a number of semiconductor materials for use in thermoelectric generators which delivered conversion efficiencies approaching 6%. These were cast mixtures of zinc plus antimony, with small additions of silver, bismuth and tin, and bismuth plus antimony. The former formed the negative leg, and the latter the positive. However, in this country, these alloys were considered a scientific curiosity, and a help in understanding semiconductors, but little else.

Meanwhile, back on the steppes, one A. F. Joffe had been placed in charge of a project to develop thermoelectric generators for the Russian back country. At present, according to all reports, Joffe and his workers have come a long way in the development of practical thermoelectric generators. In fact, a generator was manufactured and handed out to back-country farmers. This item develops 5 to 6 watts, and receives its heat from a kerosene lamp chimney; it is used to power a radio receiver. Fig. IV shows a picture of this generator.

A glance at the research and development efforts to date in the field of TE power generation shows that a goodly number of groups have already developed working models of TE generators. In the U.S.S.R., as mentioned before, Joffe and his associates have manufactured the 5-watt back-country generator for general distribution, and by 1958 had attained power outputs in larger generators of 200 watts at about 10% efficiency. We don't know exactly how far they have gotten by now, but rest assured that TE power generation in Russia is not standing still.

In this country, Westinghouse has on hand a series of practically off-the-shelf propane heated TE generators up to 500 watts and has also built for the Navy a large shipboard generator which uses seawater to cool the cold junctions. Also in development for the Navy is a multi-kilowatt generator, and built-in generators for submarines are being designed and tested. Minnesota Mining and Manufacturing Corporation, fabricators of

semiconductor pellets for TE generators, has an 11-watt, 10% efficient generator in the laboratory. General Instrument Corporation has a 5-watt generator using propane gas as a fuel, which can run to fuel exhaustion unattended, a feature that interests the Signal Corps. The SNAP-III generator produces 5 watts at an efficiency of 6½%, using a decaying isotope as the heat source; one of these was orbited in late June, 1961, as a passenger on a Transit shot. A small, ingenious generator has been developed by ATI Associates for use as a classroom demonstrator, constructed of metal, and rugged enough to take classroom treatment. At the other end of the scale, Bell Telephone has for sale a parametric amplifier which uses a tiny built-in bismuth telluride TE refrigeration unit for cooling the diodes.

These are some of the developments that have been accomplished to date, and are in reality the first steps that research people must take to generate the required "feel" for a subject. They are connected by rather tenuous, but very tough, ties to the space effort.

An impressive number of companies in this country are engaged in full time research and development on TE generators. The heaviest effort is being directed toward military and space operations, although, as usual, there are a number of offshoots already being applied in industry.

Once again, let's take a look at the application of an external energy source to conversion machinery. As in the case of the solar cells, the sun is the prime source of energy, only in the case of thermoelectric conversion, it is the long wavelength end of the solar radiation spectrum that is used. In general, in order to take advantage of the fact that conversion efficiency rises as the temperature differential increases, a collector/reflector becomes a part of the generating system, focusing the sun's radiation on the hot junctions. The present TE materials cannot accept anywhere near the temperature that the reflector is capable of supplying, due to their predilection for deterioration above 600 degrees C. At the same time, other limitations inherent in TE materials create sticky design problems. The new TE materials, such as Bismuth Telluride and Zinc Antimony, are amalgams which are cast into pellets. The cast material is extremely brittle, and very low in tensile strength, a structural combination that forces the use of short pellets, which is also forced by the fact that the internal resistance of long pellets becomes intolerable. The shortness of the pellets in turn creates the nasty problem of trying to maintain one end of the pellet cool, when the other end is an inch or less away and is at about 500 degrees C. Thus we find present designs sporting huge and fancy cooling fins on the cold end of the generator, the hot end of which is enclosed in a relatively small heated chamber. Good illustrations of this are the Russian kerosene lamp generator, and the small General Instruments' 5-watt generator. (Figs. IV and VII.)

In examining a sun-powered TE generator designed to deliver a steady output of, say, 200 watts, to be carried aloft by a space vehicle, it becomes evident that a series of very knotty design problems must be solved, especially on a systems basis. Remember, this generating system consists of a large reflector, the generating pellets, a heat exchanger which spreads the heat evenly over the hot junctions, the cooling system for the cold junctions, the connecting cabling, the rechargeable storage battery system, the power regulation system, a servo to maintain the small tolerance orientation of the reflector, and the structure that ties the whole business together. Add to this complex of problems the high order of expense of the TE materials, the difficulty of handling same, the possibility of the pellets cracking under the heavy vibration loads imposed during the boost period, the difficulties in maintaining surface tolerances in the large, flimsy reflector, and it is no idle statement to say that there are many long months of arduous labor ahead before the first generation of solar powered TE generating systems starts supplying power to space vehicles. Of course, as in most other technological efforts, development of this type of system is only a matter of time, and when that point is reached, we will have a power supply system which not only has the advantages of solid state devices—namely no-moving-part reliability—but also makes use of the very abundant and very free radiant energy pouring continuously from the sun.

The question may be asked, what can this system offer that the solar cell system doesn't have? Briefly, the answer is that it is much easier to use the very broad infra-red band of the radiation spectrum, without the problems of careful filtering that attend the solar cell, and into the bargain, the TE generator delivers more voltage per junction, and requires far fewer individual pellets than there are solar cells. This means a considerably smaller system, which in turn reflects back into the overall system design in a very favorable manner.

Thermoelectric energy conversion can be defined rather simply as the direct conversion of thermal energy into electrical energy, or conversely, the direct addition/subtraction of thermal energy from a junction by the application of electrical energy. The basic building blocks of a TE generator are 1) the use of two connected dissimilar materials, one being a positive (p) type, and the other a negative (n) type; and 2) the maintenance of a marked temperature differential between the hot end of the junction and the cold end to which the load is wired. These basics are shown in the diagram of Fig. VIII.

The p and n materials used in present TE generators are doped semiconductors such as Bismuth Telluride and Zinc Antimony. These materials act in a manner similar to the solar

cells, with the obvious exception that heat replaces light as the prime energy source. Theory states that there is a similar migration of free electrons and holes, with the heat input creating the exciting conditions for both the electron migration in the n leg, and for the hole migration in the p leg. There are four well-known major parameters which have a gross effect on the efficiency and output of a TE generator. We want the lowest resistance to electron flow, the highest resistance to heat flow—or more familiarly the lowest thermal conductivity—to keep the heat from flowing too easily to the cold end, the highest thermoelectric coefficient, meaning the intrinsic ability of the material to supply a certain amount of voltage-per-degree, and the ability of the junction to develop more and more voltage as the temperature differential increases. The two latter items Joffe combined into what is called the Seebeck coefficient, measured in volts per degree. Joffe also derived the thermoelectric Figure of Merit, which combines all four parameters, and gives a direct view of the generation efficiency of any TE material. The equation for Figure of Merit is

$$Z = \frac{S^2}{\rho K}$$

where S is the Seebeck coefficient, in volts per degree, $\rho$ is electrical resistance in ohms per centimeter of pellet length, and K is thermal conductivity in watts per centimeter per degree.

It must be realized that the TE generator is a heat engine, and as such partakes of those efficiency losses that any Carnot cycle engine is subject to during the inevitable temperature exchanges that take place. Thus, even before we can begin to convert heat into electricity, we lose well over 50% of the available heat energy to the Carnot cycle losses. In an actual design, we can assume a Carnot efficiency of 30%, and a thermoelectric conversion efficiency of 10%, resulting in a system conversion efficiency of 3%. This doesn't look so good on the face of it, but the saving factors are the free presentation of energy, and the extreme simplicity of the TE generator.

One of the problems with the thermocouple as an electricity producer is that it is inherently a high-current, low-voltage device. For instance, a TE junction formed of Lead Telluride will provide .0006 volts per degree C. At a temperature differential of 400 degrees C, the output of this junction will be only .24 volts, although its wattage is .2. Consequently, if any reasonable voltage level is required, the junctions must be wired in series or series-parallel. In order to generate enough power for a satellite mission, quite a large number of junctions are needed, although fewer than the number of solar cells by one and a half orders of magnitude. As with the solar arrays, a rather fancy design of the thermocouple assembly/heat exchanger/structure is required, unfortunately.



Also unfortunately, the good semiconductor materials used in thermoelectric generators cannot take anything like direct flame temperature without deteriorating to the point of destruction.

An intensive materials research effort is underway, both here and in Europe, to uncover semiconductors which have higher Figures of Merit than the present-day 1.2 or so, say about 3.0, and which can withstand temperatures of 1000 degrees C or more. It is estimated that a material such as this will deliver a conversion efficiency of 30%. When this development comes about, we can look forward to some rather fantastic mechanisms, not only for space applications, but doing everyday jobs right in the home. Certainly the job of the secondary space power engineer will be made easier, and who knows, it may even arrive at the point where that harassed gentleman will be reluctantly accepted as a member of the human species by structures and weights engineers, although this might be stretching the point a bit.

At the present time, TE generators have not reached the levels of cost, reliability, structural integrity, or producibility wherein they can be used for the generation of sizable quantities of electrical power in space vehicles. Lots of intensive R and D work is going on, and in fact working models of TE generating systems for space application have already been demonstrated on the ground. An excellent example of a TE system that has been developed specifically for space use is the one being developed by Hamilton Standard, which uses a large number of small parabolic reflectors on a light frame, each reflector pinpointing one, or several, TE junctions. This framework will be mounted in a similar manner to the familiar solar cell arrays or panels, and will probably be oriented continuously sunward. It will be used in conjunction with a battery pack, and will be large enough to supply power during dark periods. This configuration is shown in Fig. X.

Another type of solar powered TE generator which to a certain extent gets around the problem of carrying enough batteries for the dark periods of orbital trajectories is shown in Fig. XI. In this generator, the solar energy is collected by a large concave mirror which reflects it onto a focusing surface. From this surface, the energy is played on a container filled with Lithium Hydride in liquid form. The container is surrounded with TE junctions, and the Lithium Hydride gives up its heat to the junctions at a rate regulated by a valve in such a way that it is optimum for the particular TE materials used. During the sunlit portions of flight, the radiation shield is open, allowing the Lithium Hydride heat storage sink to be bathed continuously in the solar radiation. When the satellite moves into the earth's shadow, the insulated shield automatically closes, effectively encasing the heat sink and the hot ends of the TE junctions in an insulated container. The cold ends plus their cooling fins are all outside the container,

radiating heat into space. The amount of Lithium Hydride to be used as a heat sink for the radiant energy, and then as a heat source for the TE junctions, is governed by the mission flight plan; in this case, how many minutes will be spent in darkness, and how many bathed in solar radiation. Analysis shows that this type of system actually has a distinct weight advantage over the type which carries extra batteries for daytime charging. On the other hand, it also requires a development period which the batteries have already gone through.

Fig. XII shows a simple solar powered TE generator. A cylindrical convex mirror system collects and concentrates the solar energy on a row of TE junctions connected in series or series-parallel, as required. The system design maintains a temperature differential of about 350 degrees C. A fairly large model was fabricated and operated at ground conditions, and achieved a Carnot efficiency of 25%, a conversion efficiency of 8%, and a consequent system efficiency of 2%. This was a combined Westinghouse-Boeing effort, and was used only to test the feasibility of the concept. It used a sun-oriented drive, water cooling at the cold junctions, and was operated in a chamber to simulate space conditions. The semiconductor materials used were Zinc-Antimonide, (p), and Indium Antimonide, (n), and the number of junctions came to 16. The cylindrical collector-reflector measured 20 by 50 inches, and a power output of 3 watts was attained. In actuality, a solar TE array such as is shown in Fig. XII can be made any length. Probably the critical factor in the design of the panel length is the ability to break the array up into modules which can be folded and packaged to take flight accelerations and vibrations, and which can then be unfolded easily into a large array without too many tricky joints.

One point about system efficiency. It may be that in order to achieve high values of Carnot efficiency—25 to 30%—we will have to design very large radiators. The radiator then becomes very heavy, and although the system efficiency is high, the system weight climbs to a point where we have to do away with some of the communications equipment, or some of the precious propellant, or something else that will ruin the mission. In this case, we lay efficiency aside as a controlling design factor, and shoot for a high power-to-weight factor. Therefore, we design the cold-end temperature higher, and let the efficiency fall off; the radiator weight comes way down, with a consequent drop in overall system weight. Up to a certain point, this works fine, and this point is reached through a systems optimization study, which results in a good power-to-weight ratio, a reasonable efficiency, and no removal of equipment.

There are a surprising number of solar TE generators being designed for space vehicles. Some will need backup from extra chemical battery systems, and some will have built-in heat collectors to obviate this need. Some will use multiple small reflectors in large panels, and some will use a single huge reflector which will unfold, petallike, when in orbit, to a diameter of as much as 45 feet. These impressive, simple-in-principle, expensive machines will provide unfaltering electrical power for space vehicles during missions which last months and years. Furthermore, there isn't much doubt that these systems will act as the basis for—I hesitate over a badly beaten word—a breakthrough in power supply methods for ground use in military, commercial and home applications.



The next type of power generating system which we will examine is the *Solar Thermionic Generator.*

Just before the turn of the Twentieth Century, Thomas A. uncovered a characteristic of metal which has been heated to incandescence. Appropriately enough, this was called the Edison effect, and it states simply that electrons boil off the surface of incandescent metal, and the number of electrons boiling off increases as the temperature increases.

In our present electronic age, this statement may not create pandemonium among the brethren, but it presents a phenomenon which has only recently been pressed into service in another type of oddball heat engine that threatens to open new energy-supply vistas to an energy-greedy world. This engine has come to be called a thermionic generator or converter, and sometimes a thermo-electron engine. In principle, the thermionic generator is, like its cousins, a very simple machine. Basically, the generator hardware consists of a sealed chamber, a cathode, an anode, and a heat source. As can be seen, it strongly resembles a diode. Fig. XIII gives a picture of these elements.

There are two major types of thermionic generators: In one, the chamber is evacuated. In the other, the chamber is filled with a gas such as cesium vapor. Briefly, the thermionic generator works in the following manner: the electrons that boil off the heated cathode reach certain energy levels during the process. Certain of these electrons reach energy levels high enough so that they escape from the cathode, and migrate across the intervening space to the anode surface, which is relatively cool. If these electrons, which have been lifted to a high potential by the thermal energy, migrate to a surface which is made of material with a low work-function, some of this potential can be recovered and used to move the electrons through an external circuit. The cathode and anode materials are selected so that the electrons emitted from the hot cathode require more energy for escape than would be required for anode electrons to escape from the anode surface. This results in a stream of electrons that land on the anode with a fund of energy which allows them to do work in the low work-function environment of the anode.

A crude analogy might be the dif-

ference in work potential that an earthman would display on the moon, compared to his work potential on the earth—provided that he has been supplied with enough energy to escape from the higher gravitational field of the earth. To illustrate the availabiliy of energy in the thermionic generator, Fig. XIV presents an idealized potential energy diagram of an electron migrating from a hot cathode to a cool anode. In the diagram, $W_1$ is the work-function of the cathode, and $W_2$ that of the anode. In order to escape from the cathode, an electron must be raised above the energy level represented by $W_1$ to the level of $W_E$. Having escaped and migrated to the anode, the electron gives up energy equal to the anode work-function $W_2$, which then appears as heat in the anode. However, after having fallen from the level of $W_E$ through the potential barrier and down to the Fermi level of the anode, the electron still has an amount of energy left over equal to E, the difference between $W_1$ and $W_2$. This leftover energy appears directly as electrical energy when a circuit between cathode and anode is established.

It's hard to conceive of a much simpler machine. Two pieces of metal, a small chamber, and a candle! However, some little problem always seems to rear up and take all the joy out of living, and the label on this particular problem reads "Space Charge".

When we heated the cathode and boiled the electrons off the surface, we naturally expected, as per theory, that a certain percentage would make it across the intervening vacuum to the anode. Knowing the work-functions of the cathode and anode, the temperatures of both, and their spacing, we can calculate the electron flow, and the consequent developed current or voltage. But we failed to reckon with the very large number of electrons that didn't quite reach escape-energy level. These, in an ever-increasing number, clog up the *Space* between cathode and anode, and form a cloud which has an overwhelming negative *Charge*. In turn, this negative space charge tends to repel electrons that boil off the cathode, and only a very few of exceptionally high kinetic energy content can get through. Therefore, although the thermionic generator described above will stabilize at a certain level of output, said output will be very low in comparison to the input of heat; this makes for a very inefficient system.

Independent workers at MIT, General Electric, and RCA came up with a few excellent answers to the space charge problem. An extremely simple method which has resulted in conversion efficiencies approaching the 15% mark, is to fabricate the cathode and anode from a material such as tungsten, very carefully machined, and place them as close together as .0005 to .001 inch! This requires pretty careful machining and assembly, but it can be done, and as stated, good conversion efficiencies have been attained with this procedure.



Another very promising method of overcoming the space charge barrier is to neutralize it. Ingeniously, the researchers reasoned that somehow or other, a positive-particle cloud should be introduced, so that each electron in the space charge cloud would be attracted to a positive particle, resulting in a nulling of the space charge. Ions fit this bill, and a vapor made of cesium provides an excellent source of ions. When cesium atoms strike the hot surface of the cathode, which has a higher work-function than the cesium, they lose an electron. This electron then becomes bound to the cathode, and the newly formed cesium ions bounce out in the form of a positively charged cloud. Enough of these result in neutralization of the negative space charge, and at the proper cesium vapor pressure, with the space charge virtually absent, the flow of energetic electrons can be started and maintained at a high level by heating the cathode to temperatures easily reached by simple heat sources. There are other tricks to increasing the life, efficiency, and practicability of the cesium vapor thermionic generator. These are being pursued with utmost diligence, and in a few short years we are sure to see the utilization in space—and no doubt in ships and on the ground—of thermionic generators which will be simple, reliable, and will deliver efficiencies in the neighborhood of 30%.

It is well and expedient to point out that there are other problems which bedevil the researcher and engineer in this field. One of the obvious, and most difficult to solve, pertains to materials. Because of the basic requirement to boil off many electrons and to give them a high level of kinetic energy, it is necessary to raise the temperature of the cathode to a high value if any sizable current is to be realized. For instance, some thermionic generators have been operated as high as 3000 degrees K, and the standard operating temperature range runs between 1400 degrees K and 2000 degrees K. At temperatures such as these, the tungsten cathode doesn't last very long; it vaporizes rapidly and deposits on the anode. In a cesium vapor generator, at certain pressures the problem can be taken care of by the fact that the cesium atoms condense on the cathode, thus coating it. In this case, the cesium atoms on the cathode boil off at a great rate and migrate into the cesium cloud, but are replaced continuously via the condensing process. In this way, cesium vapor thermionic generators can operate for many hours at the high temperatures needed for decent efficiencies.

Two other prominent problems are the containment of the alkali vapors at high temperatures, and the prevention of breakdown in the electrical insulation between the cathode and the anode. However, as stated before, the concentrated attack on these and other problem areas will soon result in materials and methods that the engineer can put to good use

in the process of solution. In fact, very recently one company has solved the problem—to a certain degree—of material failure at high temperature, by simply devising a thermionic generator that works at far lower temperatures.

At the present time, a number of working thermionic generating systems have been built by quite a few companies. Many of these, of course, are laboratory models, but some are prototypes of future space power supplies. Some have delivered up to 200 watts for hundreds of hours. An intensive study and development program is underway at companies such as General Atomics, RCA, General Electric, Thompson Ramo Wooldridge, Martin, Thermoelectron, and others, with the prime objective of coming up with actual space-flyable power supply systems. These systems will incorporate the same type of solar collectors, orientation systems, heat storage sinks, et cetera, as has been presented previously relative to thermoelectric generators. Some of these are approaching the ready stage now, as far as laboratory testing is concerned, and final designs for the actual space-solar thermionic systems are well along. Just recently, after an industry-wide competition, a contract for a 135 watt thermionic solar powered system, using cesium vapor generating elements, was let to Electra Optical Systems, Inc.

The solar-powered thermionic generating system consists of a number of major components, among which are the solar collector for concentrating solar radation on a receiver adjacent to the cathode, the thermionic generator itself, a radiator to reject heat from the anode to space, heat transfer loops or thermal conductors to transport heat from the receiver to the cathode and from the anode to the radiator, control mechanisms to regulate and modulate the generated electricity, and a means for storing either thermal or electrical energy during periods of orbital shadow. Systems of this type are very similar in configuration to the TE generating systems, except for the generating element itself. Figures XV and XVI show drawings of simple and sophisticated thermionic generating systems. As in the other types of solar generators, the thermionic types use a multiplicity of generating elements, connected in series or series-parallel.

It is interesting to examine some of the design problems and their solutions, in this particular field. As noted before, the thermionic generator operates at fairly high temperatures; in fact, thermal power rates are on the order of 25,000 BTU's per square foot of cathode area. The solar collector-reflector must be designed to concentrate solar energy to match the temperature and BTU requirements. At the same time, the reflector must also supply solar energy to the thermal heat sink, and must compensate for any heat that leaks from the thermal receiver into space via radiation. Because of the many areas in a solar space power system which represent



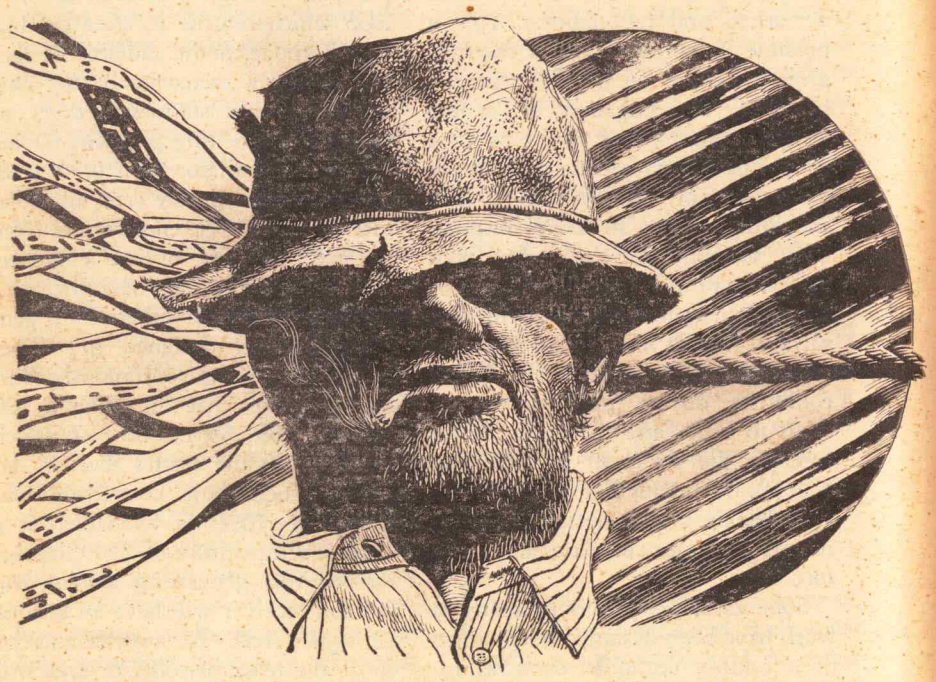
drains on the transfer of solar energy into usable heat energy at the cathode, the collector should be close to optically perfect relative to surface deviations and reflectability. This is possible if we can afford a carefully ground surface on a stiff structure; however, the bugaboo of system weight requirements limits us to a weight of about one-tenth pound per square foot of reflector surface. This exceedingly light structural requirement virtually dictates rather poor optical qualities, followed by the need for an enlargement of the reflecting surface. Add to this the immense job of stowing the reflector in a folded condition during the flight from earth to orbit, and the necessity for erecting the structure in orbit and keeping it oriented, and it can be seen that the solar reflector alone represents a major developmental effort.

Some of the collectors presently in work have been designed in the form of a folding umbrella, some as inflated plastic structures, others as flower petal structures, and the like; please recognize that these designs run as large as 100 feet in diameter!

Another sticky design area is the radiator. Because the thermionic generating elements convert only a small percentage of the applied heat into electricity, the rest of the BTU's must be dumped overboard. In space, radiation is just about the only practical method, and radiator design becomes of prime importance. One design that shows promise consists of a very thin stainless steel sheet formed to allow passage of liquid sodium. The sodium picks up heat from the anode through a heat exchanger, and is then pumped through the radiator in a loop which returns it, after cooling, to the anode. Some radiator designs incorporate a meteorite barrier covering the thin stainless; others attempt to solve this problem by designing the radiator with thick walls to begin with. In any case, all radiators are too heavy, clumsy, and complicated; ask any of the engineers who are working on these systems.

Let's look at a solar thermionic generating system designed to deliver about 6 kilowatts continuously, during a mission that comprises a 100 minute orbit, 35 minutes of which are spent in the earth's shadow. An average thermionic conversion efficiency of 10% is available, at a cathode temperature of 2500 degrees K. For this generating system, the thermal receiver will have an area of 12 square feet. At an efficiency of 40%, the reflector-collector area will be 2800 square feet. The radiator will weigh 120 pounds, the reflector 180 pounds, the controls 30 pounds, the thermal receiver and storage sink 200 pounds, and the thermionic generating pile 280 pounds. Altogether, the system weight comes to 810 pounds. An overall system efficiency of approximately 3% can be expected. Naturally, system weight will drop when we develop generators with conversion efficiencies of 30%. ■

*Moving machine power systems will be discussed in our next article.*



# MASTER OF NONE

BY NEIL GOBLE

The advantages of specialization are so obvious that, today, we don't even know how to recognize a competent syncretist!

■ Freddy the Fish glanced at the folded newspaper beside him on the bench. A little one-column headline caught his eye:

MYSTERIOUS SIGNALS
FROM OUTER SPACE

"Probably from Cygnus," he said. Freddy mashed a peanut, popped the meat into his mouth, and tossed the shell to the curb in front of his bench. He munched and idly watched two sparrows arguing over the discarded delicacy; the victor flitted to the head of a statue, let go a triumphant dropping onto the marble nose, and hopped to a nearby branch.

"Serves him right," Freddy said. He yawned and rubbed the stubble on his chin. Not yet long enough for scissors, he decided. He pulled his feet up on the bench, twisting in an effort to get comfortable. The sun was in his eyes, so he reclaimed the discarded newspaper and spread it over his face. His eyes momentarily focused on MYSTERIOUS SIGNALS FROM OUTER SPACE, right over his nose.

"Sure, Cygnus," he muttered, and closed his eyes and dropped off to sleep.

When he was awakened, it was by an excited hand shaking his shoulder and a panting, "Freddy! Freddy! Lookit the Extra just came out!"

Freddy slowly sat up, ascertained the identity of the intruder and the fact that the sun was setting, and said "Good evening, Willy. Please stop rattling that paper in my face."

"But just read it, Freddy," Willy shrieked, waving the paper so frantically that Freddy couldn't make out the big black headline. " 'Positive contact from another planet,' the guy was yellin'. They put out an Extra so I snitched one from the boy. Read it to me, huh, Freddy? I'm dyin' o' curious."

"So give it here and I'll read it for you. Quit shakin' it or you'll tear it all up," Freddy snorted.

"Read it to me, huh, Freddy," Willy said, handing over the paper. "I don't know no one else that reads so good."

Freddy studied the headline and the first paragraph silently, then whistled lightly and lowered the paper.

"Y'know, Willy," he said, "the last thing I read before I dropped off a while ago was about these signals. But the funny thing is, I'd just assumed they were from Cygnus."

"What's a Cygnus, Freddy," Willy asked, still pop-eyed. "A smoke? A dame? Or you mean like from Hunger?"

"Cygnus, my boy," Freddy explained patronizingly, "is a constellation within which there are two colliding galaxies. These colliding galaxies produce the most powerful electromagnetic radiations in the universe—an undecillion watts!"

"What's an undecillion?"

"An undecillion is ten raised to the 36th power," Freddy sighed, fearing that he wasn't getting through to Willy.

"No foolin'? What's a watt . . . aw, you're pullin' my leg again, Freddy, talkin' riddles. Where'd ya ever learn to talk that way anyhow!"

"Harvard, Yale, Princeton, Oxford, Georgia Tech, Oklahoma. Picked up a little here, a little there," Freddy said, reflecting on his indiscriminate past.

"Aw, cut it out, Freddy! C'mon, read it to me. Betcha can't! Where'd ya say it was from? Cygnus?"

"Not Cygnus. Ganymede." Freddy cleared his throat and rattled the newspaper authoritatively. "Washington: White House sources declared today that intelligent beings on a Jupiter moon have contacted the United States government. While the contents of the message have been made secret, the White House emphasized the message was friendly."

Freddy continued, "The signals, which were intercepted yesterday, were decoded this morning by a team of government scientists and cryptographers who had been at the task all night. While officials were noncommittal about the nature of the message contained in the signals, they declared 'We are authorized to state that the received message was friendly and appears to represent a sincere attempt by another race of intelligent beings to contact the people of Earth. A reply message is being formulated.' Officials further explained that the possibility of the signal's being a hoax has been thoroughly investigated and that there is no doubt whatsoever that the message is a genuine interspatial communication from intelligent beings on Ganymede. Ganymede is one of twelve moons of the planet Jupiter, and is larger than the planet Mercury."

Freddy stopped.

"Ain't there any more?" Willy whined.

"The rest of it is about how far away Ganymede is, and its relative density and mass and stuff. You wouldn't be interested, Willy."



"Oh. I guess not." Willy helped himself to a peanut. "What's it mean, Freddy?"

"Nothing much, Willy. Just that there's people somewhere besides here on Earth, and they called us on the phone."

"Whadd'ya know about that!" Willy gasped. "I didn't even know they was other people!" He stared with disbelief at the paper.

"I don't suppose anyone knew."

"How d'ya suppose they knew?" Willy asked. "I mean, that we was here, if we didn't know they was there?"

"I've been wondering about that, Willy. You know that last rocket we shot?"

"From Cape Carnival you mean?"

"Yeh. It was supposed to go into orbit around Jupiter. I wouldn't be surprised if maybe it didn't land on Ganymede; the people there could have examined it, figured out where it came from, and then radioed us on the same frequency the rocket transmitter used. Paper doesn't say that, of course, but it's a reasonable hypothesis."

"Freddy, I think you must be a genius or sumpin'."

Freddy smiled and stretched out to sleep again as Willy wandered off, staring blankly at the newspaper.

Carlton Jones, America's Number One personnel specialist, scowled at the pamphlet on his desk.

SECRET, it said in big red letters across the top and bottom. Special Instructions for Operation Space Case, said the smaller letters across the middle of the top sheet.

"Now I ask you, Dwindle," Jones said to his clerkish aide, "where, in this worldful of specialists, am I going to find someone with a well-rounded education? Much less one who'll take a chance on a flier like this?"

"Gosh, Mr. Jones, I just wouldn't know," Dwindle blinked. "Have you tried looking through your files?"

"Have I tried looking through my files," Jones sighed, looking at the ceiling light. "Dwindle, my files include every gainfully employed person in the United States of America and its possessions. Millions of them. One doesn't just browse through the files looking for things."

"Oh," Dwindle said. "I'm kinda new at this specialty," he explained.

"Yes, Dwindle. However," Jones continued, "one does make IBM runouts to find things."

"Hey, that's great!" Dwindle said, brightening. "Why don't you try making an IBM runout?"

"I did, Dwindle. Please let me finish? Our instructions call for finding a person with a well-rounded education. More specifically, a person who is capable of intelligently discussing and explaining some two dozen major 'fields of knowledge.' Plus, of course, at least a passing acquaintance with some one or two hundred minor fields of knowledge.

"So I set Mathematics into the IBM sorter. Mathematics is one of the major fields of knowledge, you see."

"Yeh," Dwindle acknowledged.

"So I took the few million mathematicians' cards which I got—good mathematicians and bad mathematicians, but at least people who can get their decimals in the right place. I set the IBM sorter for Biology, and ran the mathematicians' cards through. So I got several thousand mathematician-biologists."

"That's pretty sharp!" Dwindle exclaimed with a twinkle. "Whoever thought of that!"

"Please, Dwindle," Jones moaned, pressing his palms to his eyes. "Next I sorted according to Geology. Three hundred cards came through. Three hundred people in America who know their math, biology and geology!"

"That doesn't sound like so many to me," Dwindle said hesitantly, as if wondering what there was to get so excited about.

"And of those three hundred, do you know how many understand, even vaguely, Electronics? Twelve. And of those twelve, guess how many have an adequate background in History and Anthropology? Much less an understanding of eighteen other fields?"

"Not very many, I'll bet," Dwindle replied smartly.

"None! Not even one! I tried running the cards through in every order imaginable. We've bred a race of specialists and there's not a truly educated man among us!"

"Say, you know what I bet? Even if you did find a guy who's like what all you said . . ."

"Go ahead, Dwindle."

". . . I bet he wouldn't even go up there to Ganymede. I sure wouldn't! I'd be scared to death," Dwindle chattered, waving his finger. "How's he gonna get back, even if he gets there O.K.? Couldn't anyone fool me with a bunch of pretty talk; I know the government doesn't have a rocket that could take off again after it got there. Gotta have launching pads and computers and all that stuff. Government ever think about that?"

Jones held his head in anguish. "Dwindle, why don't you be a good boy and run along to the snack bar for a coffee break? And bring me some aspirin when you come back."

Freddy the Fish, Willy and Oscar Fronk were occupying the same bench, a comradeship made necessary by the overpopulation of the park on such a glorious day. Oscar was surveying the passing girls and scouting for worthwhile cigarette stubs. Willy was admiring a hovering beetle's power of flight, and Freddy was reading a discarded copy of *Scientific American.*

The beetle landed on Willy's sleeve and promptly located a gaping tear in the fabric, through which bare arm showed. Willy raised his other hand menacingly.

"Don't," Freddy barked, causing Willy to jump with enough force to dislodge the beetle.

"Aw, Freddy," Willy whined, "why dintcha lemme kill it? What good's a stupid bug?"



"That would have been a rather unfortunate kill, Willy, by your bare hand on your bare arm. You must learn to be cognizant of our insect friends and insect enemies."

"So what's he, poison or sumpin'?"

"Unpleasant, at least," Freddy said. "That was a blister beetle; smash it on your arm and you'll grow a nice welt. A member of the Meloidae family."

"You mean bugs have families and all, too?" Willy asked.

"Beetle 'families' are groupings of similar species of insects," Freddy explained. "Not actually kinfolk. For instance, this beetle is related to the Lytta vesicatoria of southern Europe, more commonly known as the—" Freddy glanced out of the corner of his eye at Oscar, hoping to shield the next bit of information from his perverted brain, and whispered the name.

Willy's eyes widened. "Hey, Oscar," he hollered, jumping up. "You hear what Freddy said? That bug I almost swatted's practically a Spanish Fly!"

"Which way'd he go?" Oscar squeaked, allowing his collection of stubs to scatter as he hopped around, looking on and under and behind the bench for the escaping insect.

"Hold it, hold it," Freddy commanded, trying to restore order. "I said it's like it, not IS it. It doesn't have what it takes, so skip it, huh?"

Willy and Oscar sat down again. "Freddy," Willy sighed with adoration, "how'd ya ever get so smart? I mean, bein' a bum and all?"

"I keep telling you guys; I went to nothing but the finest universities. Well, except toward the end, when I was getting desperate, I guess I wasn't so choosy."

"Aw, g'wan now, Freddy. Collitches cost money, and you're as poor as the rest of us. Bummin' for a cuppa coffee, and all the time talking about Yale, and Oxford, and Hah-vad."

"What would you say, Willy, if I told you that once I belonged to the richest family in Mississippi?"

"I'd say Mississippi was a pretty poor state," Willy said, and Oscar giggled.

"I once was Frederik Van Smelt, spoiled son of the wealthy shrimp and oyster scion. And there's nothing as bad, my father said, as spoiled Smelt. He disowned me, of course. I owned six Cadillacs—one right after the other, I wrecked them all. I traveled all over the world and probably counteracted a billion dollars' worth of foreign aid. I was kicked out of the best schools in the world."

"How come if you're so smart you flunked out of all them schools?" Oscar asked.

"Me? Flunked out? I never made less than an A in any course I took during my eight years at war with college. I was expelled from nine schools and barely escaped the highway patrol when I was bootlegging at Oklahoma University!"

"Freddy," Willy said, "you're lyin' like a dog, butcha make it sound s' real!"

Jones squirmed uncomfortably in his seat in the briefing room, phrasing and rephrasing his thoughts. It seemed that no matter which arrangement of words he chose, it still was going to be obvious that he'd flopped. He re-examined his fingernails and selected one which was still long enough to chew.

General Marcher concluded his current appraisal of the situation and began calling on the various individuals with whom certain phases of OPERATION SPACE CASE had been entrusted. Jones groaned as each arose and gave favorable progress reports.

"The pod is completed and has been tested, sir. It will by no means be plush, but it will be sufficiently comfortable even for the long voyage to Ganymede."

"The guidance system is perfected to the extent that we need."

"There are no further decelleration problems to be solved."

"The crash program has been approved for the two-way rocket; it is on the drawing board and current estimates are that the envoy can be brought back in three years."

"Ganymede has replied to our last message; a suitable artificial environment will be available for the envoy."

"Personnel Specialist Jones?"

Carlton gave his chin a final sweaty rub and slowly rose to his feet. "General Marcher, sir," he choked, "I'm . . . we're . . . experiencing a little difficulty finding a volunteer, so far—"

"Negative perspiration on that count, Jones," the Project Officer interrupted. "The draft has never been abolished; we can grab anyone you put your finger on! Now, who will it be?"

"Sir, it doesn't seem to be that so much as . . . well . . . sir, has any consideration been given to perhaps sending a delegation rather than a single envoy?"

The general smiled broadly. "Now, that is more like it! I take it you mean you have a number of equally-qualified persons who have expressed an intense desire to go to Ganymede, and there is no way to impartially select one of these men over the others? This is commendable. However, our space limitation clearly precludes sending more than one person. I'm afraid you will just have to make your choice from a hat."

Jones turned a trifle redder. "That's not exactly the problem, either, sir."

The general's smile wilted and became a frozen frown. "Just exactly what are you trying to say, Jones?"

"There's no one who can meet the qualifications, sir," Jones said, feeling sick at his stomach.

"Are you telling me that in the entire United States, there is not one person who has a basic understanding of the twenty-four major fields?"

"I'm afraid that's right, sir."

"See me after the briefing, Jones. I'm certain that the Foremost Personnel Specialist in the United States must have some further ideas on this matter."

Jones sank slowly back into his seat and covered his face with his hands. "I'm a goner," he whispered to himself. "Jones, you can be replaced."

Dwindle, sitting on his left, suddenly punched him vigorously in the ribs. "Say, Mr. Jones," he rattled, "I just thought of a great idea."

"Tell it to the general," Jones moaned. "Maybe then he'll realize what a handicap I've been working under."

Hi ya, Freddy," Willy said, sitting down on the bench and helping himself to some peanuts. "Workin' a crossword puzzle?"

Freddy pocketed his pencil stub and laid aside the newspaper. "Naw, not this time. Just playing around with one of those 'We're looking for bright young men' ads."

"Freddy! Y'ain't thinkin' a gettin' a JOB?"

"Nothing like that," Freddy laughed. "Just exercising my mind. Filling out one of those little tests they always have. Helps keep a fella sharp, you know."

"Yeh, I seen the kind. Like what has pictures and you're supposed to find things wrong in the picture like dames with beards and dogs with six feet?"

"Kinda like that, only this one's all written and is a little tougher. You're supposed to send the answers in and whoever has good answers gets to take a tougher test and whoever does good on that test gets the job. Probably selling neckties on the corner or something."

"No kiddin'. That what it says?"

"Just says 'handsome rewards,' but that's probably close to it."

"You gonna send it in?" Willy asked.

"Naw, I just fill 'em out for fun, like I said. Can you imagine me peddling neckties on the corner?"

"Then how d'ya know if you got the right answers?"

"Hell, I know the answers," Freddy bragged. "Like I said, this is just exercise. Mental gymnastics. Like this last one; it was pretty tough compared to most of them. Had some questions about things I hadn't even thought about since college, things I'd forgotten I knew. What good's an education if you forget what things you know?"

"That's why I never bothered," Willy agreed. " 'Cause I never could remember things so good."

"No, Willy. You've got it all wrong. I still know it, I just didn't know I know it."

"Aw, Freddy," Willy said unhappily. "You're pullin' my leg again!"

"Suit yourself," Freddy smiled. "Hold down the bench for me, O.K.? I'll be right back."

Willy watched Freddy until he went into the little brick building in the center of the park, and then grabbed Freddy's newspaper and scampered over to Oscar's bench.

"Hey, you know how Freddy's always talkin' big about how much he knows," Willy said breathlessly. "I got a idea how to call his bluff. He filled out one of these tests and says he knows all the answers. Let's send

it in and see if he's as smart as he says!"

"Yeh! That's great, Willy!" Then Oscar's face darkened. "Wonder where we can steal a stamp?"

That was a pretty good idea of mine, about advertising in the paper, wasn't it, Mr. Jones?" Dwindle, America's Number One Personnel Specialist, asked his surly assistant.

"Yes, Dwindle."

Jones stared gloomily out the fourteenth story window into the park, where the local bums were loafing and sleeping and feeding peanuts to the pigeons. He was nauseated with the prospect of having to address his new boss as "Mr. Dwindle," and was toying with the idea of abandoning his specialty completely to join the ranks of the happy, carefree unemployed. He watched as two uniformed policemen approached one of the less wholesome appearing characters.

"No, I don't suppose I could tolerate being in and out of jail every week on a vagrancy charge," he told himself. But then he smiled bitterly as he thought of the strange parallel between the policemen arresting the bum and other officials, elsewhere in the United States, tapping respectable citizens on the shoulder at this very moment.

"Dwindle, do you really think it was wise to issue warrants to arrest all those persons who scored perfect on the first test? How many did you say there were?"

"Only a hundred or so," Dwindle smiled sweetly. "And besides, they're not being arrested. General Marcher explained to you that they are being drafted into the service of the government. Honestly, sometimes I think you worry too much."

Jones turned back to the window, brooding over Dwindle's transformation. "Maybe so," he sighed, watching the newly-arrested vagrant pointing an accusing finger toward one of the other bums.

Willy strained and twisted, trying to reclaim his arm from the policeman's grip.

"Honest, you guys. I didn't know it was against the law. Aw, I figgered it was against the rules mebbe to send in somebody else's answers, but we wuz only makin' a joke, Oscar 'n' me. Oscar's the one who actual put it in the mailbox and stole the stamp! I bet he's the one you're after!"

"Now calm down, Willy," the beefy policeman coaxed. "No one's broken any law. Nobody's under arrest. We just want to chat a minute with whoever it was filled out that test."

"Yeh, Willy," the second policeman broke in, "if you didn't do it, and I believe you when you say you didn't, then who did?"

"What's it to ya?" Willy asked, his mouth twitching nervously.

The first policeman glanced at the second and then back at Willy. "Well, it's like this, Willy," he said. "Whoever filled out those answers got every one of them right. The people who run the contest want to meet the guy, see? And they asked us to help find him because we know you people better than anyone else does. See? That's all!"

"Yeh," said the second. "That's all. Now who did it?"

Willy stood with his jaw drooping for a moment. "You mean he got ever' last one of 'em right?" he asked. "Freddy was always braggin' about his brains, but me 'n' Oscar figgered he was makin' most of it up."

"Freddy who? Freddy the Fish you mean?"

"Yeh, Freddy." Willy perked up and turned toward Freddy's bench. "Hey, Freddy! Hey, you know that test you took in the newspaper that you didn't know I sent in? You won the contest or sumpin'! Hey, that's great!"

Jones and Dwindle watched the draftees file into the examination room.

"I still don't see how this is going to solve the problem," Jones frowned.

"I believe it will," Dwindle contradicted him. "Specialists in each of the major fields have been consulted, and each provided fifty questions."

"The hardest questions they could think up, I imagine."

"No, not at all. The purpose is to provide comprehensive coverage of each field. And each question is of the type that, if the examinee knows the answer, it can be reasonably assumed that he knows quite a bit in that particular phase of the field. For instance, if he knows what enzyme is associated with the stomach, he probably knows what enzyme is associated with the liver."

"I know one big problem you're going to run into," Jones sulked. "Just like the IBM cards. You're going to find one guy who clobbers the Electronics part of the test but completely busts out in History and everything else."

"I don't think so," Swindle said. "The preliminary test will have taken care of that. It was designed so that, in order to answer every question right, a person would have to have at least a rudimentary knowledge of all twenty-four major fields."

As Jones was considering whether it would be better to slit his own throat or Dwindle's, General Marcher entered the room and approached.

"Excellent. Excellent," the general declared. "A very distinguished looking group you've assembled here, Dwindle. Hello, Jones."

"Yes, sir," Dwindle said, "with the possible exception of the seedy chap in the rear."

Jones looked to the rear of the room, and his eyes bugged.

Freddy the Fish, clean-shaven but tattered, was alternately wetting the pencil lead in his mouth and eating peanuts.

"That's the bum who feeds sparrows in the park!" Jones gasped. "How did he get out of jail so quick? I saw a couple of policemen haul him off just a day or so ago."

"This is where they hauled him to," General Marcher said. "It just so

happens that he answered every question right on the preliminary examination. He says his name's Freddy Smith, although I doubt that he could prove it."

"He says he never had a father," Dwindle added. "Says his family was too poor."

Jones stared at General Marcher, then stared at Dwindle, then turned and stared at Freddy the Fish, who had just left his seat and was ambling toward the trio.

"Looks like he's throwing in the towel," Jones said happily. "He's bringing his paper with him."

"Maybe he just wants clarification on a question," Dwindle said.

"I'm all done," Freddy said. "Who gets this?"

"Go ahead, Dwindle," Carlton Jones smirked. "Grade the man's paper. He's all done."

Dwindle smiled uncertainly. "You're allowed all the time you need, Mr. Smith."

"Oh, that's O.K. I'm done."

Dwindle produced his red pencil and the answer sheet which had 1,200 small circles punched in it. He sat down, placed the key over the test paper, and began searching for white spaces showing through.

That's the last one, sir," Dwindle said six hours later as he added the one hundred twelfth graded test to the neat stack at the left of his desk. He stared through the thousand-plus holes in the answer key as if expecting the holes to shift.

"And still no change in the standings?" General Marcher asked again.

"Mr. Smith still has the best grade," Dwindle answered.

"The percentages again?" the general asked.

"Over all, ninety-six per cent for Mr. Smith," Dwindle said for the fourth time. "His lowest percentage in any one category was eighty per cent. The next highest score was by Dr. Schmelling, who had seventy-eight per cent, but he failed in six categories. The third highest score was by Dr. Ranson, seventy-six per cent, failing in seven categories. The fourth highest score was—"

"Enough. Enough," General Marcher interrupted. "I think we've found our man, don't you, Dwindle?"

"I hope we don't have to use pressure, sir," Dwindle replied.

Jones turned from the window, from which he was observing the bums in the park. "How can you possibly consider such a thing," he blurted, "as to send a penniless, unemployed, dirty, ragged tramp to Ganymede as the United States' Number One emissary?"

"Jones, perhaps I'd best clarify a point or two for you," General Marcher said in measured tones. "We've been searching the nation over, seeking a man who can fulfill our exacting requirements. We have found that man. There is no doubt in my mind that Mr. Smith possesses the greatest single store of knowledge about this planet and its people. So far as I'm concerned, which is considerable, it doesn't matter that this man has chosen the way of a philosopher instead of seeking an occupation. It doesn't matter that he lacks the necessary status to be listed on your IBM cards. It doesn't matter that you failed to find this man, because Dwindle succeeded. And, it doesn't matter whether I ever see you again!"

"Yes, sir," Jones said, and picked up his hat and left.

"Now, back to the business at hand, Dwindle. You say these prospects don't know the reasons behind the test?"

"That is correct, sir. I feared there might be some temptation for the prospects to not do their best, if they knew that success might result in their being removed from the face of the Earth."

"Wise. Then I suggest we approach Mr. Smith on the idea, cautiously, to determine his sentiments. If he doesn't want to go, of course, we've got to draft him."

Freddy cracked the peanut, put half in his mouth and tossed the other half to the sparrows.

"I might be going away for a while, Willy," he said, ending a rather long silence.

"You ain't gettin' a job, are ya Freddy?"

"Watch yer language," Oscar scolded.

"Naw, not really a job. At least not the kind you think of. Sort of an all-expense-paid vacation, with a change of scenery."

"Ya ain't had a run-in with the bulls, have ya?" the stricken Willy asked.

"Me? You know me better, Willy. Nothing like that. And I'm not even sure the thing will pan out, but you know all those newspaper stories about messages from another planet?"

"Yeh! Yeh! Ya read it to me!" Willy jabbered excitedly.

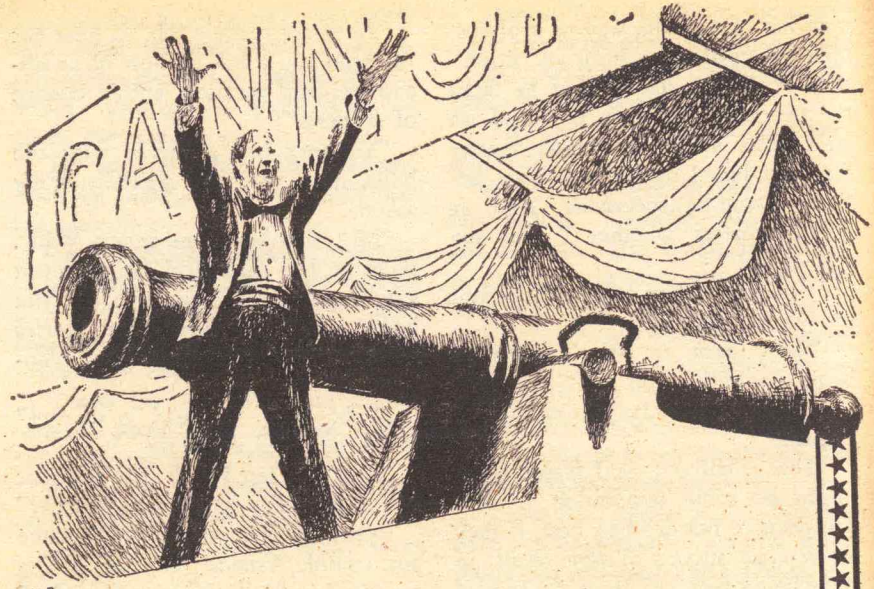
"And that test I took that you sent in and the fellas talked to me about?"

"Yeh! Say, I hope that didn't make you trouble, Freddy, 'cuz me 'n' Oscar was just kinda jokin', see, and—"

"It's O.K., Willy. Well, one of the fellas I talked to was General Marcher, who's been mentioned in the newspaper stories in connection with . . . here, Willy, take these," he interrupted himself when he saw the two men approaching. "See that new guy at the bench over yonder? Give him these peanuts. I think he'd like to feed my sparrows while I'm gone. Name's Jones, and he'll probably be around for a spell."

Freddy stood up to greet the two arrivals.

"Hello, general," he said, tipping his battered cap. "It's about the trip to Ganymede, I suppose?" ■




# HAIL TO THE CHIEF

BY SAM AND JANET ARGO

A great politician need not be a statesman . . . but it is inherently futile to be a great statesman, and no politician. Except, of course, for a miracle . . .

■ The tumult in Convention Hall was a hurricane of sound that lashed at a sea of human beings that surged and eddied around the broad floor. Men and women, delegates and spectators, aged party wheelhorses and youngsters who would vote for the first time that November, all lost their identities to merge with that swirling tide. Over their heads, like agitated bits of flotsam, pennants fluttered and placards rose and dipped. Beneath their feet, discarded metal buttons that bore the names of two or three "favorite sons" and those that had touted the only serious contender against the party's new candidate were trodden flat. None of them had ever really had a chance.

The buttons that were now pinned on every lapel said: "Blast 'em With Cannon!" or "Cannon Can Do!" The placards and the box-shaped signs, with a trifle more dignity, said: WIN WITH CANNON and CANNON FOR PRESIDENT and simply JAMES H. CANNON.

Occasionally, in the roar of noise, there were shouts of "Cannon! Cannon! Rah! Rah! Rah! Cannon! Cannon! Sis-boom-bah!" and snatches of old popular tunes hurriedly set with new words:

*On with Cannon, on with Cannon!*
*White House, here we come!*
*He's a winner, no beginner;*
*He can get things done!*
*(Rah! Rah! Rah!)*

And, over in one corner, a group of college girls were enthusiastically chanting:

*He is handsome! He is sexy!*
*We want J. H. C. for Prexy!*

It was a demonstration that lasted nearly three times as long as the eighty-five minute demonstration that had occurred when Representative Matson had first proposed his name for the party's nomination.

Spatially, Senator James Harrington Cannon was four blocks away from Convention Hall, in a suite at the Statler-Hilton; but electronically, he was no farther away than the television camera that watched the cheering multitude from above the floor of the hall.

The hotel room was tastefully and expensively decorated, but neither the senator nor any of the other men in the room were looking at anything else except the big thirty-six-inch screen that glowed and danced with color. The network announcer's words were almost inaudible, since the volume had been turned way down, but his voice sounded almost as excited as those from the convention floor.

Senator Cannon's broad, handsome face showed a smile that indicated pleasure, happiness, and a touch of triumph. His dark, slightly wavy hair, with the broad swathes of silver at the temples, was a little disarrayed, and there was a splash of cigarette ash on one trouser leg, but otherwise, even sitting there in his shirt sleeves, he looked well-dressed. His wide shoulders tapered down to a narrow waist and lean hips, and he looked a good ten years younger than his actual fifty-two.

He lit another cigarette, but a careful scrutiny of his face would have revealed that, though his eyes were on the screen, his thoughts were not in Convention Hall.

Representative Matson, looking like an amazed bulldog, managed to chew and puff on his cigar simultaneously and still speak understandable English. "Never saw anything like it. Never. First ballot and you had it, Jim. I know Texas was going to put up Perez as a favorite son on the first ballot, but they couldn't do anything except jump on the bandwagon by the time the vote reached them. Unanimous on the first ballot."

Governor Spanding, a lantern-jawed, lean man sitting on the other side of Senator Cannon, gave a short chuckle and said, "Came close not t' being unanimous. The delegate from Alabama looked as though he was going to stick to his 'One vote for Byron Beauregarde Cadwallader' until Cadwallader himself went over to make him change his vote before the first ballot was complete."

The door opened, and a man came in from the other room. He bounced in on the balls of his feet, clapped his hands together, and dry-washed them briskly. "We're in!" he said, with businesslike glee. "Image, gentlemen! That's what does it: Image!" He was a tall, rather bony-faced man in his early forties, and his manner was that of the self-satisfied businessman who is quite certain that he knows all of the answers and all of the questions. Create an image that the public goes for, and you're in!"



Senator Cannon turned his head around and grinned. "Thanks, Horvin, but let's remember that we still have an election to win."

"We'll win it," Horvin said confidently. "A properly projected image attracts the public—"

"Oh, crud," said Representative Matson in a growly voice. "The opposition has just as good a staff of PR men as we do. If we beat 'em, it'll be because we've got a better man, not because we've got better public relations."

"Of course," said Horvin, unabashed. "We can project a better image because we've got better material to work with. We—"

"Jim managed to get elected to the Senate without any of your help, and he went in with an avalanche. If there's any 'image projecting' done around here, Jim is the one who does it."

Horvin nodded his head as though he were in complete agreement with Matson. "Exactly. His natural ability plus the scientific application of mass psychology make an unbeatable team."

Matson started to say something, but Senator Cannon cut in first. "He's right, Ed. We've got to use every weapon we have to win this election. Another four years of the present policies, and the Sino-Russian Bloc will be able to start unilateral disarmament. They won't have to start a war to bury us."

Horvin looked nervous. "Uh . . . Senator—"

Cannon made a motion in the air. "I know, I know. Our policy during the campaign will be to run down the opposition, not the United States. We are still in a strong position, but *if this goes on*—Don't worry, Horvin; the whole thing will be handled properly."

Before any of them could say anything, Senator Cannon turned to Representative Matson and said: "Ed, will you get Matthew Fisher on the phone? And the Governor of Pennsylvania and . . . let's see . . . Senator Hidekai and Joe Vitelli."

"I didn't even know Fisher was here," Matson said. "What do you want him for?"

"I just want to talk to him, Ed. Get him up here, with the others, will you?"

"Sure, Jim; sure." He got up and walked over to the phone.

Horvin, the PR man, said: "Well, Senator, now that you're the party's candidate for the Presidency of the United States, who are you going to pick for your running mate? Vollinger was the only one who came even close to giving you a run for your money, and it would be good public relations if you chose him. He's got the kind of personality that would make a good image."

"Horvin," the senator said kindly, "I'll pick the men; you build the image from the raw material I give you. You're the only man I know who can convince the public that a sow's ear is really a silk purse, and you may have to do just that.

"You can start right now. Go down and get hold of the news boys and tell

them that the announcement of my running mate will be made as soon as this demonstration is over.

"Tell them you can't give them any information other than that, but give them the impression that you already know. Since you *don't* know, don't try to guess; that way you won't let any cats out of the wrong bags. But you *do* know that he's a fine man, and you're pleased as all hell that I made such a good choice. Got that?"

Horvin grinned. "Got it. You pick the man; I'll build the image." He went out the door.

When the door had closed, Governor Spanding said: "So it's going to be Fisher, is it?"

"You know too much, Harry," said Senator Cannon, grinning. "Remind me to appoint you ambassador to Patagonia after Inauguration Day."

"If I lose the election at home, I may take you up on it. But why Matthew Fisher?"

"He's a good man, Harry."

"Hell yes, he is," the governor said. "Tops. I've seen his record as State Attorney General and as Lieutenant Governor. And when Governor Dinsmore died three years ago, Fisher did a fine job filling out his last year. But —"

"But he couldn't get re-elected two years ago," Senator Cannon said. "He couldn't keep the governor's office, in spite of the great job he'd done."

"That's right. He's just not a politician, Jim. He doesn't have the . . . the personality, the flash, whatever it is that it takes to get a man elected by the people. I've got it; you sure as hell have it; Fisher doesn't."

"That's why I've got Horvin working for us," said Senator Cannon. "Whether I need him or not may be a point of argument. Whether Matthew Fisher needs him or not is a rhetorical question."

Governor Spanding lit a cigarette in silence while he stared at the quasi-riot that was still coming to the screen from Convention Hall. Then he said: "You've been thinking of Matt Fisher all along, then."

"Not Patagonia," said the senator. "Tibet."

"I'll shut up if you want me to, Jim."

"No. Go ahead."

"All right. Jim, I trust your judgment. I've got no designs on the Vice Presidency myself, and you know it. I like to feel that, if I had, you'd give me a crack at it. No, don't answer that, Jim; just let me talk.

"What I'm trying to say is that there are a lot of good men in the party who'd make fine VP's; men who've given their all to get you the nomination, and who'll work even harder to see that you're elected. Why pass them up in favor of a virtual unknown like Matt Fisher?"

Senator Cannon didn't say anything. He knew that Spanding didn't want an answer yet.

"The trouble with Fisher," Spanding went on, "is that he . . . well, he's too autocratic. He pulls decisions out of midair. He—" Spanding paused, apparently searching for a way to express himself. Senator Cannon said nothing; he waited expectantly.

"Take a look at the Bossard Decision," Spanding said. "Fisher was Attorney General for his state at the time.

"Bossard was the Mayor of Waynesville—twelve thousand and something population, I forget now. Fisher didn't even know Bossard. But when the big graft scandal came up there in Waynesville, Fisher wouldn't prosecute. He didn't actually refuse, but he hemmed and hawed around for five months before he really started the State's machinery to moving. By that time, Bossard had managed to get enough influence behind him so that he could beat the rap.

"When the case came to trial in the State Supreme Court, Matt Fisher told the Court that it was apparent that Mayor Bossard was the victim of the local district attorney and the chief of police of Waynesville. In spite of the evidence against him, Bossard was acquitted." Spanding took a breath to say something more, but Senator James Cannon interrupted him.

"Not 'acquitted', Harry. 'Exonerated'. Bossard never even should have come to trial," the senator said. "He was a popular, buddy-buddy sort of guy who managed to get himself involved as an unwitting figurehead. Bossard simply wasn't—and isn't—very bright. But he was a friendly, outgoing, warm sort of man who was able to get elected through the auspices of the local city machine. Remember Jimmy Walker?"

Spanding nodded. "Yes, but—"

"Same thing," Cannon cut in. "Bossard was innocent, as far as any criminal intent was concerned, but he was too easy on his so-called friends. He —"

"Oh, *crud,* Jim!" the governor interrupted vehemently. "That's the same whitewash that Matthew Fisher gave him! The evidence would have convicted Bossard if Fisher hadn't given him time to cover up!"

Senator James Cannon suddenly became angry. He jammed his own cigarette butt into the ash tray, turned toward Spanding, and snapped: "Harry, just for the sake of argument, let's suppose that Bossard wasn't actually guilty. Let's suppose that the Constitution of the United States is really true—that a man isn't guilty until he's proven guilty.

"Just *suppose*"—his voice and expression became suddenly acid—"that Bossard was *not* guilty. Try that, huh? Pretend, somewhere in your own little mind, that a mere accusation—no matter what the evidence—doesn't prove anything! Let's just make a little game between the two of us that the ideal of Equality Under the law means what it says. Want to play?"

"Well, yes, but—"

"O.K.," Cannon went on angrily. "O.K. Then let's suppose that Bossard really *was* stupid. He could have been framed easily, couldn't he? He could have been set up as a patsy, couldn't he? *Couldn't he?*"

"Well, sure, but—"

"Sure! Then go on and suppose that the prosecuting attorney had sense enough to see that Bossard *had* been framed. Suppose further that the prosecutor was enough of a human being to know that Bossard either had to be convicted or completely exonerated. What would he do?"

Governor Spanding carefully put his cigarette into the nearest ash tray. "If that were the case, I'd *completely* exonerate him. I wouldn't leave it hanging. Matt Fisher didn't do anything but make sure that Bossard couldn't be legally convicted; he didn't prove that Bossard was innocent."

"And what was the result, as far as Bossard was concerned?" the senator asked.

Spanding looked around at the senator, staring Cannon straight in the face. "The result was that Bossard was left hanging, Jim. If I go along with you and assume that Bossard was innocent, then Fisher fouled up just as badly as he would have if he'd fluffed the prosecution of a guilty man. Either a man is guilty, or he's innocent. If, according to your theory, the prosecutor knows he's innocent, then he should exonerate the innocent man! If not, he should do his best to convict!"

"He should?" snapped Cannon. "He *should?* Harry, you're letting your idealism run away with you! If Bossard were guilty, he should have been convicted—sure! But if he were innocent, should he be exonerated? Should he be allowed to run again for office? Should the people be allowed to think that he was lily-white? Should they be allowed to re-elect a nitwit who'd do the same thing again because he was too stupid to see that he was being used?

"No!" He didn't let the governor time to speak; he went on: "Matthew Fisher set it up perfectly. He exonerated Bossard enough to allow the ex-mayor to continue in private life without any question. *But*—there remained just enough question to keep him out of public office for the rest of his life. Was that wrong, Harry? Was it?"

Spanding looked blankly at the senator for a moment, then his expression slowly changed to one of grudging admiration. "Well . . . if you put it that way . . . yeah. I mean, no; it wasn't wrong. It was the only way to play it." He dropped his cigarette into a nearby ash try. "O.K., Jim; you win. I'll back Fisher all the way."

"Thanks, Harry," Cannon said. "Now, if we—"

Congressman Matson came back into the room, saying, "I got 'em, Jim. Five or ten minutes, they'll be here. Which one of 'em is it going to be?"

"Matt Fisher, if we can come to an agreement," Cannon said, watching Matson's face closely.

Matson chewed at his cigar for a moment, then nodded. "He'll do. Not much political personality, but, hell, he's only running for Veep. We can get him through." He took the cigar out of his mouth. "How do you want to run it?"

"I'll talk to Fisher in my bedroom. You and Harry hold the others in here with the usual chitchat. Tell 'em I'm thinking over the choice of my running mate, but don't tell 'em I've made up my mind yet. If Matt Fisher doesn't want it, we can tell the others that Matt and I were simply talking over the possibilities. I don't want anyone to think he's second choice. Got it?"

Matson nodded. "Whatever you say, Jim."

That year, late August was a real blisterer along the eastern coast of the United States. The great megalopolis that sprawled from Boston to Baltimore in utter scorn of state boundaries sweltered in the kind of atmosphere that is usually only found in the pressing rooms of large tailor shops. Consolidated Edison, New York's Own Power Company, was churning out multimegawatts that served to air condition nearly every enclosed place on the island of Manhattan—which served only to make the open streets even hotter. The power plants in the Bronx, west Brooklyn, and east Queens were busily converting hydrogen into helium and energy, and the energy was being used to convert humid air at ninety-six Fahrenheit into dry air at seventy-one Fahrenheit. The subways were crowded with people who had no intention of going anywhere in particular; they just wanted to retreat from the hot streets to the air-conditioned bowels of the city.

But the heat that can be measured by thermometers was not the kind that was causing two groups of men in two hotels, only a few blocks apart on the East Side of New York's Midtown, to break out in sweat, both figurative and literal.

One group was ensconced in the Presidential Suite of the New Waldorf—the President and Vice President of the United States, both running for re-election, and other high members of the incumbent party.

The other group, consisting of Candidates Cannon and Fisher, and the high members of *their* party, were occupying the only slightly less pretentious Bridal Suite of a hotel within easy walking distance of the Waldorf.

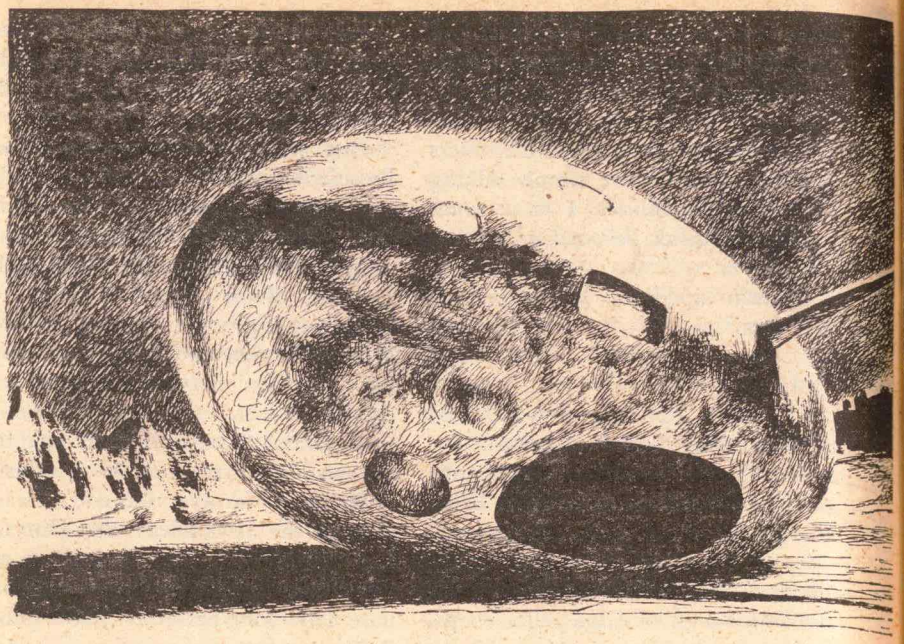
Senator James Cannon read through the news release that Horvin had handed him, then looked up at the PR man. "This is right off the wire. How long before it's made public?"

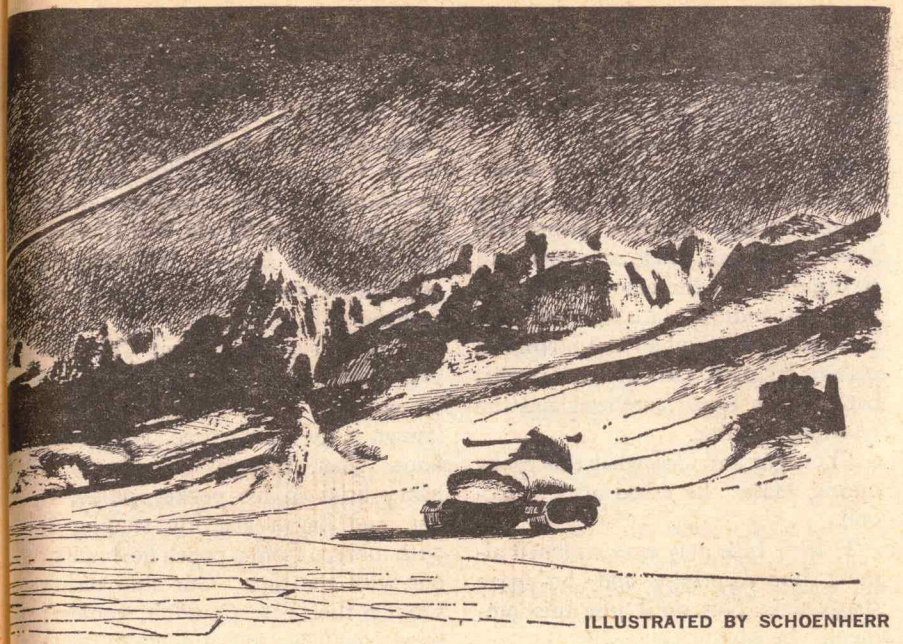
Horvin glanced at his watch. "Less than half an hour. There's an NBC news program at five-thirty. Maybe before, if one of the radio stations think it's important enough for a bulletin break."

"That means that it will have been common knowledge for four hours by the time we go on the air for the debate," said Cannon.

Horvin nodded, still looking at his watch. "And even if some people miss the TV broadcast, they'll be able to read all about it. The deadline for the *Daily Register* is at six; the papers will hit the streets at seven-fifteen, or thereabouts."

Cannon stood up from his chair. "Get your men out on the streets. Get 'em into bars, where they can pick





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up reactions to this. I want as good a statistical sampling as you can get in so short a time. It'll have to be casual; I don't want your men asking questions as though they were regular pollsters; just find out what the general trend is."

"Right." Horvin got out fast.

The other men in the room were looking expectantly at the senator. He paused for a moment, glancing around at them, and then looked down at the paper and said: "This is a bulletin from Tass News Agency, Moscow." Then he began reading.

"Russian Luna Base One announced that at 1600 Greenwich Standard Time (12:00 N EDST) a presumed spacecraft of unknown design was damaged by Russian rockets and fell to the surface of Luna somewhere in the Mare Serenitas, some three hundred fifty miles from the Soviet base. The craft was hovering approximately four hundred miles above the surface when spotted by Soviet radar installations. Telescopic inspection showed that the craft was not—repeat: not—powered by rockets. Since it failed to respond to the standard United Nations recognition signals, rockets were fired to bring it down. In attemption to avoid the rockets, the craft, according to observers, maneuvered in an entirely unorthodox manner, which cannot be attributed to a rocket dive. A nearby burst, however, visibly damaged the hull of the craft, and it dropped toward Mare Serenitas. Armed Soviet moon-cats are, at this moment, moving toward the downed craft.

"Base Commander Colonel A. V. Gryaznov is quoted as saying: 'There can be no doubt that we shall learn much from this craft, since it is apparently of extraterrestrial origin. We will certainly be able to overpower any resistance it may offer, since it has already proved vulnerable to our weapons. The missiles which were fired toward our base were easily destroyed by our own antimissile missiles, and the craft was unable to either destroy or avoid our own missiles.'

"Further progress will be released by the Soviet Government as it occurs."

Senator Cannon dropped the sheet of paper to his side. "That's it. Matt, come in the bedroom; I'd like to talk to you."

Matthew Fisher, candidate for Vice President of the United States, heaved his two-hundred-fifty-pound bulk out of the chair he had been sitting in and

followed the senator into the other room. Behind them, the others suddenly broke out into a blather of conversation. Fisher's closing of the door cut the sound off abruptly.

Senator Cannon threw the newssheet on the nearest bed and swung around to face Matthew Fisher. He looked at the tall, thick, muscular man trying to detect the emotions behind the ugly-handsome face that had been battered up by football and boxing in college, trying to fathom the thoughts beneath the broad forehead and the receding hairline.

"You got any idea what this *really* means, Matt?" he asked after a second.

Fisher's blue-gray eyes widened almost imperceptibly, and his gaze sharpened. "Not until just this moment," he said.

Cannon looked suddenly puzzled. "What do you mean?"

"Well," Fisher said thoughtfully, "you wouldn't ask me unless it meant something more than appears on the surface." He grinned rather apologetically. "I'm sorry, Jim; it takes a second or two to reconstruct exactly what *did* go through my mind." His grin faded into a thoughtful frown. "Anyway, you asked me, and since you're head of the Committee on SPACE Travel and Exploration—" He spread his hands in a gesture that managed to convey both futility and apology. "The mystery spacecraft is ours," he said decisively.

James Cannon wiped a palm over his forehead and sat down heavily on one of the beds. "Right. Sit down. Fine. Now, listen: We—the United States—have a space drive that compares to the rocket in the same way that the jet engine compares to the horse. We've been keeping it under wraps that are comparable to those the Manhattan Project was kept under 'way back during World War II. Maybe more so. But—" He stopped, watching Fisher's face. Then: "Can you see it from there?"

"I think so," Fisher said. "The Soviet Government knows that we have something . . . in fact, they've known it for a long time. They don't know what, though." He found a heavy briar in his pocket, pulled it out, and began absently stuffing it with tobacco from a pouch he'd pulled out with the pipe. "Our ship didn't shoot at their base. Couldn't, wouldn't have. Um. They shot it down to try to look it over. Purposely made a near-miss with an atomic warhead." He struck a match and puffed the pipe alight.

"Hm-m-m. The Soviet Government," he went on, "must have known that we had something 'way back when they signed the Greenston Agreement." Fisher blew out a cloud of smoke. "They wanted to change the wording of that, as I remember."

"That's right," Cannon said. "We wanted it to read that 'any advances in *rocket engineering* shall be shared equally among the Members of the United Nations', but the Soviet delegation wanted to change that to 'any advances in *space travel*'. We only beat them out by a verbal quibble; we insisted that the word 'space', as used,



could apply equally to the space between continents or cities or, for that matter, between any two points. By the time we got through arguing, the UN had given up on the Soviet amendment, and the agreement was passed as was."

"Yeah," said Fisher, "I remember. So now we have a space drive that doesn't depend on rockets, and the USSR wants it." He stared at the bowl of his briar for a moment, then looked up at Cannon. "The point is that they've brought down one of our ships, and we have to get it out of there before the Russians get to it. Even if we manage to keep them from finding out anything about the drive, they can raise a lot of fuss in the UN if they can prove that it's our ship."

"Right. They'll ring in the Greenston Agreement even if the ship technically isn't a rocket," Cannon said. "Typical Soviet tactics. They try to time these things to hit at the most embarrassing moments. Four years ago, our worthy opponent got into office because our administration was embarrassed by the Madagascar Crisis. They simply try to show the rest of the world that, no matter which party is in, the United states is run by a bunch of inept fools." He slapped his hand down on the newssheet that lay near him. "This may win us the election," he said angrily, "but it will do us more harm in the long run than if our worthy opponent stayed in the White House."

"Of what avail to win an election and lose the whole Solar System," Fisher paraphrased. "It looks as though the President has a hot potato."

"'Hot' is the word. Pure californium-254." Cannon lit a cigarette and looked moodily at the glowing end. "But this puts us in a hole, too. Do we, or don't we, mention it on the TV debate this evening? If we don't, the public will wonder why; if we do, we'll put the country on the spot."

Matt Fisher thought for a few seconds. Then he said, "The ship must have already been having trouble. Otherwise it wouldn't have been hovering in plain sight of the Soviet radar. How many men does one of those ships hold?"

"Two," the senator told him.

"We do have more than one of those ships, don't we?" Fisher asked suddenly.

"Four on Moon Base; six more building," said Senator Cannon.

"The downed ship must have been in touch with—" He stopped abruptly, paused for a second, then said: "I have an idea, Senator, but you'll have to do the talking. We'll have to convince the President that what we're suggesting is for the good of the country and not just a political trick. And we don't have much time. Those moon-cats shouldn't take more than twelve or fifteen hours to reach the ship."

"What's your idea?"

"Well, it's pretty rough right now; we can't fill in the details until we get more information, but—" He knocked the dottle from his pipe and began outlining his scheme to the senator.

Major Valentin Udovichenko peered through the "windshield" of his moon-cat and slowed the vehicle down as he saw the glint of metal on the Earthlit plain ahead. "Captain!" he snapped. "What does that look like to you?" He pointed with a gloved hand.

The other officer looked. "I should say," he said after a moment, "that we have found what we have been looking for, major."

"So would I. It's a little closer to our base than the radarmen calculated, but it certainly could have swerved after it dropped below the horizon. And we know there hasn't been another ship in this vicinity."

The captain was focusing a pair of powerful field glasses on the object. "That's it!" he said bridling his excitement. "Egg-shaped, and no sign of rocket exhausts. Big dent in one side."

Major Udovichenko had his own binoculars out. "It's as plain as day in this Earthlight. No sign of life, either. We shouldn't have any trouble." He lowered the binoculars and picked up a microphone to give the other nine moon-cats their instructions.

Eight of the vehicles stayed well back, ready to launch rockets directly at the fallen spacecraft if there were any sign of hostility, while two more crept carefully up on her.

They were less than a hundred and fifty yards away when the object they were heading for caught fire. The major braked his vehicle to a sudden halt and stared at the bright blaze that was growing and spreading over the metallic shape ahead. Bursts of flame sprayed out in every direction, the hot gases meeting no resistance from the near-vacuum into which they spread.

Major Udovichenko shouted orders into his microphone and gunned his own motor into life again. The caterpillar treads crunched against the lunar surface as both moon-cats wheeled about and fled. Four hundred yards from the blaze, they stopped again and watched.

By this time, the blaze had eaten away more than half of the hulk, and it was surrounded by a haze of smoke and hot gas that was spreading rapidly away from it. The flare of light far outshone the light reflected from the sun by the Earth overhead.

"Get those cameras going!" the major snapped. He knew that the eight moon-cats that formed the distant perimeter had been recording steadily, but he wanted close-ups, if possible.

None of the cameras got much of anything. The blaze didn't last long, fierce as it was. When it finally died, and the smoke particles settled slowly to the lunar surface, there was only a blackened spot where the bulk of a spaceship had been.

"Well . . . I . . . will . . . be —," said Major Valentin Udovichenko.

The TV debate was over. The senator and the President had gone at each other hot and heavy, hammer and tongs, with the senator clearly emerging as the victor. But no mention whatever had been made of the Soviet announcement from Luna.

At four thirty-five the next morning, the telephone rang in the senator's suite. Cannon had been waiting for it, and he was quick to answer.

The face that appeared on the screen was that of the President of the United States. "Your scheme worked, senator," he said without preamble. There was an aloofness, a coolness in his voice. Which was only natural, considering the heat of the debate the previous evening.

"I'm glad to hear it, Mr. President," the senator said, with only a hair less coolness. "What happened?"

"Your surmise that the Soviet officials did not realize the potential of the new craft was apparently correct," the President said. "General Thayer had already sent another ship in to rescue the crew of the disabled vessel, staying low, below the horizon of the Russian radar. The disabled ship had had some trouble with its drive mechanism; it would never have deliberately exposed itself to Russian detection. General Thayer had already asked my permission to destroy the disabled vessel rather than let the Soviets get their hands on it, and, but for your suggestion, I would have given him a go-ahead.

"But making a replica of the ship in plastic was less than a two-hour job. The materials were at hand; a special foam plastic is used as insulation from the chill of the lunar substrata. The foam plastic was impregnated with ammonium nitrate and foamed up with pure oxygen; since it is catalyst-setting, that could be done at low temperatures. The outside of the form was covered with metallized plastic, also impregnated with ammonium nitrate. I understand that the thing burned like unconfined gunpowder after it was planted in the path of the Soviet moon-cats and set off. The Soviet vehicles are on their way back to their base now."

After a moment's hesitation, he went on: "Senator, in spite of our political differences, I want to say that I appreciate a man who can put his country's welfare ahead of his political ambitions."

"Thank you, Mr. President. That is a compliment I appreciate and accept. But I want you to know that the notion of decoying them away with an inflammible plastic replica was not my idea; it was Matt Fisher's."

"Oh? My compliments to Mr. Fisher." He smiled then. It was obviously forced, but, just as obviously, there was sincerity behind it. "I hope the best team wins. But if it does not, I am secure in the knowledge that the second best team is quite competent."

Firmly repressing a desire to say, *I am sorry that I don't feel any such security myself,* Cannon merely said: "Thank you again, Mr. President."

When the connection was cut, Cannon grinned at Matthew Fisher. "That's it. We've saved a ship. It can be repaired where it is without a fleet of Soviet moon-cats prowling around and interfering. And we've scotched any attempts at propagandizing that the Soviets may have had in mind." He chuckled. "I'd like to have

seen their faces when that thing started to burn in a vacuum. And I'd like to see the reports that are being flashed back and forth between Moscow and Soviet Moon Base One."

"I wasn't so much worried about the loss of the disabled ship as the *way* we'd lose it," Matthew Fisher said.

"The Soviets getting it?" Cannon asked. "We didn't have to worry about that. You heard him say that Thayer was going to destroy it."

"That's exactly what I meant," said Fisher. "*How* were we going to destroy it? TNT or dynamite or Radex-3 would have still left enough behind for a good Soviet team to make some kind of sense out of it—some kind of hint would be there, unless an awful lot of it were used. A fission or a thermonuclear bomb would have vaporized it, but that would have been a violation of the East-West Agreement. We'd be flatly in the wrong."

Senator Cannon walked over to the sideboard and poured Scotch into two glasses. "The way it stands now, the ship will at least be able to limp out of there before anyone in Moscow can figure out what happened and transmit orders back to Luna." He walked back with the glasses and handed one to Fisher. "Let's have a drink and go to bed. We have to be in Philadelphia tomorrow, and I'm dead tired."

"That's a pair of us," said Fisher, taking the glass.

Another month of campaigning, involving both televised and personal appearances, went by without unusual incidents. The prophets, seers, and pollsters were having themselves a grand time. Some of them—the predicting-by-past performances men—were pointing out that only four Presidents had failed to succeed themselves when they ran for a second term: Martin Van Buren, Grover Cleveland, Benjamin Harrison, and Herbert Hoover. They argued that this presaged little chance of success for Senator James Cannon. The pollsters said that their samplings had shown a strong leaning toward the President at first, but that eight weeks of campaigning had started a switch toward Cannon, and that the movement seemed to be accelerating. The antipollsters, as usual, simply smiled smugly and said: "Remember Dewey in '48?"

Plays on Cannon's name had caught the popular fancy. The slogan "Blast 'em With Cannon" now appeared on every button worn by those who supported him—who called themselves "Cannoneers." Their opponents sneeringly referred to them as "Cannon fodder," and made jokes about "that big bore Cannon."

The latter joke was pure epithet, with no meaning behind it; when Senator James Cannon spoke, either in person or over the TV networks, even his opponents listened with grudging interest.

The less conservative newspapers couldn't resist the gag, either, and printed headlines on the order of CANNON FIRES BLAST AT FOREIGN POLICY, CANNON HOT OVER CIA ORDER, BUDGET BUREAU SHAKEN BY CANNON REPORT, and TREASURY IS LATEST CANNON TARGET.



The various newspaper columnists, expanding on the theme, made even more atrocious puns. When the senator praised his running mate, a columnist said that Fisher had been "Cannonized," and proceeded to call him "Saint" Matthew. The senator's ability to remember the names and faces of his constituents caused one pundit to remark that "it's a wise Cannon that knows its own fodder."

They whooped with joy when the senator's plane was delayed by bad weather, causing him to arrive several hours late to a bonfire rally in Texas. Only a strong headline writer could resist: CANNON MISSES FIRE!

As a result, the senator's name hit the headlines more frequently than his rival's did. And the laughter was *with* Cannon, not *at* him.

Nothing more was heard about the "mysterious craft" that the Soviet claimed to have shot down, except a terse report that said it had "probably been destroyed." It was impossible to know whether or not they had deduced what had happened, or whether they realized that the new craft was as maneuverable over the surface of the moon as a helicopter was over the surface of Earth.

Instead, the Sino-Soviet bloc had again shifted the world's attention to Africa. Like the Balkan States of nearly a century before, the small, independent nations that covered the still-dark continent were a continuing source of trouble. In spite of decades of "civilization," the thoughts and actions of the majority of Africans were still cast in the matrix of tribal taboos. The changes of government, the internal strife, and the petty brush wars between nations made Central and South America appear rigidly stable by comparison. It had been suggested that the revolutions in Africa occurred so often that only a tachometer could keep up with them.

If nothing else, the situation had succeeded in forcing the organization of a permanent UN police force; since back in 1960, there had not been a time when the UN Police were not needed somewhere in Africa.

In mid-October, a border dispute between North Uganda and South Uganda broke out, and within a week it looked as though the Commonwealth of Victorian Kenya, the Republic of Upper Tanganyika, and the Free and Independent Popular Monarchy of Ruanda-Urundi were all going to try to jump in and grab a piece of territory if possible.

The Soviet Representative to the United Nations charged that "this is a purely internal situation in Uganda, caused by imperialist *agents provocateur* financed by the Western Bloc." He insisted that UN intervention was unnecessary unless the "warmongering" neighbors of Uganda got into the scrap.

In a televised press interview, Vice Presidential Candidate Matthew Fisher was asked what he thought of the situation in East Africa.

"Both North and South Uganda," he said, "are communist controlled, but, like Yugoslavia, they have declared themselves independent of the masters at Moscow. If this conflict was stirred up by special agents—and I have no doubt that it was—those agents were Soviet, not Western agents. As far as the UN can be concerned, the Soviet Minister is correct, since the UN has recognized only the government of North Uganda as the government of all Uganda, and it is, therefore, a purely internal affair.

"The revolution—that is, *partial* revolution—which caused the division of Uganda a few years ago, was likewise due to Soviet intervention. They hoped to replace the independent communist government with one which would be, in effect, a puppet of the Kremlin. They failed. Now they are trying again.

"Legally, UN troops can only be sent there at the request of the Northern Uganda government. The Secretary General can send police troops there of his own accord only if another nation tries to invade Uganda.

"But—and here is the important point—if the Uganda government asks the aid of a friendly government to send troops, and if that friendly government complies with that request, *that cannot be considered an invasion!*"

Question from a reporter: "Do you believe that such intervention from another country will be requested by Uganda?"

"I do. And I am equally certain that the Soviet representative to the UN, and his superiors in Moscow, will try to make a case of invasion and aggression out of it."

Within twenty-four hours after that interview, the government of North Uganda requested aid from Victorian Kenya, and a huge contingent of Kenyan troops marched across the border to help the North Uganda army. And the Soviet representative insisted that the UN send in troops to stop the "imperialist aggression" of Victorian Kenya. The rigidly pro-Western VK government protested that the Sino-Soviet accusations were invalid, and then asked, on its own accord, that a UN contingent be sent in to arbitrate and act as observers and umpires.

"Win one, lose one," Matthew Fisher said privately to Senator Cannon. "Uganda will come out of this with a pro-Western government, but it might not be too stable. The whole African situation is unstable. Mathematically, it has to be."

"How's that?" Senator Cannon asked.

"Do you know the Richardson-Gordon Equations?" Fisher asked.

"No. I'm not much of a mathematician," Cannon admitted. "What do they have to do with this?"

"They were originally proposed by Lewis Richardson, the English mathematician, and later refined by G. R. Gordon. Basically, they deal with the causes of war, and they show that a conglomeration of small states is less stable than a few large ones. In an



*Sometimes "resignation" means the highest determination . . . when you can't simply resign.*

arms race, there is a kind of positive feedback that eventually destroys the system, and the more active small units there are, the sooner the system reaches the destruction point."

Senator Cannon chuckled. "Any practical politician could have told them that, but I'm glad to hear that a mathematical tool to work on the problem has been devised. Maybe one of these days we won't have to be rule-of-thumb empiricists."

"Let's hope so," said Matt Fisher.

By the end of October, nearly two weeks from Election Day, the decision had been made. There were still a few Americans who hadn't made up their minds yet, but not enough to change the election results, even if they had voted as a bloc for one side or the other. The change from the shouting and arguing of mid-summer was apparent to anyone who knew what he was looking for. In the bars and restaurants, in the subways and buses, aboard planes and ships and

trains, most Americans apparently seemed to have forgotten that there was a national election coming up, much to the surprise of Europeans and Asians who were not familiar with the dynamics of American political thought. If a foreigner brought the subject up, the average American would give his views in a calm manner, as though the thing were already settled, but there was far more discussion of the relative merits of the horses running at Pimlico or the rise in Lunar Developments Preferred than there was of the election. There were still a few people wearing campaign buttons, but most people didn't bother pinning them on after the suit came back from the cleaners.

A more detailed analysis would have shown that this calmness was of two types. The first, by far in the majority, was the calmness of the complacent knowledge of victory. The second was the resignation to loss manifested by those who knew they were backing the wrong man, but who, because of party loyalty or intellectual conviction or just plain stubbornness, would back him.

When Senator Cannon's brother, Dr. Frank Hewlitt Cannon, took a short leave of absence from Mayo Clinic to fly to the senator's campaign headquarters, there was a flurry of speculation about the possibility of his being appointed Secretary of Health, Education, and Welfare, but the flurry didn't amount to much. If President Cannon wanted to appoint his brother, that was all right with the voters.

A tirade by the Soviet Premier, charging that the UN Police troops in Victorian Kenya were "tools of Yankee aggressionists," Americans smiled grimly and said, in effect: "Just wait 'til Cannon gets in—*he'll* show 'em."

Election Day came with the inevitability of death and taxes. The polling booths opened first on the East Coast, and people began filing in to take their turns at the machines. By the time the polls opened in Nome, Alaska, six hours later, the trend was obvious. All but two of the New England states were strongly for Cannon. New York, Pennsylvania, New Jersey, West Virginia, and Ohio dropped into his pocket like ripe apples. Virginia, North Carolina, South Carolina, Georgia, and Florida did the same. Alabama wavered at first, but tagged weakly along. Tennessee, Kentucky, Indiana, and Michigan trooped in like trained seals.

In Mississippi, things looked bad. Arkansas and Louisiana were uncertain. But the pro-Cannon vote in Missouri, Illinois, Iowa, Wisconsin, and Minnesota left no doubt about the outcome in those states. North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas—all Cannon by vast majorities.

And so the returns came in, following the sun across the continent. By the time California had reported three-fourths of its votes, it was all over but the jubilation. Nothing but an honest-to-God, genuine, Joshua-stopping-the-sun type of miracle could have saved the opposition. And such was not forthcoming.



At Cannon's campaign headquarters, a television screen was blaring to unhearing ears, merely adding to the din that was going on in the meeting hall. The party workhorses and the volunteers who had drummed for Cannon since the convention were repeating the scene that had taken place after Cannon's nomination in the summer, with an even greater note of triumph.

In Cannon's suite, six floors above, there was less noise, but only because there were fewer people.

"Hey!" Cannon yelled good-naturedly. "Lay off! Any more slaps on my back, and I'm going to be the first President since Franklin Roosevelt to go to my Inauguration in a wheelchair! Lay off, will you?"

"A drink, a drink, we got to have a drink," chanted Representative Edwin Matson, his bulldog face spread wide in a happy grin while he did things with bottles, ice, and glasses. "A drink, a drink—"

Governor Harold Spanding's lantern-jawed face looked as idiotically happy as Matson's, but he was quieter about it. Verbally, that is. It was he who had been pounding Cannon on the back, and now he was pounding Matthew Fisher almost as hard.

Matt Fisher finally managed to grab his hand, and he started pumping it. "What about you, Harry? I'm only a poor, simple Vice President. You got re-elected governor!"

Dr. Frank Cannon, looking like an older, balder edition of his brother, was smiling, too, but there was a troubled look in his eyes even as he congratulated the senator. Congressman Matson, passing out the drinks, handed the first one to the senator.

"Have a drink, Mr. President! You're going to have to make a speech pretty soon; you'll need a bracer!" He handed the second one to the physician. "Here you go, Doc! Congratulations! It isn't everyone who's got a President in the family!" Then his perceptive brain noticed something in the doctor's expression. "Hey," he said, more softly, "what's the trouble? You look as though you expected sickness in the family."

The doctor grinned quickly. "Not unless it's my own. I'm used to worrying about a patient's health, not a Presidential election. I'm afraid my stomach's a little queasy. Wait just a second; I've got some pills in my little black bag. Got pills in there for all ailments. Find out if anyone else needs resuscitation, will you?" Drink in hand, he went toward the closet, where his little black bag was stashed.

"Excitement," said Senator Cannon. "Frank isn't used to politics."

Matson chuckled. "Do him good to see how the other half lives." He walked off, bearing drinks for the others. Governor Spanding grabbed one and came over to the senator. "Jim! Ready to tear up your capitulation speech now?"

Cannon glanced at his watch. "Almost. The polls closed in Nome just ten minutes ago. We'll wait for the President's acknowledgment of defeat before we go downstairs." He glanced at his brother, who was washing something down with water.

Behind him, he heard Matson's voice saying: "I'm sure glad Horvin isn't here! I can hear him now: 'Image! Image! That's what won the election! Image!'" Matson guffawed. "Jim Cannon was winning elections by landslides before he ever heard of Horvin! Jim Cannon projects his own image."

"Sure he does," Matt Fisher said, "but what about me?"

"You? Hah! You're tops, Matt. Once a man gets to know you, he can see that, if he's got any brains."

Fisher chuckled gently. "Ed, you've got what it takes to be a politician, all right."

"So do you, Mr. Vice President! So do you! Hey!" He turned quickly. "We got to have a toast! Doc, you're his brother. I think the honor should be yours."

Dr. Frank Cannon, looking much more chipper since swallowing the pills, beamed and nodded at his brother. "It will be a pleasure. Gentlemen, come to attention, if you will." They did, grinning at first, then forcing solemnity into their expressions.

"Gentlemen," said Dr. Cannon gravely, "I give you my brother, Senator James Harrington Cannon, the next President of the United States!"

"To the President!" said Governor Spanding.

"To the President!" chorused the others.

Glasses clinked and men drank solemnly.

Then, before anyone else could say anything, Dr. Cannon said: "I further propose, gentlemen, that we drink to the man who will spend the next four years in the White House—God willing—in the hope that his ability to handle that high office will be equal to the task before him, and that he will prove worthy of the trust placed in him by those who had faith in that ability."

"Amen," said Congressman Matson softly.

And they all drank again.

Senator Cannon said: "I thank you, gentlemen. I—"

But, at that moment, the ubiquitous clatter of noise from the television abruptly changed tenor. They all turned to look.

". . . And gentlemen," the announcer's voice was saying, "The President of the United States!"

The Presidential Seal which had been pictured on the screen faded suddenly, to be replaced by the face of the President. He looked firmly resigned, but neither haggard, tired, defeated, nor unhappy. To the five men who stood watching him in that room, it was obvious that the speech to come was on tape.

The President smiled wanly. "Fellow Americans," he began. "as your President, I wish both to congratulate you and thank you. As free citizens of a free country, exercising your franchise of the ballot to determine the men and women who are to represent and lead you during their coming terms of office, you have made your decision. You have considered well the qualifications of those men and women, and you have considered well the problems that will face our country as a whole and each individual as a free citizen desiring to remain free, and you have made your choice accordingly, as is your right and duty. For that, I congratulate you."

He paused for a dramatic moment.

"The decision, I think, was not an easy one. The citizens of our great democracy are not sheep, to be led first this way and then that; they are not dead leaves to be carried by every vagrant breeze that blows; they are not children, nor are they fools."

He looked searchingly from the screen, as though to see into the minds of every person watching.

"Do not mistake my meaning," he said levelly. "I do not mean that there are no fools among us. There are." Again he paused for effect. "Every man, every woman, who, through laziness or neglect or complacency, failed to make his desire known at the polls in this election—is a fool. Every citizen who thinks that his vote doesn't count for much, and therefore fails to register that vote—is a fool. Every person who accepts the *priviliges* of American citizenship and considers them as *rights,* and who neglects the *duties* of citizenship because they are tiresome—is a fool."

He waited for half a second.

"Fortunately for us all, the fools are in a minority in our country. This election shows that. Most of you have done your duty and followed your conscience as you see fit. And I congratulate you for that."

The smile became less broad—by just the right amount.

"Four years ago, exercising that same privilege and duty, you, the citizens of the United States, honored me and those who were working with me by electing us to the highest offices in this nation. You elected us, I believe, because we made certain promises to you—solemn promises that were made in our platform four years ago."

He took a deep breath and folded his hands below his chin.

"I am certain that you all know we have endeavored to keep those promises. I am certain that you know that we have kept faith with the people of this nation."

He looked down for a moment, then looked up again.

"This year, in our platform, we made more promises. We outlined a program that we felt would be of the greatest benefit to this nation." He unclasped his hands and spread them with an open gesture.

"Senator James Cannon and his party have also made promises—promises which, I am sure, they, too, feel are best for our nation."

Another pause.

"You, the citizens of the United States, have, in the past few months, carefully weighed these promises against one another—weighing not only the promises themselves, but the integrity and the ability of the men who made them.

"And you have made your choice.

"I cannot, and do not, quarrel with that choice. It is the essence of demo-

cratic government that disagreements in the upper echelons of that government shall be resolved by the action and the will of the governed. You, the people of the United States, have done just that.

"And—for that, I thank you."

A final hesitation.

"Next January, Senator James Harrington Cannon will be inaugurated as President of the United States. Let us show him, and the men who are to work with him, that we, as citizens of this great nation, resolving our differences, will strive unceasingly under his administration to further the high resolves and great ideals of our country.

"I believe—I *know*—that you are all with me in this resolution, and, for that, too,—

"—I thank you."

The face of the President of the United States faded from the screen.

After a few seconds, Matson sighed. "Not bad at all, really," he said, stepping over to shut off the set. "He's been taking lessons from you, Jim. But he just hasn't quite got it."

Senator Cannon took another swallow of his drink and said nothing.

"Sincerity," said Governor Spanding. "That's what's lacking. He hasn't got it, and the voters can feel it."

"He managed to be elected President of the United States on it," Senator Cannon said dryly.

Spanding didn't turn to look at Cannon; he kept looking at the dead TV screen. "These things always show up by comparison, Jim. In comparison with some of us—most of us, in fact—he looks pretty good. I've known him since he was a fresh junior senator, and I was just attorney for the House Committee for Legislative Oversight." He turned around. "You know what, Jim? When I first heard him talk, I actually thought about changing parties. Yeah. Really." He turned around again.

"But," he went on, "he's all hot air and no ability. Just like Matt, here, is all ability and no hot air. No offense meant, Matt, believe me," he added, glancing at Fisher.

"I know," Fisher said quietly.

Spanding turned around once more and looked Cannon squarely in the eyes. "You've got both, Jim. The blarney to put yourself over, and the ability to back it up. And you know I'm not trying to flatter you when I say that."

When Cannon nodded wordlessly, Spanding gave himself a short, embarrassed laugh. "Ah, Hell. I talk too much." And he took a hefty slug of his drink.

Matthew Fisher took the overcharge out of the sudden outburst of emotion by saying: "It's more than just ability and sincerity, Harry. There's determination and honesty, too."

Matson said, "Amen to that."

Dr. Frank Cannon was just standing there, looking at his brother. There was a definite look of respect on his face.

Senator Cannon said: "You're all great guys—thanks. But I've got to get downstairs and make a speech. Ed, get the recording tape out of that set; I want to make some notes on what he said. And hurry it up, we haven't got too long."

"No canned speech for you, eh, Jim?" Spanding said.

"Amen to that, too," said Representative Matson as he opened the panel in the side of the TV set.

From a hundred thousand loudspeakers all over the United States, from the rockbound coast of Maine to the equally rockbound coast of Alaska, from the sun-washed coast of Florida to the ditto coast of Hawaii, the immortal voice of Bing Crosby, preserved forever in an electronic pattern made from a decades-old recording, told of a desire for a White Christmas. It was a voice and a tune and a lyric that aroused nostalgia even in the hearts of Floridians and Californians and Hawaiians who had never seen snow in their lives.

The other carols rang out, too—"Silent Night," "Hark! The Herald Angels Sing," "God Rest Ye Merry Gentlemen," "O Little Town of Bethlehem," and all the others. All over the nation, in millions upon millions of Christian homes, the faithful prepared to celebrate the birth, the coming, of their Saviour, Who had come to bring peace on Earth to men.

And in millions of other American homes, the Children of Abraham celebrated the Festival of Lights—*Chanukah,* the Dedication—the giving of thanks for the Blessing of God upon the priestly family of the Maccabees, who, twenty-odd centuries before, had taken up arms against the tyranny of a dynasty which had banned the worship of Almighty God, and who, by winning, had made themselves a symbol forever of the moral struggle against the forces that oppress the free mind of Man.

The newspapers and television newscasts were full of the age-old "human interest stories" which, in spite of their predictability—the abandoned baby, the dying child, the wretchedly ill oldster—still brought a tear to the eye during the Holiday Season.

As President-elect Cannon slowly made his cabinet appointments, the announcements appeared, but there was hardly any discussion of them, much less any hue and cry.

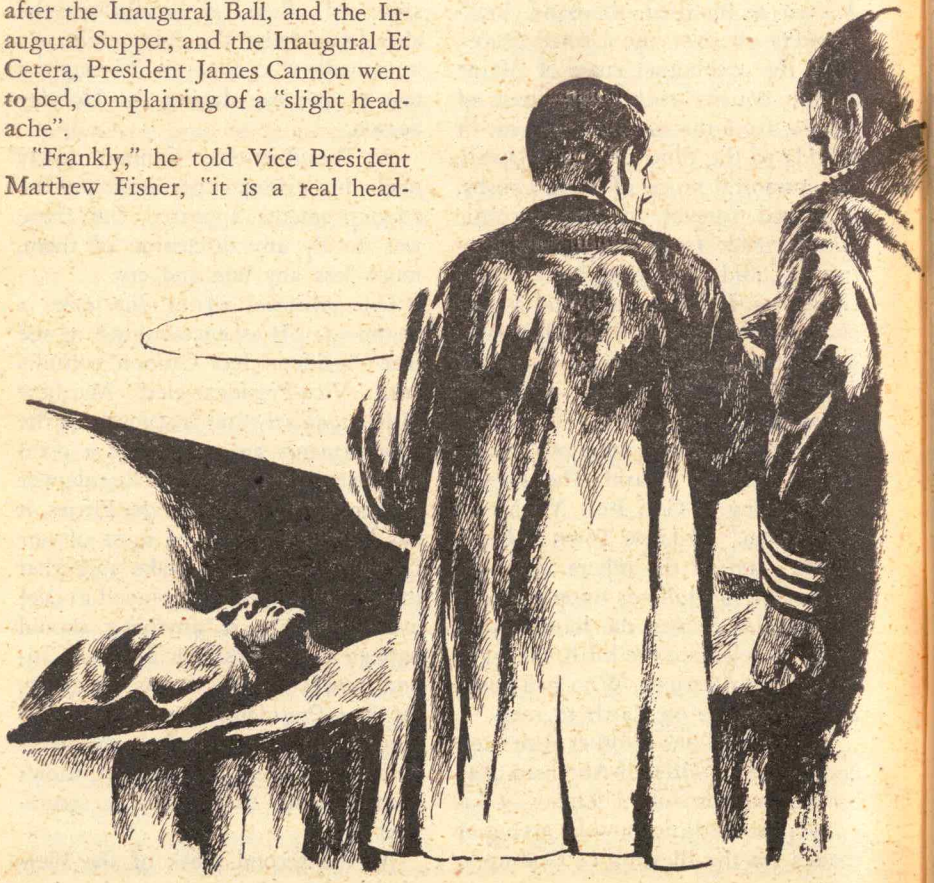
One editorial writer did make a comment: "It is encouraging to see that President-elect Cannon consults with Vice-President-elect Matthew Fisher regularly and frequently as the appointments are made. For a good many years, ever since the Eisenhower Administration, back in the Fifties, it has been the policy of most of our Chief Executives to make sure that the Vice President is groomed to take over smoothly if anything should happen to the President. Senator Cannon, however, is, as far as we know, the first President-elect who has begun this grooming before the Inauguration. This, in our opinion, shows both wisdom and political astuteness."

By the second week of the New

Year, the new Cabinet had been picked. Contrary to the rumors before the election, the senator's brother had not been selected for any post whatever, but the men who *were* picked for Cabinet posts were certainly of high caliber. The United States Senate had confirmed them all before Inauguration Day.

That day was clear and cold in Washington. After the seemingly endless ceremonies and ceremonials, after the Inaugural Ball, and the Inaugural Supper, and the Inaugural Et Cetera, President James Cannon went to bed, complaining of a "slight headache".

"Frankly," he told Vice President Matthew Fisher, "it is a real head-





splitter." He took four aspirin and went to bed.

He said he felt "a little better" the next day.

The fifth of February.

Ten forty-eight in the evening.

The White House, Washington, D.C.

Dr. Frank Hewlitt Cannon stood in a darkened bedroom in Blair House, across the street from the Executive Mansion, nervously looking out the window at the big white house across the way. He was not nervous for himself, although he had plenty of reason to be. He was clad in pajamas, as his brother had ordered, and had even taken the extra precaution of rumpling up his hair.

He looked at his watch, and then looked back at the White House.

*How long?* he thought. *How long?*

He looked at his wrist again. The sweep hand only moved when he looked at it, apparently. He dropped his hands and clasped them behind his back. How long before he would know?

*My kid brother,* he thought. *I could always outthink him and outfight him. But he's got something I haven't got. He's stuck to his guns and fought hard all these years. I couldn't do what he's doing tonight, and I know it. You're a better man than I am, kid.*

Across Pennsylvania Avenue, Senator James Cannon was doing some heavy consideration, too. He sat on the edge of his bed and looked at the small tubular device in his hand.

*Will Frank be safe? That's the only weak point in the plan.*

Frank was safe. He *had* to be. Frank hadn't been over from Blair House in three days. They hadn't even *seen* each other in three days. The Secret Service men—

He threw a glance toward the door that led from his bedroom to the hall.

The Secret Service agents would know that Frank couldn't possibly have had anything to do with it. The only possible connection would be the hypogun itself. He looked at the little gadget. *Hell,* he thought; *now or never.*

He got up and strode purposefully into the bathroom. He smiled crookedly at his own reflection in the mirror. It was damnably difficult for a President to outwit his own bodyguard.

*Get on with it!*

He swallowed the capsule Frank had given him. Then, placing the muzzle against the precise spots Frank had shown him, James Cannon pulled the trigger. Once . . . twice . . . thrice . . .

Against each nerve center in his left side. Fine.

Now that it was done, all fear—all trepidation—left Senator James Cannon. Now there was no way to go but ahead.

First, the hypogun that had blown the drug into his body. Two minutes to get rid of that, for that was the only thing that could tie Frank in to the plan.

They had already agreed that there was no way to get rid of it. It couldn't

be destroyed or thrown away. There was only one way that it could be taken from the White House . . .

Cannon left his fingerprints on it, dropped it into the wastebasket, and covered it with tissue paper. Then he left the bathroom and walked toward the hall door. Beyond it, he knew, were the guarding Secret Service men.

And already his left side was beginning to feel odd.

He walked to the door and opened it. He had a scowl on his face.

"Hello, Jenkins—Grossman," he said, as the two men turned. "I've got a hell of a headache again. Aspirin doesn't seem to help, and I can't get any sleep." He looked rather dazed, as though he wasn't sure of his surroundings. He smiled lopsidedly. "Call Frank, over at Blair House, will you? Hurry?" Then he swallowed, looked dazed, and fell to the floor in a heap.

The two Secret Service men didn't move, but they shouted loudly. Their orders were to guard the body of the President—*literally!* Until it was declared legally dead, that body was their responsibility.

The other Secret Service men in the White House came on the run. Within one minute after Cannon had fallen, a call had gone to Blair House, asking for the President's brother.

Inside of another two minutes, Dr. Frank Cannon was coming through the front door of the Executive Mansion. In spite of the chill outside, he was wearing only a topcoat over his pajamas.

"What happened?" he snapped, with the authority that only a physician can muster. "Where is he?"

He heard the story on the way to the President's room. Jenkins and Grossman were still standing over the fallen Chief Executive. "We haven't moved him, except to make him more comfortable," said Grossman. "He's still O.K. . . . I mean, he's breathing, and his heart's still going. But we didn't want to move him—"

"Fine!" snapped the doctor. "Best thing." He knelt over his brother and picked up his wrist. "Have you called anyone else?" he asked sharply while he felt the pulse.

"The Naval Hospital," said another agent. "They're coming fast!"

"Fine!" repeated Dr. Frank. By this time, most of the White House staff was awake. Frank Cannon let go the wrist and stood up quickly. "Can't tell for sure, but it looks like a slight stroke. Excuse me."

He went into the Executive bedroom, and on into the bathroom. He closed the door. Quickly, he fished the hypogun out of the wastebasket and dropped it into the little black bag which he had carried with him. He came out with a glass of water. Everything was taken care of.

*PRESIDENT SUFFERS STROKE!*
*JHC Taken To US Naval Hospital*
*In Washington After Stroke In*
*White House*

All over the world, headlines and newscasts in a hundred tongues carried the story. And from all over the world came messages of sympathy and concern for the stricken Chief Executive. From England, simultaneous messages arrived from the Sovereign and the Prime Minister; from France, notes from both the President and the Premier of the Seventh Republic; from Ethiopia, condolences from His Imperial Majesty and from the Chief Executive. The United German Federation, the Constitutional Kingdom of Spain, the Republic of Italy, the United Austro-Yugoslavian Commonwealth, and the Polish Free State all sent rush radiograms. So did Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela. From Africa, Australia, Southern Asia, Oceania, and Central America came expressive words of sorrow. Special blessings were sent by His Holiness from Vatican City, by the Patriarch of Istanbul, and by the Archbishop of Canterbury. The Presidente of the Estados Unidos Mexicanos personally took a plane to Washington, as did the Governor General of Canada, carrying a personal message from the Prime Minister. Even the Soviet Union sent a radiogram, and the story of the tragedy was printed in *Pravda,* accompanied by an editorial that almost approached straight reporting.

President James Harrington Cannon knew none of this. He was unconscious and unable to receive visitors.

As far as actual news from the White House was concerned, news commentator Barton Wayne gave the best summary over a major American TV network on the morning of the sixth of February:

"Last night, at approximately eleven p.m., James Harrington Cannon, President of the United States, collapsed at the feet of the Secret Service men who were guarding him. Within a few minutes, Dr. Frank Hewlitt Cannon, the President's brother, called by the Secret Service in obedience to the President's last conscious words, had arrived from Blair House, where he had been staying.

"Dr. Frank Cannon diagnosed the President's illness as a—quote—slight stroke—unquote. Later, after the President had been taken to the Naval Hospital for further diagnosis, Dr. Cannon released a statement. Quote—further tests have enabled the medical staff of this hospital to make a more detailed analysis. Apparently, the President has suffered a slight cerebral hemorrhage which has, temporarily at least, partially paralyzed the muscles of his left side. The President, however, has regained consciousness, and his life is in no danger—Unquote.

"After only sixteen days in the White House, the President has fallen ill. We can only wish him Godspeed and an early recovery."

Dr. Frank Cannon stood firmly by his brother's bedside, shaking his head firmly. "No, commander; I cannot permit that. I am in charge of

this case, and I shall remain in charge of it until my patient tells me otherwise."

The graying Navy medical officer pursed his lips. "In cases of this sort, doctor," he said primly, "the Navy is in charge. The patient is, after all, the President of the United States."

Dr. Frank went right on shaking his head. "Cuts no ice, commander. I was specifically summoned by the patient. I agreed to take the case. I will be most happy to accept your co-operation; I welcome your advice and aid; but I will *not* allow my patient to be taken from my charge."

"It is hardly considered proper for the physician in charge of a serious case to be a relative of the patient."

"Possibly. But it is neither unethical nor illegal." He gave the commander a dry smile. "I know my brother, commander. Quite well. I also know that you have the authority and the means to expel me from this hospital." The smile became positively icy. "And, in view of the former, I should not advise you to exercise the latter."

The commander wet his lips. "I have no intention of doing so, doctor," he said rather huffily. "But, inasmuch as the X rays show no—"

There came a mumble from the man on the bed, and, in that instant, both men forgot their differences and became physicians again, as they focused their attention on the patient.

President Cannon was blinking his eyes groggily. Or, rather, *eye*. The left one refused to do more than show a faint flicker of the lid.

"Hullo, Jamie," Dr. Frank said gently. "How d'you feel?" It took nerves of steel to show that tender composure. The drug should wear off quickly, but if Jim Cannon's mind was still fuzzy, and he said the wrong thing—

For a moment, the President said nothing as he tried to focus his right eye.

"Don't try to move, Mr. President," said the Navy doctor softly.

President Cannon smiled lopsidedly, the left side of his face refusing to make the effort. "Arright," he said, in a low, blurred voice. "Wha' happen', Frang?"

"Apparently," said Dr. Frank carefully, "you've had a little bit of a stroke, kid. Nothing to worry about. How do you feel?"

"Funny. Li'l dizzy. Don't hurt, though."

"Good. Fine. You'll be O.K. shortly."

The President's voice became stronger. "I'm glad you're here, Frank. Tell me—is it . . . bad?"

" 'Tain't good, kid," Dr. Frank said with a bedside grin. "You can't expect a stroke to put you in the best of health, now, can you?"

The lopsided smile came back. "Guess not." The smile went away, to be replaced by a puzzled frown. "My whole left side feels dead. What's the matter?"

Instead of answering, Dr. Frank Cannon turned to the Navy medic. "I'll let the commander explain that. What's your diagnosis, doctor?"

The commander ran his tongue nervously over his lips before speaking. "There's apparently a small blood clot in the brain, Mr. President, interfering with the functioning of the efferent nerves."

"Permanent?"

"We don't know yet, sir. We hope not."

President Cannon sighed. "Well. Thank you, commander. And now, if you don't mind, I'd like to speak to my brother—alone."

The commander glanced at Dr. Frank, then back at the President. "Certainly, sir." He turned to leave.

"Just a moment, commander," Dr. Frank said. "There'll be news reporters out there. Tell them—" He frowned a little. "Tell them that the President is conscious and quite rational, but that there is still some weakness. I don't think anything more than that will be necessary."

"I agree. Certainly, doctor." At the door, the commander paused and said: "I'll keep everyone out until you call."

"Thanks," said Dr. Frank as the door closed behind the Navy man.

As soon as it closed, President Cannon struggled to get up.

"Don't try it, kid," the doctor said, "those muscles are paralyzed, even if you aren't sick. Here, let me help you."

"How did it come off?" Cannon asked as his brother propped him up.

"Perfectly. No one doubts that it's a stroke. Now what?"

"Give me a cigarette."

"All right, but watch it. Use your right hand, and smoke with the right side of your mouth. Here." The doctor lit a cigarette and handed it to his brother. "Now, what's the next step?"

"The next step is to tell Matthew Fisher," said the President.

Dr. Frank Cannon scowled. "Why? Why not just go through with the thing and let him be fooled along with the rest? It seems to me he'd be . . . well, more secure in his own position if he didn't know."

"No." The President hunched himself up on his pillows. "Can't you raise the head of this bed?"

Dr. Frank touched a button on the bedside panel, and the upper portion of the bed rose smoothly at an angle. "Better?"

"Fine. Much better."

"You were saying—"

"Yeah. About Matt Fisher. He has to know. He'll guess eventually, in the next four years, anyway—unless I hide away somewhere. And I have no intention of doing that.

"Oh, I'm not trying to show Matt what a great guy I am, Frank. You know better than that, and so will he. But Matt will have to have all the facts at hand, if he's to do his job right, and it seems to me that this is a pretty important fact. What do you say, Frank?"

The doctor nodded slowly. "I think you know more about the situation than I do. And I trust your judgment, kid. And Matt's, too, I guess."

"No." President Cannon's voice was firm as he looked at his brother

with one bright eye. "Don't trust Matt's judgment, because he doesn't have any."

Dr. Frank looked astonished. "Then *what*—?" He stopped.

"Matthew Fisher," said President Cannon authoritatively, "doesn't need judgment any more than *you* need instinct. No more so, and no less. I said he doesn't have any judgment, but that's not exactly true. He has it, but he only uses it for routine work, just as you or I use instinct. We can override our instinctive reactions when we have to. Matt can override his judgment when he has to.

"I don't pretend to know how Fisher's mind works. If I did, I wouldn't be doing this. But I *do* know that Matt Fisher—by some mental process I can't even fathom—almost invariably knows the *right* thing to do, and he knows it without using judgment."

"And you're still convinced that this is the only way out?" Dr. Frank asked. "Couldn't you stay in office and let him run things under cover?"

"We discussed all this months ago, Frank," Cannon said wearily. "My reasons remain the same. Matt couldn't possibly operate efficiently if he had to go through me every time. And I am human, too; I'd have a tendency to impose my own judgment on his decisions.

"No, Frank; this is the only way it can work. This country needs Matthew Fisher as President, but he could never have been elected. Now I've done my job; now it's time for me to get out of the way and turn the Presidency over to a man who can handle the office far better than any other man I know."

"You make him sound like some sort of superman," said Dr. Frank with a wry grin.

"Hell," said President Cannon, "you don't think I'd turn this job over to anything less, do you?" He chuckled. "Call him in, will you?"

PRESIDENT CANNON RESIGNS!
Ill Health Given As Reason;
Doctors Say Recovery
Unlikely In Near Future.
VP Fisher To Take Oath Tomorrow.



# the Reference Library

## P. Schuyler Miller

### WHO'S NEXT?

Stories about the race or species that supplants Man as master of the Earth are one of the oldest *genres* in science fiction and fantasy. Sometimes the suggestion is made subtly, sometimes crudely; often the author is merely trying to find something new in the way of fauna or flora on which to hang the placard with the title, "The Boss."

Currently we have on the shelf three recent books on this theme—a paperback, abridged reprint of a 1947 classic—a new, thoroughly underplayed British novel—and a serious, if popular, account by a surgeon of his attempts to communicate with a species which may be as intelligent as ourselves. Respectively, the three books are Ward Moore's "Greener Than You Think"—Ballantine Books No. 527; 185 pp.; 35¢—"The Papers of Andrew Melmoth," by a Welsh novelist, Hugh Sykes Davies—Morrow, New York; 221 pp.; $3.50—and "Man and Dolphin," by John C. Lilly, M.D.—Doubleday, Garden City, N.Y.; 312 pp.; $4.95.

I have not been able to compare Moore's abridgement with his original novel, which came out as a dark horse and died, I fear, as an also-ran. The book is really a variation on the sorcerer's apprentice theme—the discovery or invention that "gets away" and destroys the world. The author's broad and sardonic humor should be expected by anyone who has read his better-known "Bring the Jubilee" and some of his short stories. Here its first blow is struck with his choice of an antagonist and successor for Man—the suburban pest that most Easterners call "crab grass." In its ruthless annihilation of human stereotypes, the book might be considered a forerunner of today's "sick" humor, except that the tone is more Rabelasian than Lennybrucean.

The annotating observer of the decline of Man is an opportunistic nobody, even as you and I, wearing the name of Albert Weener. He is in on the beginning of the end, making a

quick buck with the Metamorphosizer, presiding over the revivification of Mrs. Dinkman's devilgrass lawn. He sees to it that he is knee-deep in most of the developments that follow, and he is doggedly taking notes when the last green shoot waves triumphantly over the deck of the last ship in mid-Atlantic. This is how the world ends, not with a bang but a rustle . . .

The Welsh approach is gentler, subtler, and less melodramatic, and the author's candidate for supremacy is more familiar. The author, let it be said at once, wrote "The Papers of Andrew Melmoth" in a manner of gradually unfolding complexity and perplexity, with the real nature of Melmoth's obsession and the question of what he has discovered withheld from the reader until almost the end. The publisher, on the other hand—at least, the American publisher—has given the whole thing away in his jacket blurbs and advertising, as you will have noted from the ads here in Analog some months ago. This has rather the effect of converting the last chapter of Agatha Christie's "Murder of Roger Ackroyd" into a prologue, so that the puzzle is solved and the suspense destroyed before it begins to develop. There is consequently no longer any point in not telling you that Andrew Melmoth believes that the rats will replace us.

But for the science-fictional theme, this would be a "straight" novel of character, as a group of Melmoth's friends try to find out what has happened to him. We watch his interest in rats develop and intensify—watch with him on the brink of a Spanish ravine—join him and the veteran rat-catcher, Dan Talgarry, as they test the old stories of the gigantic "king rats" that are fed and coddled by their subjects—finally go down with him into the sewers of London where strange scribblings in the muck suggest that the sewer rats, mutated by the radioactive concentration of their environment, have taken the first step into civilization.

Quiet, subtle, not for everyone since there is next to no action and the suspense element has been thrown away, "The Papers of Andrew Melmoth" is a memorable example of its type.

"Man and Dolphin" joins fantasy and reality in the author's account of his growing belief that porpoises—whose brains are larger and more complex than our own—may be as intelligent as men, and may be capable of communication with men. Dr. Lilly is thoroughly aware of the implications, both for the present and the future, of his suggestion. "Within the next decade or two the human species will establish communication with another species: nonhuman, alien, possibly extraterrestrial," his book begins, then goes on to state his belief that we will find the aliens in the seas and not in space. Dolphins—porpoises—have the capacity for communication, he says; let's learn to talk to them, so that when we meet someone out among the stars we'll know what to do.

With this promising start, "Man and Dolphin" develops disappointingly. It wanders around its subject, talking about what Dr. Lilly and his colleagues do but very little about what they conclude. The reader develops a real respect for the capabilities of dolphins, but sees very little evidence that Dr. Lilly will be their Boswell. The slaughter of innocents with which the investigations opens is doubly bitter because the author has already suggested that these are "people" who are dying because of our—his—blundering approach. This may be a book written too soon; certainly press reports have implied more than Dr. Lilly claims. If Washington is host to the 1963 World Science Fiction Convention, perhaps Dr. Lilly can be invited as a speaker. If so, he should bring his wife and assistants—they are well up to conventional standards.

It may no longer be news to many of you that Analog took home two "Hugos" from the 19th World Science Fiction Convention in Seattle. The magazine regained its place as "Best Magazine," and Poul Anderson's "The Longest Voyage" was voted best short S-F of 1960. To complete the tally, Walter Miller's "A Canticle for Leibowitz" earned its place as Best Novel of the year, "Twilight Zone" again took the award as Best Dramatic Work, and the symposium, "Who Killed Science Fiction?"—which we've discussed here—took the fanzine Hugo. Ed Emsh also has another chrome-plated rocket for his mantle, if he has a mantle.

Chicago, having no real rivals, won the 1962 Convention. Time: August 31 to September 3, 1962 at the new Pick-Congress Hotel. Guest of Honor: Theodore Sturgeon. Membership: $2.00 to the Treasurer, George W. Price, 20th World Science Fiction Convention, P.O. Box 4864, Chicago 80, Illinois. Join early: the first of the Chicon progress reports is already out, and you'll want to have a hand in selecting the outstanding science fiction of 1961.

On October 1st, *This Week,* the syndicated Sunday newspaper magazine, published a report of "What Young Americans Are Reading." This is a quarterly poll of young adult librarians . . . and Poul Anderson's "The High Crusade," serialized right here not too long ago, is up there with "The Guns of Navarone," "The Last Hurrah," and Poe's "Tales." It's to be hoped that the young people don't form their ideas of Poe from Lee Sheridan's novelization of Richard Matheson's screenplay of Poe's "The Pit and the Pendulum," an American-International release which may still be in the drive-ins and neighborhood popcorn galleries. The two title roles are from Poe; the rest is from hunger.

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**A CUPFUL OF SPACE,** by Mildred Clingerman. Ballantine Books No. 519K. 1961. 142 pp. 35¢

Mildred Clingerman is one of that bevy of accomplished feminine writers with whom Anthony Boucher sur-

rounded himself when he edited *Fantasy & Science Fiction.* These sixteen stories, including two new ones, are long overdue, though Miss Clingerman has not been neglected by the anthologists.

Many of the stories are out-and-out fantasy, taking the supernatural for granted. I'm inclined to believe in it myself, this morning, when with two hours to go before I start a two-week trip photographing Indian artifacts, my camera jams. So I'll learn to sketch . . . but it's just this kind of perversity in the world that Miss Clingerman handles very nicely, with the barest suggestion that "they" are responsible.

They are friendly in "First Lesson," from *Collier's,* in which magic keeps a paratrooper's wife from seeing her nightmare come true. They are hostile in "The Wild Wood," when a young wife is trapped at Christmas time. They—he—are old and vengeful in "A Gay Deceiver," and hungry in the well-remembered "Stickeney and the Critic," a thorough delight about the monster at the bottom of the old, old well.

With so many stories, a word or two identifying each is about all I can do. If you remember it with pleasure, read it again; if you don't recall it, now's the time to read it.

In "Stair Trick," also magic, a bartender's trick turns real. The "Minister Without Portfolio" is the nice old lady who finds space people just as pleasant as the neighbors. "Birds Can't Count" is another emotion-packed story about the young wife who realizes "they" are watching her. "The Word" is a sentimental little Hallowe'en yarn that might have been done to go with one of the *If* covers. "The Day of the Green Velvet Cloak" is a romantic switch on time travel, and "Letters from Laura" a tellingly unromantic one—the Minotaur is a slob!

In "Winning Recipe" another housewife, a little older this time, rebels against automation. "The Last Prophet" flays humanity in the guise of rationalizing an old tradition. "Mr. Sakrison's Halt" is another story that everyone seems to do once, about the pleasant town that isn't there. "The Little Witch of Elm Street" presents a miniature portrait of two children who personify white and black magic—or magic and science, if you will. "A Day for Waving" is a genteel ghost story, every bit as modern as any 1962 small town. Finally, "A Red Heart and Blue Roses," new in the collection as is "A Gay Deceiver," there is what seems to be an almost ordinary story about an unpleasant young man who fastens himself on a chance friend's family—except that Damon is anything but ordinary.

Women's stories, all of them: of and by, at least, but not necessarily for.

» » »

**BYPASS TO OTHERNESS,** by Henry Kuttner. Ballantine Books No. 497K. 1961. 144 pp. 35¢

Collections like this serve to perpetuate the memory of one of the real shapers of current science fiction, but they also demonstrate how much he's missed. Whether they are as slight as another story of the Hogbens, those immortal, paranormal hillbillies, or as ridiculously compulsive as "Nothing But Gingerbread Left," here in 1943 to explain how we won a war that wasn't over, as carefully plotted and thought-provoking as the first of the "Baldy" stories, "The Piper's Son," or as ridiculous as the closing farce of "Housing Problem" with its fairy cottage in a birdcage, this is a touch we miss now.

The Hogbens are represented by "Cold War," in which the gifted family takes on the highly ornery Pughs, father and son. Familiar but ever powerful is the often reprinted "Call Him Demon" with its last chilling look into a child's mind. "The Dark Angel" and "The Piper's Son" illustrate two entirely different treatments of the superman theme, the first emotional, the second both emotional and intellectual as old readers of Astounding know well. Then there is "Absalom," with still another insight into what *Homo Superior* may be—and "The Little Things," a nightmare of a world just a little wrong.

It simply isn't necessary to describe or discuss a Kuttner story to bring it to mind. Eight in all, they may add up to the most memorable collection of the year.

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**A FALL OF MOONDUST,** by Arthur C. Clarke. Harcourt, Brace & World, Inc., New York. 1961. 248 pp. $3.95

Arthur Clarke in his best documentary vein can't be beat, even by Heinlein. You come out with the conviction that this is how things really will be, in our world, in our near future—yet, looking back, you realize how intricately this will-be future has been worked out. The bones and muscles are more evident than in one of Heinlein's best futures, but I suspect that this is intentional.

In this new novel we have a situation that could occur only on the Moon—only on a moon, I should say, since it was also used by A. Bertram Chandler, quite recently, in his "Bring Back Yesterday." The Sea of Thirst is a deep bowl of micro-dust, across which young Pat Harris, skipper of the sightseeing sled *Selene,* takes lunar tourists to see the wonders of the Mountains of Inaccessibility. In an accident that would occur once in a million years or so, a buried bubble heaves itself to the surface and entraps the ship—swallows it under fifty feet of the strangest dust in the universe. Problem: how do they get out?

As you can see, this is "hard" science fiction—the kind that many scientists and engineers are thinking of when they complain that the current brand is no good, or isn't even science fiction. Every detail is an extrapolation of what conditions must be like in a lunar economy of the kind Clarke has imagined here. The problem of rescue is a technical one: find the buried ship . . . get in touch with it . . . rescue the crew and pas-

sengers. The obstacles also arise out of the nature of the situation: the body heat of the trapped people, insulated by the dust, threatens to cook them . . . then destroys the absorbing power of their carbon dioxide removal system; one passenger has been psychologically conditioned against taking the shot that will slow down his oxygen intake; their water-disposal system triggers another catastrophy.

Nor is the action on the sidelines neglected. We see a young astronomer, sure the world is against him, suddenly getting recognition and feeling his oats. A veteran newsman sets up a system for putting the rescue on the waves for the world to watch. Various personal dramas erupt and are solved inside the buried moon-sled.

This is the kind of book that proves that "old fashioned" science fiction isn't dead. It can be written, and it can be very good. Would there were more of it. But it will never again be the dominant element—not until we really go to the stars, and the universe becomes truly unlimited.

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**TIGER BY THE TAIL**, by Alan E. Nourse. David McKay Co., New York. 1961. 184 pp. $3.50

The perceptive but anonymous juvenile reviewer for the New York *Times* Book Review, who put me on the trail of several of the other junior SF books I've discussed elsewhere, said of this collection: "Mr. Nourse is an imaginative craftsman, sometimes humorous and always thought-provoking, who wastes no time in getting to the point. Almost invariably, that point is very sharp indeed." Although the book is nominally for young adults, all of the nine stories were written for and published in adult magazines—two of them here. The comment goes for adult readers, too.

Actually, it's odd that Alan Nourse hasn't had a collection of his own before. Lesser lights, including your reviewer have, but the Nourse byline has been limited to regular representation in the anthologies, where some of these stories have previously appeared. Presumably it's the teen-age tag that brings them all together now, with the assumption—wrong—that young readers won't have seen them before. I hope they'll enjoy reading them again, and I hope the collection will give teachers and librarians a new view of science fiction.

The title story, from *Galaxy,* is a short, fast, gimmick story about the shoplifter who popped her pilfered merchandise into a literally bottomless bag, and what happened when the scientists tried to find the bottom. "Nightmare Brother," here in 1953 and the best story in the book, describes the grim program of seemingly insane torment undergone by a man who realizes that he must find the purpose behind the madness. It's a classic.

"PRoblem"—also *Galaxy,* and not a typographical error—is another light puzzler with a snapper at the end: how to make mankind love the Grdznth, those lovely green crocodiles that keep popping out of nowhere and bring such goodies with them. "The Coffin Cure"—same source—suggests some unexpected consequences of curing the common cold; the author, you know, is an M.D. out in North Bend, Washington.

"Brightside Crossing" is another of those old-time man-against-the-element stories that just can't be written any more. It was in *Galaxy* in 1956, and it has also become a classic story of hardship and foolhardiness in the attempt to cross the bright side of Mercury when the Sun is at its closest and hottest. *Fantastic Universe* had "The Native Soil," a rather zany and gimmicky yarn about conditions in the mudholes of Venus, and *F&SF* had another comedy, "Love Thy Vimp," about little monsters even less lovable than the Grdznth. "Letter of the Law," from *If,* is another problem story: how will an interplanetary swindler save his neck when he comes up against the peculiar legal structure of the Altairians? Finally, the most outrageous comedy of all to come from a medic, is "Family Resemblance," here in ASF in 1953, which develops very plausibly the concept that man's ancestor was a pig.

The smile on the author's face in the jacket portrait may not be quite what Mona Lisa is wearing, but it does make clear that there can be fun in science fiction. See that NYT quote again . . .

**TIME IS THE SIMPLEST THING**, by Clifford D. Simak. Doubleday & Co., Garden City, N.Y. 1961. 263 pp. $3.95

Since this book was serialized here in Analog just a few months ago as "The Fisherman," I don't suppose I really need do much more than say "here it is."

Once it is realized that the hard radiation of the Van Allen belts and the solar storms beyond them is going to keep mankind on Earth, most people turn their backs on the stars. Not, however, Project Fishhook, which finds a means of sending men's minds into space to bring back a variety of economic and scientific treasures. Outside Fishhook, though, the "parries" — paranormals — are hunted like the witches people believe them to be, and inside the powers that be keep a close watch for signs that one of their explorers may "go alien." This happens to Shep Blaine, and he is presently running from everybody, making fumbling use of his new super-psi powers, and up to his ears in plots within plots in which nobody is what he or she seems.

Simak making like Van Vogt, and being more coherent about it than the Master, but I prefer Simak as Simak.

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**BRING BACK YESTERDAY**, by A. Bertram Chandler.
**THE TROUBLE WITH TYCHO**, by Clifford Simak. Ace Books No. D-517. 1961. 173 + 82 pp. 35¢

The longer novel in this Ace Double is one of Chandler's "Rim" series;

the shorter was a one-shot in the October, 1960 issue of *Amazing*. In it, Clifford Simak leaves Earth for some bizarre adventures on the Moon, and comes off second best. Chandler's hero, on the other hand, never gets out to the Rim Worlds but is involved in some time traveling.

A. Bertram Chandler is Chief Officer of an Australian coastal steamer, and his hero is a Second Officer on one of the TransGalactic Clippers, who was out on the town when he should have been shipping back from Carinthia and is consequently left behind. He is shortly working for a detective, trying to get at the facts behind a situation that seems to involve time travel—and in no time at all he is on Carinthia's dust-drifted moon, fighting off a civil service army and invited to stand off a siege in the very stronghold he was trying to crack. Lots of good action, and some enticing vignettes of Chandler's own future history.

From Clifford Simak it's adventure, too—a young prospector on the Moon, a girl whose brother has lifted one edge of the cloak of mystery that hangs over Tycho, a mysterious professor who never amounts to anything, some delightful energy-critters—all in a well realized, isolated society.

Purpose, entertainment; achievement, entertainment.

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**MAYDAY ORBIT, by Poul Anderson.**

**NO MAN'S WORLD, by Kenneth Bulmer. Ace Books, No. F-104. 1961. 126 + 128 pp. 40¢**

The school of critics who feel that science fiction must be portentous and thought-provoking—all of it, that is—have no patience with pure entertainment of the kind Poul Anderson handles exceedingly well, and Kenneth Bulmer is handling better each time 'round.

"Mayday Orbit" is another of the violent adventures on weird world undertaken by that Saint of the spaceways, Captain Sir Dominic Flandry, field agent, Naval Intelligence Corps, of the blandly rotting Terrestrial Empire. It's his job to prevent a probably disastrous showdown with the space-gobbling reptilian Merseians, and to dissuade the local rulers of assorted human-populated worlds from gnawing off too big a chunk of the Imperial domain. This time the world is Altai, out back of somewhere, peopled originally, it seems, when the USSR decided to send up a shipload of the neighbors from its base in Moslem High Asia. The local Khan is making a deal with the Merseians, and it's up to Flandry to save his neck and get word to the Navy before a big blowup comes to pass. How he does it, with the aid and opposition of assorted races and species on a wild and wonderful world is the story.

On the flip side, we are even deeper among the stars in an English view of imperial shenanigans. Our hero is a would-be merchant, living under the name of John Carter, who is framed into espionage. Presently he comes up against Carson Napier—and if that isn't clue enough, just wait and see what happens when the marines arrive.

Flandry's girl friends seem to be more the hard-working type than Bulmer's : Bourtai is a particularly competent gal. Maybe the new English industry—I'm told English girls are in greatest demand as strippers in European night spots—has forced a more static role on English womanhood. Now if Messrs. Bulmer and Brunner would put someone more like Joan Collins into their yarns . . .

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**THE MALE RESPONSE, by Brian Aldiss. Galaxy Novels No. 305. 1961. 188 pp. 35¢**

Although this is one of the series of reprints and original sexed-up science-fiction and fantasy novels allegedly sponsored by our contemporary, *Galaxy*, this is not SF. Not, that is, unless you feel that the presence of a super-computer, which never gets a chance to do much, is a qualifier.

What the book is, is an African comedy in the manner of the family Waugh, with the "male response"—to females, naturally—prominent but not dominent. Soames Noyes is flying to Africa to finalize the sale of a giant computer to the King-President of a pocket state somewhere on the borders of the Congo. The plane crashes, but the computer is saved. While it is being installed, Noyes has ample time to investigate—and become involved with—the rare collection of bizarre humanity assembled in Umbalathorp, capital of Goya. The local witch doctor is opposed to him as a matter of course. Various politically minded individuals, Chinese, Portuguese, English, Goyan, *et al*, would like his assistance in grinding axes, and using them on each other. The President-King, his spouses, offspring, *et al*, are eager for the blessings of civilization, for themselves and their country.

Brian Aldiss makes a rare and slightly bawdy comedy out of the whole business, building to an ironic payoff. And the cover illustration has nothing whatever to do with the book.

P.S. *Galaxy* is reputed to have washed its hands of this messy series. Whether Beacon, the actual publisher, will continue, remains to be seen.

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**CATSEYE, by Andre Norton. Harcourt, Brace & World, New York. 1961. 192 pp. $3.25**

Again you find your besotted commentator, grinning like a thoroughly happy Airedale, singing the praises of unashamed wonder. Again you hear the ukase: "Forget it's for teenagers and enjoy yourself." And again you will come up at the end with a plaintive wail of desperation: "Yes, but what about—?"

This story of a galactic future explores another facet of one of the themes of the author's earlier "The

Beast Master," the symbiotic relationship that may develop between men and animals. Here the hero is a young D.P., exiled from the frontier world where his people have led a simple, rugged life for several generations. Finding a temporary job in a pet shop, he discovers some very strange things and is in no time deep in the plotting and counterplotting.

That, before she is done, the author has created an entire complex future civilization, and done it in touches as deft as any of Robert Heinlein's, goes without saying. There are some wonderful telepathic animals from Earth. There is the mystery of the lost native civilization of Korwar. There is the feudal brotherhood of the Hunters—keepers of the outlands. There is plotting and peril and mystery, much of it boldly unresolved so that the reader's imagination will plunge on and out and beyond the events of the story to go on building the universe the author has sketched . . . for it is increasingly evident that this is one of Andre Norton's strengths, used masterfully, boldly, and always delightfully.

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**THE SUN SABOTEURS**, by Damon Knight.

**THE LIGHT OF LILITH**, by G. McDonald Wallis. Ace Books No. F-108. 1961. 101+123 pp. 40¢

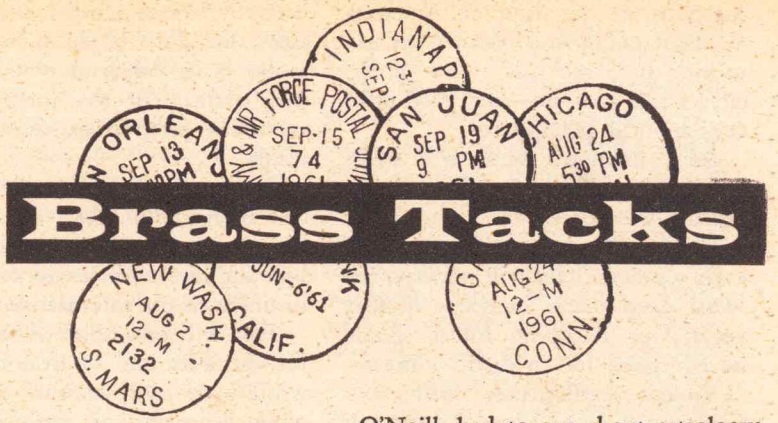
Damon Knight's professionally written half of this Ace double saves it from total oblivion; Miss Wallis' offering might have gone over in the '30s, but not now.

"The Sun Saboteurs" constructs a nicely complex refugee society and lets it stew in everybody's juice. Human odds and ends—Chinese, Russian, and assorted other minorities—live in the Quarter, a reasonably comfortable ghetto on a totally alien world. Political and personal stresses have brought them to the bursting point: ultra-conservatives who refuse to believe that their handful of humans do not "rule" all space—compromisers of the Minority People's Legion—and a small, strong, vicious remnant of the military who will destroy anything they can't dominate.

"The Light of Lilith" would be right at home back in those "good" old days when a lot of colorful paraphernalia and scientific double-talk made a "memorable" story. The "other" colors of Lilith could perhaps have been explained away by assuming that the world does something chemically to alter human perceptors, but instead we have the old one about "unknown" wave lengths in a spectrum that physicists have very thoroughly explored from the hard gammas to long radio waves. We're told that mixing light from opposite ends of the spectrum produces horrendous results, whereas this is what the non-spectrum color purple is—red plus blue. There's more in the same vein, and the action is equally violent.

If the publisher didn't provide a biography of sorts, we'd assume "G. McDonald Wallis" is a pen name for a resurrected Ed Earl Repp.






# Brass Tacks

October 9, 1961

Dear John:

In 1928, Dr. Michael I. Pupin, Columbia professor and President of the American Association for the Advancement of Science, claimed that "every star communicates with every other star and with man, by sending out electrical waves. It is much simpler to determine how these waves pass through space than to understand how their influence is transmitted over the nerves to the central brain, where the message is finally deciphered."

Does this sound like astrology? It does to me and I'm firmly convinced that serious scientific study should be given to this ancient art and science. At this date the entire world would benefit from the works of conservative, mundane specialists such as the American Federation of Astrologers.

Here's what the late Pulitzer-Prize winning Science Editor of the New York Herald Tribune, John H. O'Neill, had to say about astrology: "This is one of the most important fields for scientific research today, and one of the most neglected. Astrology, properly defined, is the science of the relationship of man and his celestial environment; it is the accumulated and organized knowledge of the effect on man of the forces reaching the earth from surrounding space . . . it is still a virile intellectual mother lode out of which a continuing succession of new sciences and new knowledge will be born."

Astronomer O'Neill added with emphasis that "there is absolutely nothing unscientific about engaging in research in this field, and no stigma of any kind should be associated with it in the mind of any scientist or layman."

Now we are faced with a celestial phenomenon which is unprecedented in recorded history. On February 4th and 5th (1962) seven celestial bodies will conjoin within thirty degrees of geocentric longitude; astro-

logically, in the Sign of Aquarius. Without going into detailed technicalities, here are just a few of the effects this stellium—and total solar eclipse—will precipitate:

Some unknown virus will strike South Africa, India and East China, causing widespread chaos and death.

Western Europe, the British Isles, even southern Italy will undergo the worst deep freeze in thirty to fifty years. Our European forces should be equipped for an arctic winter.

Violent earthquakes will rock Communist East China; the contour of the land will alter and rivers will change course.

Radically changeable weather will strike the eastern half of the United States from the Atlantic Ocean to the Mississippi River. Seven-day cycles.

The west coast of America will be subjected to earthquake activity; tides will rise and large tracts of land will be submerged. In other areas, subterranean quakes will thrust new islands from the sea, possibly just north of Japan. Our west coast will get its share of freak weather—which began yesterday with a tornado off San Diego, California*.

The extremely abnormal winter in Western Europe will be balanced by excessive heat and drought in South Africa and India, possibly Australia.

The celestial location of the stellium-eclipse, according to the basic tenets of astrology, symbolizes "fraternity and co-operation for mutual benefit." In the United States' solar chart for July 4, 1776, the natal moon is in Aquarius, which places this country in the foreground of espousing progressive, humanitarian ideals.

But Soviet Russia's natal Sun is also in Aquarius. As a consequence, both nations are gradually being brought into a vortex of crucial adjustment in the international picture.

This will be a time of showdown for dictators and oppressors in the world-wide swing toward liberation of small nations and vast numbers of people. Nikita Khrushchev's popularity will decline; his eventual fall from power is imminent.

On February 21, 1962, we'll see the first indication of a situation which will mean the beginning of the end for the present kind of totalitarianism in Red-dominated countries. The aggressive, subversive character of Communism will change, but by no means disappear from the world scene.

Around this date, (February 21st) revolutionary activity, triggered by disease, natural calamities of impressive proportions and food shortages, will break out in China. The present Red leaders will be unable to cope with the situation. One by one, they'll disappear to be replaced by new faces whose attitude toward the West will be conciliatory.

A week later a bitter struggle for power will be waged in the Kremlin. Khrushchev will lose out to more liberal and humanitarian leaders.

On the United States' east coast, labor leaders will be spotlighted, especially those connected in any way with transportation and/or supply facilities. Accordingly, Michael Quill and Jimmy Hoffa will again be featured in the headlines; it may spell the end of Hoffa's rule of the Teamsters at a time when dictators in labor and education will be meeting their respective Waterloos. Also along the eastern coast, new health programs will come in for a great deal of publicity as the result of an early, wet winter and the widespread outbreak of colds, flu and virus attacks among the working population.

Weatherwise, from the Mississippi River Valley eastward and from lower Michigan into Alabama and Georgia, it will be a variable winter season of freakish wet extremes with excessive cloudiness and sporadic fogs. The weather will constantly fluctuate in approximate seven-day cycles with alternating snow, rain, cold waves and thaws. On January 15, 1962, the temperature will drop to around zero; on January 22nd, it will drop far below.

These sudden changes in temperature and a high relative humidity combined with isolated flash flooding from rain and periodic thaws definitely indicates that public vitality will be at a low ebb after January 20th and even more so after February 5th when the new moon follows the stellium—eclipse.

We can anticipate heavy snowfalls in inland areas. A bitterly severe cold wave in elevated locations and the northern border states will strike these areas about January 22nd and last until late February.

On March 14, 1962, conforming to a 6.9-year astronomical cycle, ionospheric storms will begin buffeting our upper atmosphere and destroying short-wave radio communication. The maximum intensity of these storms will originate in a line southward from Fairbanks, Alaska, with secondary disturbances beginning just east of Cape Cod. High winds, especially strong in the upper atmosphere, will begin between March 6th and 9th, then increase in velocity on the 14th.

Throughout most of the United States, spring will arrive very late in 1962. Although southwesterly winds along the Atlantic seaboard will soften daily temperatures, most inland and high elevation areas will still be gripped in wintery temperatures until the middle of April.

Although the United States will have its share of bad winter, it should seem like a picnic compared to the cold wave that will grip England and Western Europe. This area will experience a deep freeze the like of which hasn't been felt in thirty to fifty years. Beginning on January 21st, the temperature will begin to drop as cold, dry masses of air sweep out of the northwest, pushing tremendous amounts of snow over coastal and inland areas. Then, almost exactly conjoining the stellium-eclipse on February 4th and 5th, the freeze will reach its lowest point. Even Rome will feel the effects.

* This has never happened before.

It will be a time of real world co-operation among all peoples as differences diminish and similarities are emphasized. The exploration of space will belong to no favored nation, but to the human race.

These are but a few of the events the disorganized astrology of today can foresee. There's nothing wrong with astrology; it's the handful of charlatans who abuse the ancient art which has caused its drop in respectability. The good, competent hard researchers are the ones you never hear about. I'm sure that by the time the next Great Stellium rolls around we'll be ready to listen to them.—Joseph F. Goodavage, 270 West End Avenue, New York 24, New York.

*Be it remembered that nearly all the great astronomical discoveries were made by men interested primarily in astrology. Kepler worked out his laws to make his astrological predictions better; Newton wrote more on astrology than on astrophysics!*

*So . . . let's have some fun; here's one amateur astrologer who's willing to stick his neck well out, with specific times, places, and events. By the time you read this, it will largely lie in the past—but it was written October 9, 1961, so you can check to see whether Goodavage's average is good! (And, be it noted, that's not a pen name; it's on his birth certificate.)*

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Dear Mr. Campbell:

I strongly recommend that you read the article entitled "Resistance of Scientists to Scientific Discovery" which was written by Mr. Bernard Barber and published in the September 1961 issue of *Science*—by the American Association for the Advancement of Science.

Mr. Barber discusses the problem which you presented in the October 1961 issue of Analog. He cites specific examples of strong resistance to certain discoveries which are now widely acknowledged, among which is Roentgen's discovery of the Xray —whose acceptance you considered to have been so ready.

It is my opinion that any man confronted with something very different will always prefer to err in such a way that he can never be shown to have been hoaxed (it might ruin his reputation so much that he would never be considered level-headed enough to entrust with important matters or funds); thus he can always insist that the discoverer had not explained it sufficiently for its acceptance.

The fact that only a few will ever know that he has refused to accept something of merit whereas the multitude—including people important to his future—will laugh at his being hoaxed is an overwhelming one. One might state that there is no penalty for (deliberate?) disinterest in something that works—so such a scientist is rapidly promoted to the position of judge for all new things—but utter calamity for overt (fanatical!!!) interest in anything that does not.

Any man will hesitate to risk much on the untried, and the public no less than his peers will insist upon including his reputation. Expect nothing really startling—such as concurrence in the discovery of anything which, being not understood, seems unpleasantly suggestive of perpetual motion or some other booger-bear of scientists—except from people who have nothing to lose and to whom any change is for the better.—Robert P. Kidwell, 2213 Calle de Suenos, Las Cruces, N. Mex.

*Or, as that Dean of stuffed shirts said, "Be not the first by whom the new is tried, nor yet the last to cast the old aside."*

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Dear John:

One always likes to see those who stick their neck out vindicated. In *Popular Mechanics,* September '61 p. 131, is an illustrated article on the Dean Drive. Hope that when the history of this entirely new system of prime mover is written they will not forget that you and Analog were the first to get it before the public.

Dean offers no new explanation for the results obtained, and as you remember, you suggested that it might be the overthrow of Newton's action/reaction principle. I disagree, and here's why.

Archimedes—I think—stated that if he had a place to stand, he could lift the earth—lever/fulcrum principle. Examination of the Dean apparatus indicates that it applies force by way of a lever, resting on a fulcrum, and the resting point of the fulcrum is the inertial plane of the rotating weights. In other words, the gyroscopic effect of rotating mass, provides the base against which the whole apparatus operates. The apparatus advances three steps but falls back only two.

In short, the "inertial" field may be compared with the "magnetic field" which we utilize everyday as a base for a fulcrum, or even as a lever, whenever we operate an induction motor or a selenoid.

So rather than overthrowing Newton's three laws of motion, I believe that Dean has come up with a unique practical application of these principles, so new that the theorists have been caught with their pants around their ankles.—H. C. Dudley, 46 Colonial Avenue, Garden City, New York

*Trouble is—"inertia" or "inertial field", as I said in the December 1959 editorial on Dean, are undefined terms too!*

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« *Continued from page 5* »
tal periods of great growth and accomplishment.

However, if the system pushes so much as 1% of the brilliant, competent and determined down into the ruled group, and out of the ruling—that 1% will destroy the system. The 80% *are* stupid; a few brilliant leaders can organize their stupidity into a revolt that benefits only the 1%—or, many times, not even that 1% is benefited, save in terms of the deep, glowing satisfaction of "Vengeance at last!" as the whole cultural structure tumbles down to destruction. Samson, after all, was overjoyed to bring the temple of his enemies tumbling down about them, suicide though it was.

The trouble is that those who are not ruling are very sure that they could do a much better job—and that they "have a right to" the things they want, and know they can never earn. They will, inevitably, blame the system, not their own failure to earn what they want, no matter how many times they see individuals who start beside them wind up far above.

The fool exists always, and the prime characteristic is that while you can readily make a wise man feel uncertain of his wisdom, it is absolutely impossible to make a fool doubt his wisdom. His every failure is someone else's fault, or the evil influence of sheer bad luck, or . . . he always has some answer.

Therefore, we have as observational data: All men believe themselves competent to rule. And while the wise and competent believe they are competent to rule, the fools are unshakably convinced of the certainty of their competence.

This factor alone will assure the instability of any government men ever seek to erect. The very nature of men assures a power-source to keep dynamic action going.

That power-source can either produce random action—sheer destructive heat—or can be channeled into progressive dynamic stability.

The thing that makes governmental systems explode is the accumulation of high-competence individuals in the Outs group. That's far more important than the decrease of competence in the Ins group. No matter how incompetent a government may be, if there is no competent opposition, it will remain in power by simple inertia.

The New Testament tells of Herod's effort to eliminate the threat of a high-competence individual among the Outs, by a technique that was popular during most of human history. Having heard that a new king was born, but not having any exact details on the matter, Herod ordered the slaughter of all boys who had been born in a certain period.

That approach to the problem had about the usual degree of success; Jesus had, of course, been moved out of the danger area as soon as the threat appeared. The generalization being, simply, that the really smart ones are always hard to stop.



The one sure way of guaranteeing that *every* high-competence individual will be brought into the Ins group is simple Universal Suffrage. The nice, simple, sure way of solving the whole problem . . .

But it is, actually, a sure way to ruin the culture—again, because of genetics and statistics. No matter how you slice it, no matter how you define your terms, one half of the population must be rated as subnormal. You can establish a test so simple as "If it looks vaguely human, and is breathing, it votes," which anyone capable of protesting about things can pass—and still one half of the population is subnormal. You may pass all the laws you like—but man-made laws don't affect the laws of Nature, and the statistical nature of genetics existed long before Mendel discovered the fact, and will exist no matter what laws are passed against the fact.

Any successful culture *must be an oligarchy.* The rulers must be a selected group. If a mass of solid propellant fuel is burned in free space, it produces an expanding gas-cloud that isn't going anywhere. Only when it is confined, channeled, and directed will the energy available produce progress. A random system gets nowhere—and will, with perfectly predictable certainty, be taken over by a nonrandom progressive system.

Voters must be selected; the Ins must be selected.

But the method of selection must be one that is based on the individual's own, individual, personal abilities and competences, and not on heredity . . . save as heredity influences his individual abilities.

Awhile back, I proposed the test of pragmatic competence to earn an income in the top 20% as a test for the right to vote. This was hotly objected to—quite largely by individuals who did not realize that, in damning the "rich, greedy, selfish" people in the top 20% they were damning themselves.

Very well; let's try another test procedure. We will, this time, make the test a simple use-vocabulary test. Any individual who can pass a use-vocabulary test showing a use-vocabulary greater than *n*-thousand words gets to vote, with no other requirement whatsoever, of age, sex, race, creed, financial standing, or police record.

Now the interesting gimmick on this test is that it is, flatly in contradiction to what it may appear to be, absolutely *not an academic test.* And many extensive studies of the subject by psychological testing groups has turned up the surprising-at-first fact that the magnitude of an individual's use-vocabulary has *no relationship whatever to his educational background.* It doesn't even have any marked correlation with his cultural background! It turns out to be not a linguistic test at all—but a mental-precision test in the purest sense. A brilliant German, Russian, Chinese, or Ghanian, coming to the United States and living here for a year may

display a use-vocabulary approaching 40,000 words . . . while a native born moron of thirty-five years residence here has a use-vocabulary of 4,000. Under the standards of our modern school system, moreover, the native-born moron may have a high school diploma—and the Russian may have grown up in a remote area of Siberia, and have no schooling whatever.

The whole test is a snide trick, a subtle gimmick, based on the very nature of the fool's thinking. He knows—he knows beyond any possibility of question—that he is as competent as anyone. The breaks may have been against him, and They may have been against him, but he knows unalterably that he is smart. The use-vocabulary test is obviously simple—just a few hundred test words.

The tricky subtlety underlying it is one the fool can't spot; it depends on the resolving power of the mind, not on how much is in the mind. A fool can be a learned man—the Mr. Memory type, for instance, who can recite endlessly, and quote a quotation any time. But while he can quote these words—he can't *use* them properly. He will, typically, use the word "funny" excessively, almost never say "peculiar," and never use the word "odd" at all. And note carefully that it isn't a matter of "big words"; "odd" is the smallest of the three above, and yet the rarest in modern usage.

It doesn't do you any good to be able to quote definitions in a use-vocabulary test; you have to perceive the fine distinctions implied by the similar, nonsynonymous words. Take the group *thief, robber, crook, bandit,* et cetera, as an example; there is a definite distinction in their meanings. Or *feminine, womanly, effeminate.*

And this ability to distinguish between concepts is *not* a matter of linguistics or education; the individuals who have the ability, develop and use it automatically, no matter where they may start. A German coming to the United States, or an American going to Germany will, if he has a high-resolution mind, learn the local precise-definition terms because he needs them and knows he needs them. The early scientists insisted that Science could be carried on only in Latin and/or Greek—not in English, French, or any of the then-living languages. Why? Very simply because the then-living languages simply did not have the rich, and subtly differentiated terms needed for precision thinking.

Now, of course, we have more terms in modern languages than the Romans or Greeks ever had—but it took massive borrowing, and a lot of word-inventions to do it.

Because it depends on the innate resolving power of the mind of the individual, no matter how much formal education he may be given, he will not learn a large use-vocabulary, if he does not have that ability. It does you no good to stare at a book, if your eyes have such low resolving power they cannot distinguish the letters—and it does you no good to look at words, if your mind lacks the resolving power necessary to distinguish the concepts those words symbolize.

Psychological testing groups have found, again and again, that the one measurable quantity that correlates at near unity level with practical success in the real world is use-vocabulary. The president of a firm may not have graduated from grammar school, while his second assistant secretary has a Ph.D. in English Literature—but the use-vocabulary of the president somehow turns out to be about 175,000 words, while the secretary's use-vocabulary seems to be about 22,000. Oh, the secretary can recognize, and quote passages, with 70,000 words . . . but he can't apply those words himself . . .

Every indication is that a man who has the high-resolution mind will learn the vocabulary he needs, whether he ever gets formal schooling or not. And that no amount of coaching can make a man learn the meanings of words when his mind can't perceive the difference in concepts.

In other words, the vocabulary test is *not*:

1. Culturally based.
2. A matter of formal education.
3. A linguistic test—save for the first year or two.
4. A test of family background.

and the vocabulary test *is*:

1. A test of that specific individual's personal mental resolving power.
2. That correlates very highly with pragmatic success in the real-world.
3. And looks to any fool like a snap that anybody can pass by just studying the words.

It is, in other words, a real test of real competence that would almost 100% eliminate the effects of cultural, educational and family background—would pass any competent individual, no matter what his previous history—yet which will reject the mentally ill-equipped. And *looks* so easy that the unshakably self-assured fool would be willing to vote for it!

The reason the use-vocabulary test is of real importance is quite readily understandable; anyone with a high-resolution mind automatically does a job of semantic analysis on propaganda, and on viewpoint-statements, that the low-resolution mind neither can, nor ever does. For instance, consider the statement "Russia is a highly aggressive nation," and recognize that the usual usage of the statement is intended to imply that "aggressive" and "belligerent" are the same thing. To the low-resolution mind they are; he can't distinguish between an *aggressive* salesman and a *belligerent* salesman, either, probably.

A nation whose national policies are controlled by voters who cannot clearly distinguish between "aggressive" and "belligerent" is almost certain to make serious errors. Most American voters today cannot distinguish between *conservative, reactionary,* and *intransigent,* nor between *liberal, communist* and *fascist* actu-

ally, save on the basis "Well . . . *liberal* is good, and *communist* and *fascist* are bad." Now that's a real help! Is the proposition "All major industries should be taken over and operated by the State," a Communist, Fascist, or Liberal doctrine?

What do those words they throw around—and can't use!—actually mean? And on what basis are the American voters deciding the national policy?

And . . . what would be the result in a society which did apply that use-vocabulary test? What sort of economic, political, and class structures would result? What would happen to educational systems?

There's no use installing more courses in Semantics and Linguistics, either! If a man has poor eyesight, we can help him with lenses—but if he has poor color vision, courses in Art and Aesthetics won't help a bit.

I never knew how poor my color vision was, until I discovered that my wife could travel twelve hundred miles from home, see a piece of silk material of an extremely complex gray-blue tone, recognize that it matched a piece of wool she had at home, and buy it. Despite the very different textures of the two fabrics, and some two weeks of time-lapse—she was perfectly correct.

Now her level of color-memory and color-discrimination is abnormally high. The point is simple; it would be utterly futile for me to seek to train a talent I simply don't have. I'd never be able to match that performance.

But if you've got that talent . . . training comes so automatically you never notice it.

So with use-vocabulary, which is simply an objective expression of semantic-discrimination ability.

What would happen, in educational philosophy, with such a factor recognized, and made directly, personally important to every citizen?

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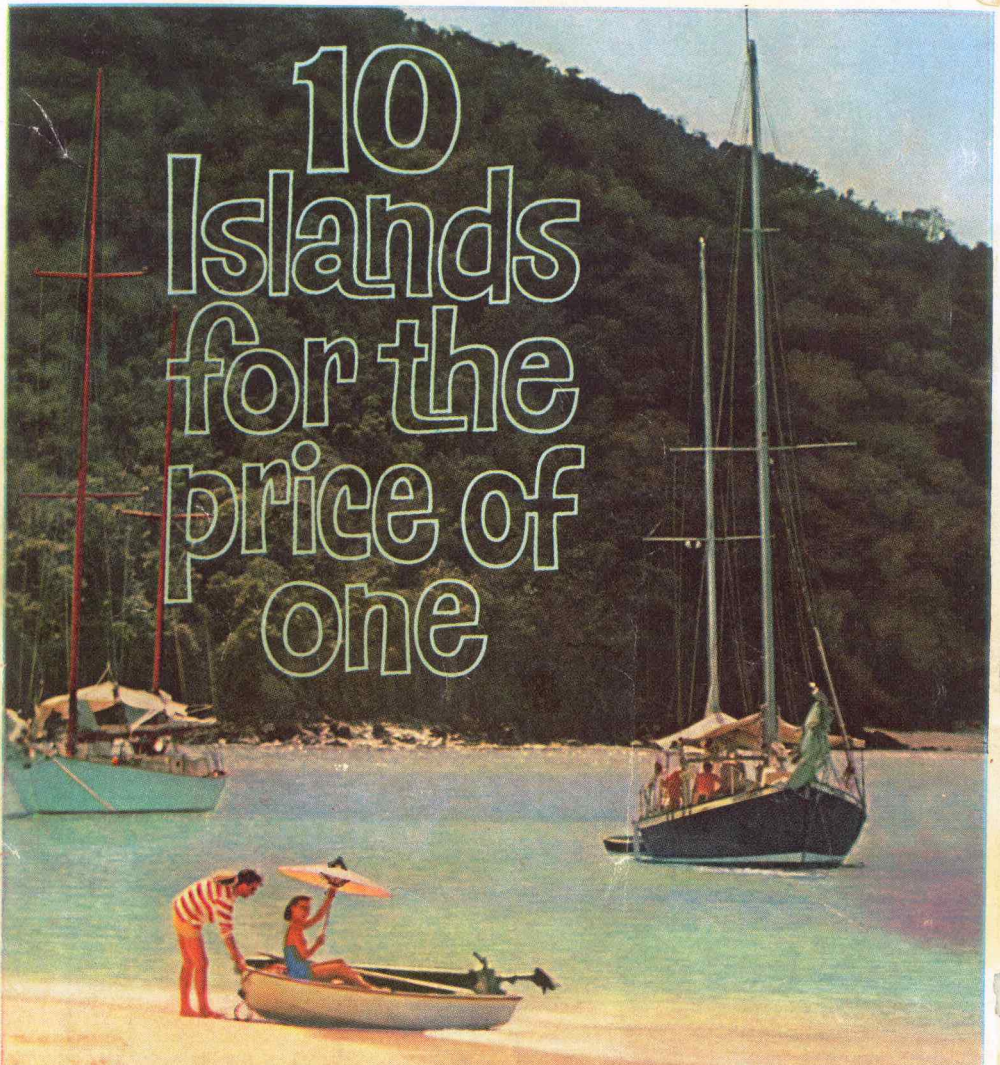


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