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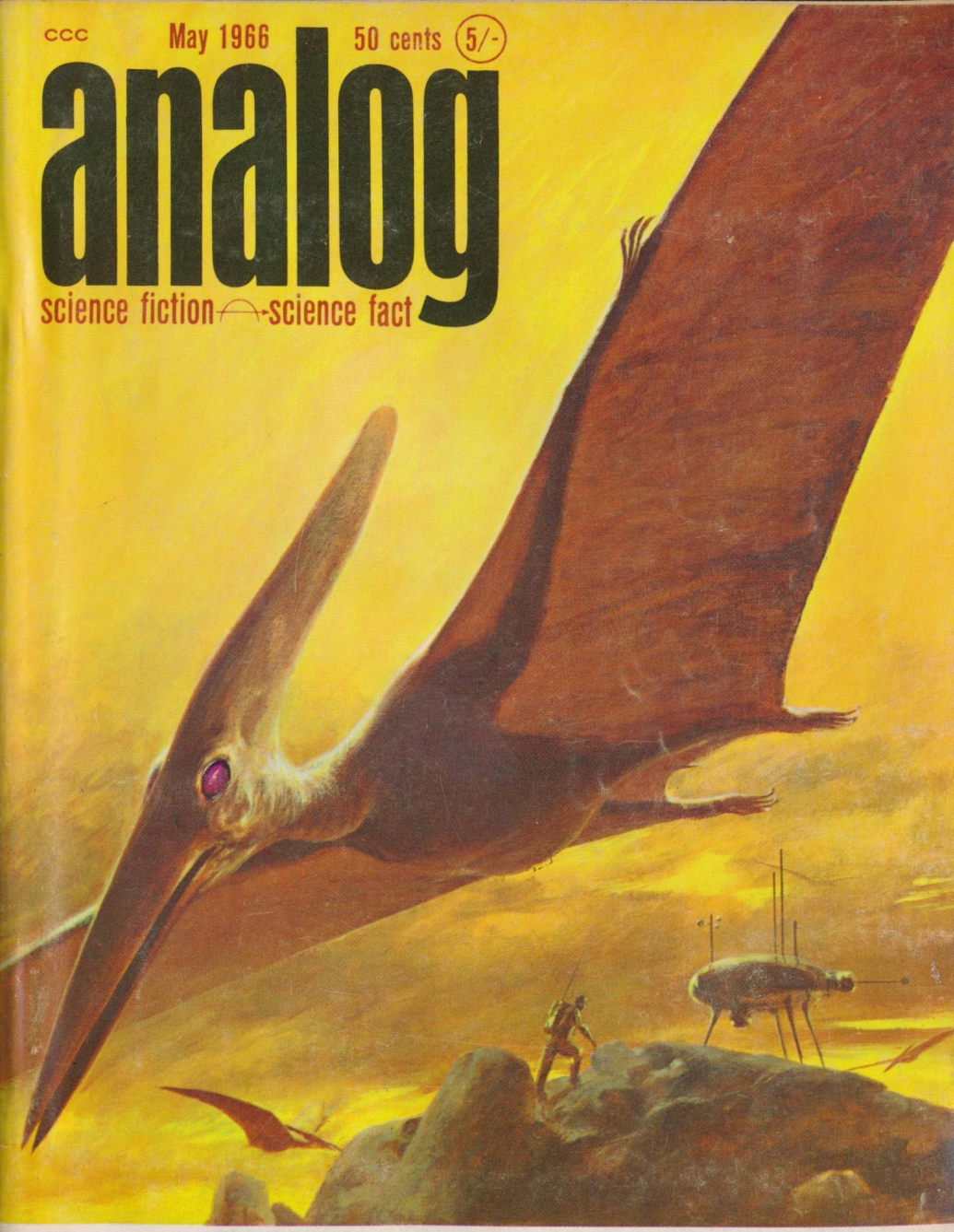

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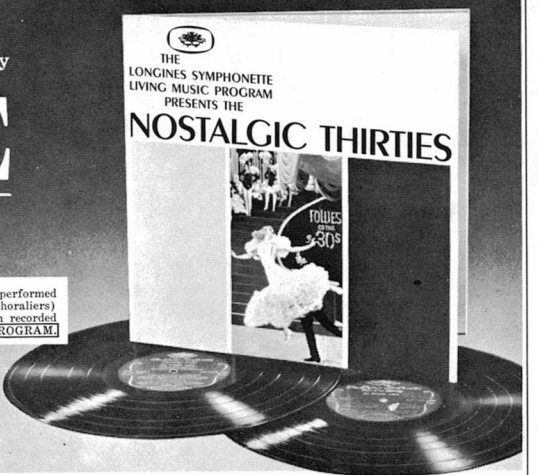

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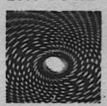

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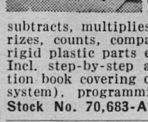

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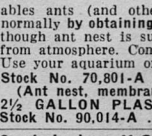

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"the public be damned!"

Editorial by John W. Campbell

As of this writing, there's a transit strike going on in New York City. It'll undoubtedly be long-since settled when this appears—but the causative factors will continue to exist, and can predictably be expected to bring about other strikes in other places. The cause rests in a false cultural philosophy; until that philosophy is changed, the situation simply continues to manifest itself.

Basically, the transit workers in New York City are striking against the people of New York City. That's the real target of the strike; the Transit Authority of the city is the legal target, of course, but that's largely a fiction.

New Yorkers are fairly familiar with the background; for others, the sequence goes like this:

Mike Quill, of the Transit Workers Union, started "bargaining" with the Transit Authority of the City of New York, which operates the subways and buses in the city, some months before January 1, 1966—the date on which the newly elected Mayor, John Lindsay, was to take office. From the beginning, Mike Quill insisted that Mayor Lindsay had to come into the negotiations. Now Mike Quill is an intransigent, rebellious, and remarkably undiplomatic man and offensive. This was, of course, a serious handicap to the negotiations.

And John Lindsay, as of late November 1965, had no authority whatever in the city, and none with respect to the Transit Authority. Legally, he had nothing whatever to say and had no place in the negotiations.

So why did Mike Quill want him hauled in?

Because for all his personally infuriating characteristics, Quill is not a fool; he was fully aware of what the situation was, and what would have to be done.

The problem is political, and only a political solution is possible.

The Transit Workers have a legitimate beef; a motorman for the Transit Authority's subways gets about fifty cents an hour less than a motorman doing precisely the same work for the Port Authority Trans-Hudson subways, which run from New Jersey into Manhattan. A mechanic working for the city's Transit Authority gets about fifty cents an hour less than a mechanic doing similar work for the Police Department.

Clearly, there's legitimate grounds for the TWU to demand a major increase.

However—the New York Subway system is operated by the City, which took it over several years ago from private operators, because the cost of running the subways exceeded the revenues pro-

duced by the city-permitted fares. The subways were losing money, and the only possible way to keep them running was to get more income—or else cut down on wages, which wouldn't have been exactly practical in the current cultural atmosphere.

The old five cent fare got boosted, after the City took over, anyway. As of January 1, 1966 it's fifteen cents.

When the city took over the subways, the rolling stock was in rather sad state; it was overaged and under-maintained. A company that's losing money tends to try to cut costs in such ways. The City's been replacing some of the worst cars, and doing maintenance work —but New York can still boast of having about the dirtiest, ugliest subways of any great city in the world. The subway guard forces were cut to a minimum—until the high incidence of muggings, knifings and assorted JD crimes got so high that the guard force was increased again.

There's no way to save money left; there are no (anathematized) profits to be cut into. The Transit Authority is broke, and going into the red steadily.

The Transit Workers wanted a $600,000,000 a year increase.

The Transit Authority turnip simply wasn't in a position to yield much blood.

And the perfectly obvious solution—raising the subway fares to about thirty cents, so that decent maintenance, wages, and rolling stock renewal could be maintained —is a suggestion that brings shrieks of anguish and howls of anger from the voters of the Great City of New York.

Everybody wants to charge high for what he does, and pay low for what he gets. And what people *want* is always fairly easy to determine; getting them to accept what they *need* is something else again. The people *want* that old five cent fare. They *need* a thirty cent fare.

The Transit Authority doesn't dare order it—it's a political issue that's far too hot to touch.

The Mayor doesn't dare order it —not when the voters would react with the most violent sort of anger and anguish.

Mike Quill knows perfectly well what he's asking for; the TWU is officially asking for a wage increase from the Transit Authority, but they're actually asking Mr. J. Q. Public to accept that a thirty cent fare is proper.

The result is that nobody can act to break the strike until the public says "Oh, for Pete's sake—give 'em their money, dammit, and get these blasted subways running again! This walking to work is driving me nuts. Driving in costs me three dollars or more every day and I can't afford it! Give 'em their money and stop this damn nuisance!"

When Johnny Q. Public, in other words, finally acknowledges that he

has to pay for what he gets—then he'll get what he wants.

Thus Mike Quill & Co. are not striking against the Transit Authority; they are striking against the People of the City of New York.

Their strike is directed at forcing the people of the City to grant the workers higher wages—at the expense of the people of the city.

Now when a Union strikes against a company, people tend to identify with the union men. That's easy, because they're happy to spend the other guy's (the company's) money. The fact that Mike Quill has a manner that infuriates isn't helping the TWU a bit, because the people of the City aren't at all happy anyway, and Quill makes a good villain. The basic trouble is, however, that Quill and the TWU are forcing the people into the position normally assigned to the Company, to Big Business, to Management—to traditional villains who refuse to spend their money to pacify the workers. This time, the people have to spend *their* money if they want the strike settled.

Of course, it's perfectly obvious to any economist that any time the Unions get more money, it actually comes out of the pockets of John Q. Public—but when a private company, such as an automobile manufacturer, is the immediate source

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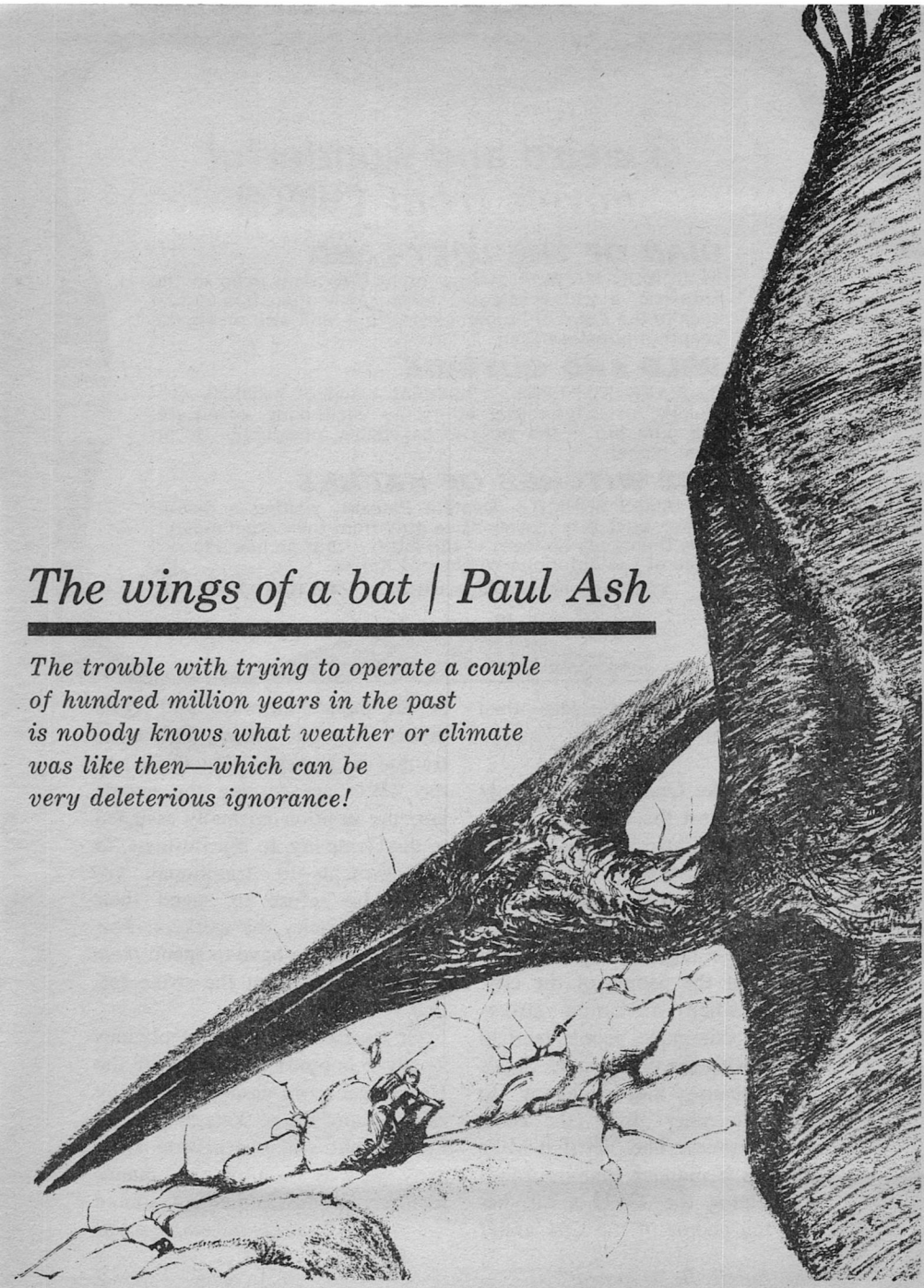
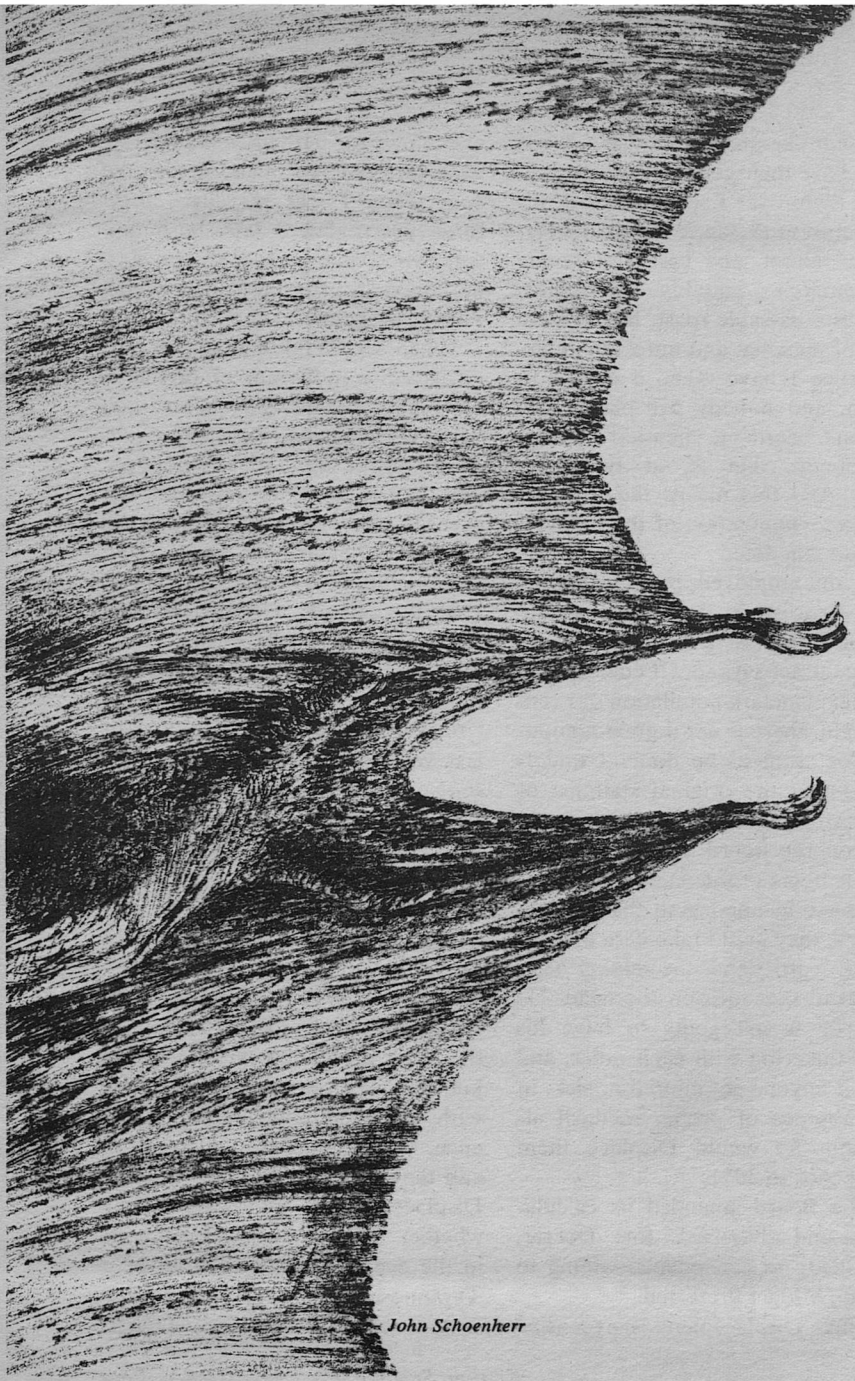
The wings of a bat | Paul Ash

The trouble with trying to operate a couple of hundred million years in the past is nobody knows what weather or climate was like then—which can be very deleterious ignorance!





John Schoenherr

I do *not* like pterodactyls. No doubt they have their good points; the evening flight over Lake Possible lends a picturesque touch to the Cretaceous sunset, and breast of young *Pteranodon,* suitably marinated, makes a passable roast. But as a result of personal and unfortunate experience I have taken a dislike to them, and nobody can claim they haven't heard me mention the fact —nobody, that is, at Indication One. And this means the whole—human—population of the world at the present date.

I am employed by the Mining and Processing Branch of Cretaceous Minerals, Inc. as a doctor—my contract says so. Of course, with a total planetary population of twenty-eight, there is not a great amount of doctoring to be done. I understand that the original staff list of Indication One did not call for a doctor; the Board intended to have all members of the team take a hypnocourse in nursing so that, if necessary, they could take care of each other. Yaro Land, the mining boss, knocked that idea on the head. He said he wasn't going to have his staff tinkering with each other, and that if anyone got injured or sick, in the absence of proper medical attention, he would Displace them right back to 2071.

The Board amended its calculations and advertised for: Doctor, qualified; no dependents; willing to travel; Midget Preferred.

Time Displacement is expensive even now—or perhaps I should say, even *then*—even, that is, in the year when I was recruited, fifty-three years after I was born and somewhere between 100 and 110 million years after the date at which I am writing this.

When Dr. Winton Boatrace first displaced a milligram of matter it went back twenty-four hours, and the experiment cost him 272 Credits for power alone. C.M. Inc.'s engineers can do better than that, but even so, the power to displace the average staff member costs about Cr.500,000, give or take Cr.100,000 —or thereabouts. It's not the date that counts—Displacement is a threshold effect and it takes no more *power* to get to the Middle Cretaceous than to the middle of last week—it's the weight. I suppose someone in Personnel did read my diploma and references, but their most important checking was done with a pair of scales. I weighed forty-one kilograms, and got the job. Except for Henry, I'm the smallest man here.

Yaro Land is the biggest—five-foot-seven, and stocky. I imagine the Board couldn't get first-class knowledge of sea-mining, combined with all-round engineering experience, plus administrative ability—and the sheer guts to make the first Displacement of all, not knowing whether he might find himself in the ocean or right in front of a Tyrannosaur—in a smaller package.

As a matter of fact, the details of

my qualifications weren't that important. Diploma or no, there are not so many things I could do that anyone else on the team couldn't do almost as well. They've all been trained in the first-aid treatment of injuries, from a sprained pinkie to a fractured skull. The deep freeze contains a billion units of Unimycin, the latest, safest, most powerful antibiotic on the market, in self-injecting ampoules. And if anyone needs major surgery or really elaborate nursing he'll *still* have to go back to 2071—or, to be quite accurate, 2071 plus however much time he's spent at Indication One. But, if anyone gets moderately sick—the kind of condition that cures itself in a week or two, provided someone feeds the patient nourishing meals and keeps him from getting out of bed—I'm at hand.

No doubt any member of the team could do that, too. The weak point in the Board's original plan was that it provided no spare wheels at all—for nursing, or anything else. Even the most skilled specialist sometimes needs a third hand, or an eye on dials somewhere at the back of his head. So it's also in my contract that I lend a hand—or eye, or foot—as and when required. I don't mind, even though I'm seldom trusted with anything that could not be done just as well by one of these dexterous little egg-eating Dinosaurs, if you caught it and trained it young. I still have a good deal of free time; among other things I edit and print our weekly newspaper—with a great deal of interference from the subscribers and contributors. Within reason, I'll do anything that's asked . . . bring in the tapes from the meteorology station, watch dials on the mineralometer, cook supper. But I will *not* act as veterinary surgeon to stray items of the Cretaceous fauna. It isn't reasonable, it isn't in my contract, and one must draw the line somewhere.

I hold surgery every morning; that is, I sit in my office, and anyone who feels like it drops in for a chat. Mostly they come to complain about the cuts in their last literary effort. If anyone has any symptoms they care to discuss I'm there to listen and help. That Unimycin has been burning a hole in the deep freeze for over a year.

When Henry came in I was polishing up my editorial for the next issue, and I took the opportunity to read him part of it. He seemed restless, but I paid no attention; he usually is. Too much thyroid, I suspect. Also, we have different ideas on literary style. It was Henry who got the name of the paper, *Weekly Bulletin of the Indication One Branch of Cretaceous Minerals, Inc.* — which at least had the merit of accuracy—shortened to *The Chalk Age Gazette*. The switch, admittedly, was carried by the unanimous vote of the subscribers and contributors—the Editor abstaining—but it was Henry's idea.

Halfway through my third paragraph he interrupted.

"Doc, it's *suffering!* Please!"

"Henry," I said, "I am accustomed to criticism. Lack of appreciation I have grown to expect. But downright abuse, combined with atrocious grammar—"

He pointed a quivering finger at my blotter.

"But it's *sick!*"

I began to suspect that I had here the first case of delusional insanity in the Middle Cretaceous—which would, of course, be the earliest on record. I looked at the blotter. On it—put there by Henry, presumably, while I thought he was listening—was a lumpish something which seemed to be wrapped in large, withered leaves. I took it to be crude tobacco—the plant grows like a weed in this climate, but nobody has managed a satisfactory cure—and poked it experimentally with the tip of my pen.

Henry groaned—loudly. I looked up in astonishment whereupon the pen jerked violently against my hand and was twitched away.

I looked down. The lump on my blotter had expanded to twice its previous size, revealing that the "leaves" were broad leathery wrinkled wings. A bloodshot little eye had opened in the middle. It had produced from somewhere a sharp, swordlike beak about seven inches long, and with this, and a set of bony fingers, like a spider's legs, it was trying to dismember the pen.

I said: "Get that creature out of here!"

"But, Doc," protested Henry, "she's *sick!* and she's only a baby!"

I valued that pen. Pouncing, I attempted to get it back. The "baby's" grip tightened; pen, pterosaur, and blotter slid towards me as a unit. The head drew back, preparing for a thrust. I reversed direction hastily and shoved the whole outfit to the other side of the desk.

"Henry, I will *not* have pterodactyls in my office! Take it away!"

I maintain that my attitude was not unreasonable, or even unkind. I knew no more about the treatment of sick pterodactyls than Henry did—if anything, less. And, as I said, I dislike them. I had a very nasty experience once with a pterodactyl, and, if Henry doesn't know that, he ought to; he's heard the story often enough.

It happened when I was out on Lake Possible, fishing, in a glass-fiber dinghy—about six weeks after my Displacement—at the end of a beautiful day.

That lake! C.M. Inc.'s engineers claim that they understand Dr. Boatrace's Theorems of Temporal Displacement—if "understand" is the word, when you have to plod through three brand-new systems of calculus before you can even begin—but they don't pretend to know how he made his map of Indication One.

So far as I can see, getting a fix on a section of past time is like casting a line over weeds; you can be pretty sure the hook will catch *somewhere,* but how far away depends not only on the length of your line but also on the current, the distribution of weeds, and how hard and fast you reel in. Boatrace's "hook" was the gadget he called his Minimal Temporal Trace; I gather he was pretty sure he could Displace it to somewhere in the Middle or Upper Cretaceous, and so he did, but there's still a slight uncertainty about the exact date—a factor of ten million years or so.

Once the Trace was fixed he could Displace other items to the same point—like sliding a ring along your snagged line. I understand that—I think. What I don't see, and neither does anyone else, is how the Trace —a bit of metal and crystal no bigger than the top of my thumb— could send back and tell him what kind of place it had landed in.

Well, there it is. I'm told he used to displace one, and shut himself up for several hours, then come out and displace another. One day, he came out with a penciled map that looked as though Baby had got hold of the telephone pad, and told them he'd found what he wanted and they could dust off the big machine —the one built to displace a man.

Yaro, who's not afraid to use a dirty word when there's no other that fits, told me once he reckoned the old man was using some form of Psi technique. Boatrace knew what he wanted—the ideal setup for seamining, a medium sized island with strong deep-water currents close by —and he just went on casting until the "feel" of the line told him that this time he was into a fish instead of a snag.

Another thing I'll never understand is why Yaro was willing to make that first Displacement, with only Boatrace's map as evidence that he'd find solid ground at the Exit Point. It's just a faint wavering oval, about twice as long as it is wide, with a scribble underneath that reads—I'm told—*"First Indication of Desires . . ."* Not even his daughter can decipher the final word. There's just one feature marked; a clear, hard-edged circle, near one end, about half the width of the oval. It looks as though he put a semi-credit on the paper and ran the pencil round it. By some freak the label he wrote on is quite legible, even to me: *"Aq. p . . . ? Lake, possibly??"*

As a drawing of a natural feature, it's about as convincing as a monocle on an amoeba. Well, I'm a respectable matter-fearing materialist, but if Boatrace was really using Psi . . . No. As a member in good standing of the WMA I prefer to assume he was using something else. (The principle of hyperdimensic transductility, perhaps, or a couple of patent double million magnifying gas microscopes of extra power.) But Lake Possible is a flooded cal-

dera; seen from above—from the island's central peak, for instance—it forms an unbelievably perfect ring.

Seen from dinghy level, that afternoon, it looked like the best fishing water I'd ever seen. Great clumsy twelve-inch insects, something like a dragonfly, were blundering into the wavelets, and big fat red-lipped fishes—a kind of Coelacanth—were popping up to take them all around the boat. The only trouble was that they didn't see the desirability of any lure in my book.

I didn't really care; it was such a perfect day. The air was warm, but crisp, not steamy; there was just enough wind to dry the sweat on my face. However, our cook-housekeeper wanted to try her hand at fish chowder and I'd promised to bring in the raw materials. So an hour before sunset I decided to try trolling from a moving boat. I fixed a couple of rods, one with a minnow, one with a spoon, and hoisted the sail.

Close-hauled, the boat moved through the water at just the proper speed. I sat back, with half an eye on the rods and another half on the sail, leaving one to enjoy the general peacefulness of the scene. Then, after about ten minutes, I glanced over my shoulder, and the Devil was after me.

Well, what would *you* have thought? Bat wings, twenty feet across—rolling eyeballs, China white and black—a scarlet devil's grin and a horn on its head.

I let out a yell, and ducked. The sail flapped, once; I automatically tightened the sheet and the rough feel of it brought me back to my senses—or I thought it did. The actual effect was to make me assume I'd had a brief hallucination; I simply could not have seen what I thought I had.

I screwed up my courage to look back—and there it was, huge, hideous, and three-dimensional as I remembered it. Like the boat, it was headed into the wind. There was a single row of bony struts along the front of each wing, and the great leathery membrane was ballooning like a spinnaker behind. It wasn't Old Nick, of course. However, I did not feel that much better when I realized that I was being followed by a *Pteranodon.*

I'd seen them often enough at a distance, planing slowly around the circle of the cliffs; or out at sea, skimming along with those incredible beaks half-open, just above the surface of the waves. That had not prepared me for the sheer *monstrosity* of the creature riding the wind behind me, twenty feet away. It looked big enough to carry me off and feed me to its young.

The beak was foreshortened, of course, since I was seeing it head-on; it was also half agape, so that I saw the bright-red lining of the mouth. The "horn" was that great sloping bony crest that continues the line

of the beak back over the shoulders, which was foreshortened, too, when I first caught sight of it.

I couldn't cram on more sail—I had only a little balanced lug—but I could get the wind behind me by heading in to the nearer shore. However, if I did that straightaway I would wind up at the base of a two-hundred-foot cliff. I would have to hold on for a quarter of a mile, then run for Landing Gap.

May I never have such a sail again. I tried to keep my mind on flag, sheet and tiller, but I couldn't refrain, any more than Lot's wife could, from looking back. Once when I glanced over my shoulder I found that frightful thing wagging its head at me—left, right, left, right, showing off the two-foot length of beak and the bright blue streaks on the side of the crest.

When I headed in to the Gap I hoped the wind would bother it, blowing directly from behind it, but it wheeled along with the boat and just flattened out a little, holding station without so much as a flap. Aerodynamically, those things aren't primitive; they're the culmination of seventy million years of evolution. The air is their home. I was in such a lather that I didn't think at all about shedding way from the boat. I left the sail full until I heard the keel grate on the shingle. I had just enough sense, then, to let the sheet go, but it was too late. The mast was just a little pole of green wood—there had been no time to season it, even Yaro had been less than a year at Indication One—and it snapped clean in two. Down came the sail on top of me as I sprawled on the bottom of the boat, and by the time I mustered up enough spunk to crawl out from under, the *Pteranodon* had gone.

That's why I don't like pterodactyls—pterosaurs—*Pteranodons*—in the Cretaceous all three words come to the same thing. If the little fluttering *Pterodactylus* was still around, or even the hen-sized *Rhamphorhynchus*, I might be able to regard them as fellow-creatures, but they both died out at the end of the Jurassic. The creature Henry had dumped on my desk was another *Pteranodon*. It was a very young one, admittedly, about the size of a pigeon apart from those shrouding wings, and with only a faint ridge to mark the incipient crest. Nevertheless its beak was quite large enough to do damage.

"Doc, she's *sick*," Henry told me in accents of maudlin reproach. "I found her on the roof this morning . . . she must have lost her mammy during the night. Did you, Fiona?" He spread his hands in a protective gesture over the leathery bundle, removing them just in time to avoid a fast jab.

Pteranodons are viviparous, bearing one young at a time. After birth the infant clings head-down to the lower part of the mother's belly,

held in place partly by her feet, partly by its own and by the four unmodified "fingers" projecting from the second joint of the wing. I had no idea how big they were when they first ventured on independent flight.

I looked up at Henry in an incredulous double-take.

"*What* did you call her?" Hastily I recollected myself. "Never mind. Get her *out* of here."

Henry is not quite twenty, and it has never seriously occurred to him that anybody might disagree with him, fundamentally, over anything that really *mattered* . . . such as the right-to-life—and hence to medical assistance—of a sick infant reptile of repulsive appearance and dubious disposition. He thought I was simply acting crusty and middle-aged for the fun of being a "character," and hadn't time to humor me.

"I think the trouble is exhaustion," he said earnestly. "It's been blowing half a gale for three days, so probably her mother couldn't get fish for her. Are you hungry, Fiona?"

"Henry!" Yaro loomed in the doorway, monumentally disapproving. "We wait for you!"

"Bettertryheronfishdocthere's someinthiscanI'llbebackassoonas possiblebegoodnowFiona," said Henry on his way to the door, and was gone.

I had drawn the line at acting as vet but Henry's assumption that all good men come to the aid of the party was a powerful eraser. Besides, it's very difficult deliberately to let an animal starve. I couldn't even make believe that I was too busy. Yaro's team were busy assembling and testing a cadmium extraction unit, which is not a job for unskilled labor, and the other specialists were immersed in their various routines. Even Elsa was doing the week's baking—not quite like Mother's, but you'd never think the base was carbohydrate extracted from pulped water-weed—and the kitchen was out of bounds until she finished.

Fiona had found my "In" tray and was squatting in it, tented in her wings. The pen lay on the desk, slobbered but undamaged. I rolled it cautiously towards me with a ruler and she opened her mouth—the lining was shell-pink, not the adult scarlet—and hissed faintly, but seemed to lack energy for anything else. I got out a pair of heavy gauntlets, made from the belly-leather of a sea-crocodile, and a pair of long bone forceps and opened Henry's can. It contained pieces of steamed fish left from dinner the night before.

How do you persuade a pterodactyl to open its jaws? I hesitated to use force—the bones looked fragile. I tried tapping the tip of her beak with a morsel of fish, held in the forceps. She retreated promptly to the farthest confines of the "In" tray and pulled her wings

over her head. I spread several choice fragments on a small dish and put them in front of her. Fiona inspected them with a red-rimmed eye, then, deciding they were harmless, paid no further heed to them.

I tried hissing, while waving the forceps under her beak; I even picked up bits of fish in my gloved fingers and thrust them upon her. No good. She hid inside her capacious wings and this time showed no sign of coming out. I removed some bits of fish from my chair and sat down to think things out.

Fish-eating birds, I seemed to remember, did not simply drop bits of fish for their offspring to pick up; they stuck food right down their throat. Which meant that the beak had to be open. Vague recollections of high-school biology indicated that the opening of the beak was often a reflex response to the sight of the mother—or father—bearing supplies. No, not even that. A dummy with just a few parental features would often set off the response.

Wildly I thought about draping myself in a tarpaulin to suggest wings. But in all probability the essential feature was the beak, from which, after all, the food would come. I considered ways and means of constructing one before I remembered that there were a couple of *Pteranodon* heads, dried and mounted, on the common-room wall. We did not hunt for amusement, but we had tested the edibility and other useful characteristics of every species on the island and somebody with baronial instincts had imposed this form of decoration. Elsa was always wanting to get rid of the trophies but so far as I remembered they were still in place.

They were. I unhooked the larger one and brought it back to the office. It had been varnished, and kept its color quite well; even the eye, thanks to the bony ring in the sclerotic, was still quite lifelike. I got a bit of fish ready, worked my hand into the skull, and hissed to attract attention.

Fiona drew back the edge of her wing and peered at me suspiciously from one half-open eye. Then her wings shut down as abruptly as an umbrella and she was shuffling towards the head, beak gaping and neck outstretched. I pushed the bit of fish to the back of her throat.

Fiona closed her beak thoughtfully, and I whipped the head out of sight. The underside of her baggy throat heaved once, twice, and I thought she was swallowing. Then she stretched forward, shook her head up and down a few times, and opened her beak. The bit of fish fell out.

I rushed off to the kitchen and begged a raw fish from Elsa. This time I thought I'd got it; for about ten minutes Fiona gaped obediently at the dried head and then I thrust the fish into her beak. I saw it go down, until there was a

distinct bulge under her sternum and she was weighed down in front. Apparently she would have gone on feeding forever, but I called a halt at that point, not knowing how to cope with indigestion in a pterodactyl. I left her, as I thought, digesting. About an hour later I heard a faint rhythmic gasping, and looking up from the proofs I was correcting I saw Fiona, beak downwards, regurgitating the lot.

The fragments were unchanged; no sign of digestion. Perhaps parent *Pteranodons* pre-digested food for their young. By this time my blood was up; I didn't intend to let this infuriating creature die if I could help it. I've had less prepossessing patients in my time. I had no pepsin in stock, but Elsa had brought some pawpaw seeds with her, and while the resulting trees had not yet born ripe fruit there were plenty of leaves. I knew these could be used as tenderizers; they might do the trick. I sneaked into the kitchen garden and removed a few; wrapped the remainder of the fish in them, and left them for an hour in the sun.

Henry came in as I was shoveling the messy, part-digested result into Fiona's beak, and was, I am glad to say, impressed. He removed Fiona, the In-tray, the forceps, and what was left of the fish, and I cleaned up the office and myself and went to lunch.

I felt distinctly pleased with myself, which was tempting Fate, of course, and I should have known better. The staff abounded in amateur naturalists, many of them with strongly-developed maternal—or paternal—instincts. I had a pretty picture of myself advising and directing them in the care and feeding of the young *Pteranodon*. What I had forgotten, of course, was that, however pleased they might be to baby-sit with Fiona, their professional schedules would make it impossible for them to do so during working hours.

There was great competition to take care of her once work was over; but *Pteranodon,* like most reptiles, is a strictly diurnal creature. Half an hour after sunset, which in those latitudes occurred every day at 18:15 hours, Fiona was asleep. At least I didn't have to get up and feed her at dawn. Half the camp took turns at keeping her overnight, until nearly every cabin had acquired a faint lingering stink of predigested fish. Henry, with one person chosen by rota for the privilege, looked after her during the luncheon break. But from 8:00 till 12:30, 14:00 till 17:30 hours, she was mine, all mine.

You may wonder why, feeling as I did, I allowed myself to get stuck with the brute. The explanation, though complicated, can be given in one word: Morale. It's a tricky thing in any community. When twenty-nine people make up the total population of the world and will for the

next nine years, it's the most important thing of all. It was outrageous of Henry to foist his beastly protégée on me, but then Henry, as I have mentioned, was quite incapable of seeing the matter in that light. A Henry who knew and accepted the fact that some men just don't care to act as foster-fathers to the strayed young of other classes of vertebrates would be someone quite different from the Henry I knew. And sudden personality changes are upsetting in a small community. Or, to put it another way, we all had to depend on each other for things far outside the services we had contracted to supply, and anything that upset that dependence—reasonable or not—was dangerous and bad. Or, to put it in the simplest way possible, I simply hadn't the moral courage to refuse.

Fiona ate voraciously and grew at an inordinate rate—she must have put on about two ounces a day. At the end of two weeks she weighed four pounds, with a wingspan of more than eight feet, and I began to think, hopefully, that any day now she would start flying and be able to fend for herself. My hopes took a severe setback when someone pointed out that, for all we knew to the contrary, she had no inborn instincts in that direction and would have to be *taught* to fly. Several people tried it; they took her out into the clearing around the cabins, perched her on rocks, trees, or roofs, withdrew to a distance, waved pieces of fish, and called her to come. Fiona, after gaping hopefully for some minutes—she had now learned to open her beak at the sight of a human being—usually turned her back on them and signified disapproval in a vulgar but unmistakable manner. To some extent I sympathized. After all, none of her would-be-instructors was able to fly.

Quite by accident, this time, I solved the problem myself. A small outdoor shelter had been constructed for Fiona alongside my office. Three weeks after her arrival I had given her the second feed of the day and returned to the office to read some manuscripts. It was becoming increasingly difficult to get people to write anything except Nature notes, a development which had started with Fiona's arrival. I had just unearthed a perfunctory review on the latest batch of books—C.M. Inc. sent us a dozen, on micro-microfilm, once a month—when I heard an irritable hiss, and there was Fiona shuffling through the door.

She made straight for the desk, gave an inefficient-looking hop and caught the raised edge at the back with the fingers of one wing. With a prodigious effort she got a grip with the other "hand," and there she hung, feet scuffling at the smooth surface, waving her beak angrily at me over the top until I came out of my stupefaction and got to my feet. This seemed to stimulate her. She brought up one hind foot, took a grip on the raised edge, and heaved

up and forward. A moment's confused and indescribable activity and she landed with a flop on my pile of manuscripts.

Half of them shot off the desk, but she caught the top one in her foot and began methodically ripping it to pieces. I seized a towel which was hanging over the back of my chair —I needed a shower every time I fed her—and flapped it angrily.

"Go away, Fiona! Shoo—!"

Fiona unfolded her wings and flapped vigorously back, sending the remainder of the papers flying.

Idiotically, I flapped again. Fiona drew herself up, raised her wings as high as she could, ran at me over the blotter—and took off.

I, of course, knew that she *ought* to be able to fly, but I doubt whether she had ever suspected the fact. Anyway, there was no room to do it in the office. She sailed straight into the wall and was knocked out.

For the rest of the morning she was punch-drunk, but I had discovered how to teach her to fly. She simply needed a stimulus; the sight of something that flapped. In Nature, no doubt, it would have been a parent's wings, unfolding and limbering up, but the towel was a sufficient substitute. In a couple of days Fiona was flying from the top of the computer building right across the clearing—a distance of a hundred yards. In a week she had discovered how to use a thermal and would spiral effortlessly in the updraft over the sun-warmed rooms; and come down only to be fed.

That was the snag. Fiona had no idea of fishing for her own food. Taken to the lake, she would fly there for a while, but every time she got hungry she wheeled and planed unerringly for home. We tried throwing fish to her, to teach her to feed on the wing. If it fell on the ground, she landed and picked it up. If it fell in the water she squawked angrily, landed, and opened her beak to show us where it ought to have gone.

"The trouble is," Henry informed me accusingly, "Fiona doesn't know she's a *Pteranodon*. She probably thinks she's a human being." He reflected. "Or perhaps she thinks *Pteranodons* look like you."

It seemed improbable to me, but various works on animal behavior seemed to agree with him. A bird—and pterodactyls are more similar to birds than to any other Tertiary group—reared in captivity tends to direct many of its instinctive activities towards people, rather than its own species. Konrad Lorenz was fed on caterpillars by a pet raven; and there are numerous sad cases of geese and peacocks and other large birds which fell in love with their keepers and tried to lure them on to the nest. Henry and I were almost equally disquieted by what we read; Henry on behalf of Fiona's psyche and future sex life, I because I was beginning to doubt whether I would ever be free again.

In the end, by simply throwing her fish into a small pool—dead at first, later on alive—I taught Fiona to take food from water. It was not at all the same thing as fishing on the wing, but it was the best I could do. Then Henry and I took her out on Lake Possible one evening, in the dinghy, and marooned her on a rock.

We rigged the sail to cover the boat, and, when she was not looking, crawled underneath it and hid. Presently we heard indignant hissings and the gulping squawk that indicated she wanted to be fed. Then there was a scrabbling on the side of the boat, and a weight descended on the canvas covering my back.

I kept as still as I could while Fiona shuffled around on my shoulder blades and finally came to rest on the back of my head. I wanted nothing to distract her at the critical moment, which must—I thought, resolutely stifling discomfort as sharp claws probed the crevice between my ear and my skull—come soon. Ten minutes later we heard a series of rustling flaps; the *Pteranodons* on their homeward flight dipping down to inspect Fiona, and rising again as they made for the caves and ledges of the cliffs. I began to think that we were on a fruitless errand; then I felt Fiona's grip tighten on my occipital bones and heard her wings flap, once. Then nothing for a moment; until there was one last swooping rush above me—a belated member of the flock—and my face was pushed down on to the thwart as Fiona took off.

We waited until full dark, not to risk distracting her; then rowed to shore and plodded home. Henry seemed rather dispirited and I felt that a show of pleasure would be out of place. As we parted on the way to our respective cabins he looked back over his shoulder.

"Cheer up, Doc," he said, "at least we know that *she* knows the way home."

I gave him a cold look—wasted, of course, in the darkness—and went off to shower and change. I slept badly that night; waking three or four times from a doze, in the belief that I had heard the click of claws on the fiber-glass roof. In the morning I opened the door cautiously, half expecting twenty pounds of young *Pteranodon* to come plummeting down with an urgent squawk, demanding to be fed. But no. Fiona's favorite roosts and perches were still clearly marked, both to the eye and the olfactory sense, but they were all vacant. Fiona, it appeared, had left us for good.

The details of the mining operations are not, for the most part, relevant to this story, and some of them—for instance, the reason why it's economically practical to carry out the process in the Cretaceous, although sea-mining in the Twenty-first Century pays no Displacement costs—form part of a very big in-

dustrial secret. So I'll just say that the extraction units consist of gently-tapering tunnels about fifty feet long, constructed of hoops and slats, and lined with plastic-coated cloth. They're not heavy, in fact they are amazingly fragile for the work they have to do, but they're unwieldy. When a whole battery of tunnels is complete, they are lashed side by side into rafts, towed out to sea, stacked one raft on top of another, and sunk in water deep enough to put them safely below the turbulence zone. The units float at first, but after an hour's soaking they lose buoyancy. That's the moment when you maneuver the next raft over the top and get them bolted together; then the next, and so on. The timing's tricky, and the whole operation calls for a flat calm—twelve hours of it.

The first battery—thirty-five units—was ready for assembly just about two years after I arrived at Indication One. Yaro was closer to jitters than I'd ever have thought he could be. Those units represented two years of hard work for all concerned—even me. The assembly and sinking *had* to go right. This was the test. Of course, since all the basic manufactures—aluminum, fiberglass, cloth, plastic—had been set up, it would only take three months to produce the next battery. If anything went wrong with this one morale would take a terrible beating and the whole project would be set back far more than three months. Besides, he needed to make tests, check that the thing really did work as it should—it would take most of a year to be certain of that.

We waited out three days of light winds and loppetty little waves—some people wanted to take a chance on them, but Yaro was taking no risks with this first batch of babies—and then on the fourth morning I woke to a flat, oppressive stillness and thought: This is it.

Everyone else thought so, too; breakfast arrived half an hour early and found everyone present, except for half a dozen who'd grabbed themselves sandwiches and gone to start the units on their way to the beach. At least, I hadn't noticed that anyone else was missing, until Yaro wanted to ask Linda McDonough a question and then found that she wasn't there.

Linda is our astronomer; she also took a six months' cram course in meteorology before being Displaced. If you wonder why a mining company needs an astronomer—enough to pay Cr.500,000 just for her fare—I have to say that that's part of the industrial secret aforesaid. The reasons why we need a meteorologist are obvious; we needed her particularly that morning and she was missing.

One of the girls went to her cabin, and came back in a hurry for me. I went—in fact, I ran; not that Linda sounded dangerously sick, but it was the first call for my professional services in over a month.

I found Linda half-dressed and very cross with herself for oversleeping; she was also feverish, puffy, and covered with an irritating rash.

She admitted having been slightly off-color for several days. It was plainly an allergy of some sort. I was planning scratch tests, and had just realized the interesting possibilities—she hadn't been affected by any of the common allergens in the Twenty-first Century, such as eggs, or shellfish, or pollen, but proteins, as well as physical structure, can undergo a lot of evolution in a hundred million years—when Linda gave me details. For the last few days, since she'd done all the calculations she could on the data available and further observation had been impossible owing to overcast, she'd been helping to apply plastic to the filter-cloths for the extraction units. She began to feel seedy the following day.

That left nothing to investigate, except which of the plastics caused the trouble. There are several in use here, all with molecules so complex they're halfway to being alive; the whole extraction process depends on their peculiar properties. I had to admit, though, that the question was of purely academic interest. Standard anti-allergen treatment would clear up the trouble and she'd have to stay away from the filters, whichever plastic she was allergic to. Linda said that she wasn't going to be scratched to bits simply in the name of medical science—a deplorable attitude and an extreme overstatement—and we were still arguing when Yaro arrived, wanting to know whether the calm would last out the day, or not.

Linda tottered over to her desk and found the latest computer-digest of the meteorology data. Her eyes were watering and she obviously found it hard to concentrate. After several minutes she announced that there had been a slight, steady drop in the barometer readings for two days, which probably meant a blow coming up; it might be today or it might be tomorrow but without last night's data tapes she couldn't be sure.

I thought Yaro was about to explode. It was very unlike him—or very unlike anything I knew of him so far—but the situation was clearly getting on nerves he had never realized he possessed.

"I'll go and get the new tapes," promised Linda feverishly, reaching for her clothes. "I'll be able to tell you in an hour or so."

"You're not going anywhere," I told her. *"I'll* fetch the tapes. I've done it before."

"But if I go I can get a direct reading on the barometer and call Yaro on the radio and—"

"Young lady," I said, "that meteorology diploma has gone to your head. I was reading barometers before you were born."

"Why I permitted that station to be set up on a hill top two miles

away . . ." came in a threatening background rumble. I knew that the site had been chosen, with his approval, for several excellent reasons, and that Linda had suggested asking for a few duplicate instruments to be kept in the settlement—but that, on grounds of Displacement costs, Yaro had turned her down.

Plodding up the way to the Peak, with the two-way radio strapped to my back, I found myself thinking: *The calm before the storm.* In our weather-controlled society the cliché has lost all contact with its real meaning. I simply didn't know whether it applied to this situation, or not. There had been quite a number of gales in the two years I had spent at Indication One; I seemed to remember that there *had* been an interval of calm before most of them, but how long it lasted, and whether calm was *always* followed by a storm, I simply could not decide. There seemed, now, an ominous heaviness in the air. I was not sure that I had noticed it before Linda mentioned the drop in barometric pressure.

Yaro's dilemma was plain. If he called off the assembly of the battery today and there was no storm —or if it held off for twelve hours—he would have wasted the best opportunity he was likely to have for at least a week, and probably more. It would give his reputation a heavy knock, which was important; faith in Yaro's judgment was a very vital factor in general *morale.* In some ways it might be worse than losing part of the battery in an unexpected storm that could be written off as bad luck. Holding things up unnecessarily might be considered old-maidish.

I came out on the first ridge, high enough to see over the rise on the other side of the settlement, and caught a glimpse of the sea. It was so smooth it didn't even sparkle, though that might have been partly due to the haze of overcast. There were no distinct clouds; I found I didn't care for the look of the sky.

A long train of light, big-wheeled carts was assembling at the edge of the settlements. There were caves—pumice—in the hillside and we used them for storage and for working on rainy days—mostly we worked out of doors. At the moment those precious extractor units could be wheeled back under cover in ten minutes or less, but once they'd been taken down to the beach it would need an hour. If they'd been unloaded from the carriers—

I dropped that line of thought and pressed on. The path led through a stand of cycads in a sheltered dip, then out onto bare rock, where it was marked only by cairns. One of the things one misses in this era is grass, also heather, gorse, bracken—cover-plants in general. I had been walking rapidly for twenty minutes, most of it uphill, and was sweating freely, but I was

pleased to note that my respiration was steady and undistressed. Two years ago I'd have been panting after half as much exercise.

The Met station was on top of a bluff; the shortest way up to it involved leaving the path and climbing twenty feet of rock-face. It was easy enough in daylight, broken into convenient ledges. I knew that Linda used the path only after sunset or when her hands were full.

I had just got up onto the first ledge and was reaching for a handhold when two things happened simultaneously. The radio receiver gave a loud click, indicating that someone had turned on a transmitter, and a huge triangular shadow slid suddenly down the rocks and away over my head.

For a moment I simply froze; then I got a grip on a knob of rock and turned my head very carefully to look behind me.

Yaro's voice said sharply, "Doctor, have you read the barometer?"

His voice seemed to come from my shoulder blades, which was one minor element in my confusion—I kept wanting to get round and see where it was coming from. However, my attention had already been split three ways. Part for his question—by no means the biggest part. Another—even smaller—for an unexpected glimpse of the sea, with a dull steely shine to it now and a dark purple line on the horizon that had not been there before. But the largest—paralyzingly large—fragment was taken up with the full-grown *Pteranodon* that was just wheeling to pass over me again.

"Doctor, answer, please. What is the pressure?"

I said, "I can't—" Then, at the top of my voice, *"Go away!"*

The Pteranodon was circling in a tighter curve than I would have believed possible for those twenty-foot wings. It was going to brush right over my scalp if it didn't hit me in the face. I flattened against the rocks. There was a thump above me and the brief rattle of a pebble, dislodged. I squeezed a glance past the rock-face an inch from my eyeballs, and saw the *Pteranodon* sitting on the ledge above me, huddled in its wings.

"Doctor, what is wrong? Did you fall just then? Are you hurt?"

I managed a rather croaky *"No."* Then, coming to my senses with a rush, "I haven't got to the Met station yet. I just started the final climb, but there's a *Pteranodon* in the way!"

"A what?"

"It's sitting on a ledge above me. Maybe it's got a nest here or something. I'll go round by the path; I'll be there in ten minutes. Don't worry, I'll get that reading." An idea which had been nagging away at the back of my brain suddenly surged to the front. "Yaro! Don't let the carriers move any farther! There's a storm coming up over the sea, I *saw* it!"

Yaro said sharply, "I am looking at the sea. I see nothing."

"I'm higher up than you, I can see farther. Over the horizon, a dark line. I think it's getting closer. Put those units under cover. If it comes up fast you won't—"

"Calm yourself, they have not started the journey. This storm, how sure are you that it approaches us?"

That was a nasty one. The situation did not exactly make for accurate judgment, even if I'd had any experience on which to base one. That dark line might not be a storm at all. It was not as though I spent much of my time gazing out to sea; for all I knew the horizon might have a thick purple border every second day.

I didn't want to be responsible for holding up the job, possibly for nothing. The answer, of course, was to get those barometric records as quickly as I could. I looked up at the *Pteranodon* and yelled, "*Shoo!*"

By way of answer the creature unfolded its wings halfway and leaned forward over the ledge, and I stepped backwards into the air and dropped four feet onto a rock.

It was a flat rock, and by some miracle I didn't tumble backwards and break the radio; I managed a flop forwards and landed on all fours. I scrambled away crab-fashion, got to my feet, and ran. Fifty yards round the base of the bluff would bring me to a relatively gentle slope, and another hundred yards up that was the Met station. The first stretch was flat, in the sense that it wasn't rising, but it was far from smooth. I was panting hard, now, and my legs were only half under control, but I had almost reached the beginning of the slope when there was a *swoosh!* A vast canopy of wings slid over me, dipped into a curtain, and then suddenly shut down into a shape no bigger than a two-year-old.

It had a beak, though. I stopped, and backed away. I was vaguely conscious of Yaro shouting to somebody—not me—he was calling someone to take over the radio. I sidled slowly along a wall of rock, keeping an eye on the enemy, remembering that presently I would come to a sort of niche or alcove about six feet wide. If I wasn't careful I could get backed into it and be trapped—

"Hey! Doc!" It was Henry, sounding excited. "What's wrong? Yaro said you were having trouble with a *Pteranodon*. Is it Fiona?"

As though stimulated by the sound of his voice the creature half unfolded itself, then shut down tight and waddled a few steps after me.

"*Now* look what you've done," I muttered crossly. "Don't *shout*."

Henry obediently lowered his voice. "What's happening? What's she doing? *Is* it Fiona, Doc?"

With difficulty I kept my voice down to an infuriated whisper. "How would I know?"

It was nine months since I'd last seen Fiona. It was almost as long since I'd even thought of her. This creature was about twice as large as she'd been when I loosed her. Would Fiona be full grown now? I hadn't the slightest idea. Nor did I find it even faintly reassuring that this creature *might* be my former acquaintance. Even when we were closest she had had no inhibitions about taking a peck at me.

The *Pteranodon*—Fiona or not—repeated its performance, opening, shutting, and coming a few steps closer. I backed, and found the rock curving away into the alcove. I hastily abandoned my hold on it and took two steps rapidly backwards, intending to get past the gap and have my back to solid stone once more.

With an angry-sounding squawk, the *Pteranodon* jumped. I did a complicated and ungainly dance-step that took me backwards and sideways—into the alcove. Then my foot slipped and I landed with a bone-shaking thump on hard dampish mud.

The reptile took a little run at me, folding its wings the while. I flopped wildly away from it on elbows and bottom until I hit my head on a rock. I was at the back of the alcove. Being unable to retreat farther I sat up—there was just room to do so without braining myself on the overhang and shrank into the smallest possible space; knees up, head down, arms folded over it to protect my eyes. There was a rustle and a hiss like a gas-leak, but no savage thrust. Instead, after a minute or so, I felt a sharp but not unfriendly nudge; I became conscious of a strong dry musky odor; and peeking cautiously under my folded arms I found the *Pteranodon* sitting quietly beside me.

Henry was uttering questions and exhortations in a steady, whispered string.

"Shut up!" I breathed back. "No, I'm not hurt. I'm in a sort of shallow cave. The brute's right here alongside, if I try to escape it'll probably attack."

"Doc, listen, this is important. It *must* be Fiona. It's like we said, she thinks she's human, or maybe she thinks you're a *Pteranodon*. What was she doing before? How did she get you into the cave?"

"For God's sake!" I whispered fiercely. "Forget your blasted Nature Notes! I can't get to the Met station. Tell Yaro I'm dead *certain* there's a storm coming and I'll take the responsibility if I'm wrong . . . No, don't say that, just tell him I'm *sure*."

I felt my voice weaken on the last word. I still wasn't sure—and there was no way for me to take the responsibility for the decision. The team would still blame Yaro for trusting me if I turned out to be wrong.

Henry was still whispering. "Doc, did she keep opening and shutting her wings? Shutting them *right*

down, as though she wanted to take up as little space as possible? And did she chase you into the cave? Did she—"

"Yes!" I screamed—so far as one can scream in a whisper. "Yes, she did! And now that you've proved how much you know about *Pteranodons,* will you get your alleged mind off your hobby and on to your job? Will you tell Yaro—"

"Doc, it's all *right.* Yaro decided five minutes ago to put everything under cover; it's being done right now. The cabins were battened down before he called you, just in case. You don't have to worry. We can see the storm from here, now; the sky's changing. There's a sort of dark edge sliding up it. It'll be overhead in two minutes. But listen, that opening and shutting the wings—that's the Wind Dance. I mean that's what the old *Pteranodons* do to warn the young ones there's a blow coming and to get under cover. George and I saw them at it three or four times, and there was *always* a high wind afterwards. Maybe they see it coming from high up, like you did. Fiona was trying to warn you, that's all."

I was just preparing a comment when I heard the storm break.

It hit the settlement thirty seconds before reaching the Peak, so that I heard the rising howl twice over—once on the radio, once, incomparably louder, right overhead. Fiona also heard the transmitted sound of it and huddled even tighter into her wings. I saw the nictitating membrane slide over her eyeball—and then the wind came.

It whipped past the cave mouth with a noise like torn silk, carrying a mass of leaves and twigs ripped from the cycads a quarter of a mile away. It must have torn the trees bare in its first rush. One moment the air outside seemed solid with flying greenery, the next it had gone past, still in one mass—except for a small part that eddied into the cave and whirled round us before it was snatched out again.

The cave was about six feet deep; it kept us out of the path of the storm, but the stray tendrils that reached in the mouth of it were enough to pluck violently at my hair and clothes—and Fiona's wings. I saw her quiver at the first tug of it, and put an arm across in front of her. Henry was yelling something about adaptive behavior, the one really dangerous enemy of *Pteranodons* being a really strong wind. I heard the words *ritual behavior* and *adaptation* emerging above the transmitted noise—Henry was indoors, of course. They were vaguely familiar to me from the reams of notes which he and several others, apparently mistaking the *Gazette* for *The Journal of Animal Behavior* and undeterred by previous rejections, were always sending in. Then, incredibly, the noise began to increase, to a level where not even Henry could compete. Battered by

sheer volume of sound even more than by the searching fingers of the wind, I crouched dazedly at the back of the cave. I was vaguely aware of pressure as Fiona shoved in behind me—having done her bit by getting me under cover, she was now capitalizing on it. Then I ceased, really, to be aware of anything outside the small tight-packed huddle of my own body.

After the wind, rain. How long either of them lasted I had no idea. Suddenly the howling died, and a moment later the floor of the cave was swamped; its mouth was curtained with a waterfall, and my already-deafened ears were assaulted by the drumming of water on naked rock. That didn't stop all at once; the rain eased off slowly, so that I was barely conscious that the noise decreased.

Then something moved beside me. Fiona pushed out from behind my back and waddled, squelching, to the cave mouth. She sat there for a minute or two, folding and unfolding her wings in an irritable manner. Then she waddled outside. Six feet away was a boulder; she scrambled up on to it, stretched to her full height, and began limbering up—shaking, flapping, jumping up and down.

I watched, without really taking it in. I hadn't moved; I didn't think I *could* move; I was stiff, soaked, and too numb to be really aware of it. Then I noticed Yaro. He was talking to me, from a little way off—quietly, insistently. I realized suddenly that he'd been talking for quite a while, but I hadn't paid attention to him.

I said, "Sorry, Yaro. What did you say?"

That at least was the idea. It was kind of creaky and not, I gather, very audible, but it was speech of sorts.

There was a wild shout: "He answered!" It didn't sound like Yaro at all. I mean it was his voice, all right, but completely out of character; positively excited.

I said, "Sorry; must have dropped off."

"Dropped off!" He sounded rather wild and positively hilarious. I began to feel something must be *really* out of key. "Caught out of doors in a hurricane, he drops off! Doc, you found some shelter? You are not hurt?"

Now he mentioned it, I wasn't sure. I tried to unfold myself and investigate, but my hands were locked around my knees and I seemed to have lost the combination; also I had stiffened in one piece. I couldn't figure out how to get undone. Then I realized that the view had altered outside. Something was missing.

"She's gone," I said. "Fiona. She's gone."

I managed to start moving after a while. I didn't get very far, though. They came to fetch me as fast as they could; nearly every man

in the team. There were all sorts of new gulleys in the way; a couple of temporary rivers several feet deep; tree trunks and boulders scattered in all directions. I could have walked, though; there was no need to carry me. But they did, taking turns until I came out of my daze sufficiently to rebel. I got back to the settlement walking on my own feet.

The damage was surprisingly small. Linda says we caught just the fringe of a hurricane, or maybe a typhoon—the Met station was blown right off the bluff, so she didn't get the records to see how it developed. The units, and all the more important machinery, had been moved into the caves and the entrance blocked. Only one cabin blew away. They're domes of fiberglass, securely anchored six feet down; nothing for the wind to catch hold of, provided the windows and doors are properly closed. It was three weeks before the extraction units could be assembled, but when the weather finally quieted it was done without a single hitch.

There's been a lot of nonsense about the whole affair. Maybe Fiona saved my life; I don't know. I imagine one glance at the barometer would have been enough for me; I'd have run for shelter, and I might have reached it—there are lots of caves. But it's certainly nonsense to say that her warning saved the whole of Indication One. Yaro had given the orders to batten down before he knew anything about the Wind Dance; in fact I heard Henry and George explaining it to him next day, with pantomime—very odd they looked. And, if she'd only let me get to the Met station, the figures would have warned him a lot more convincingly than anything else could.

But there it is—nearly everyone is firmly convinced that Henry's stray baby grew up to save the settlement, and, of course, me. It creates a sort of moral climate which is irresistible. I no longer dare to turn down contributions on natural history, and the name of the paper has been changed to *The Chalk Age Gazette and Pterodactyl-Watchers' Guide.* ■

SCILENCE

Scientific data that doesn't conform and is smothered by Scientific Orthodoxy.

Call Him Lord

There are many characteristics desirable in an Emperor that can be done without if necessary. But there is one that any true ruler absolutely must possess.

He called and commanded me
—Therefore, I knew him;
But later on, failed me; and
*—*Therefore, *I slew him!"*
"Song of the Shield Bearer"

The sun could not fail in rising over the Kentucky hills, nor could Kyle Arnam in waking. There would be eleven hours and forty minutes of daylight. Kyle rose, dressed, and went out to saddle the gray gelding and the white stallion. He rode the

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stallion until the first fury was out of the arched and snowy neck; and then led both horses around to tether them outside the kitchen door. Then he went in to breakfast.

The message that had come a week before was beside his plate of bacon and eggs. Teena, his wife, was standing at the breadboard with her back to him. He sat down and began eating, rereading the letter as he ate.

". . . The Prince will be traveling incognito under one of his family titles, as Count Sirii North; and should not be addressed as 'Majesty'. *You will call him 'Lord' . . .*"

"Why does it have to be you?" Teena asked.

He looked up and saw how she stood with her back to him.

"Teena—" he said, sadly.

"Why?"

"My ancestors were bodyguards to his—back in the wars of conquest against the aliens. I've told you that," he said. "My forefathers saved the lives of his, many times when there was no warning—a Rak spaceship would suddenly appear out of nowhere to lock on, even to a flagship. And even an Emperor found himself fighting for his life, hand to hand."

"The aliens are all dead now, and the Emperor's got a hundred other worlds! Why can't his son take his Grand Tour on them? Why does he have to come here to Earth—and you?"

"There's only one Earth."

"And only one you, I suppose?"

He sighed internally and gave up. He had been raised by his father and his uncle after his mother died, and in an argument with Teena he always felt helpless. He got up from the table and went to her, putting his hands on her and gently trying to turn her about. But she resisted.

He sighed inside himself again and turned away to the weapons cabinet. He took out a loaded slug pistol, fitted it into the stubby holster it matched, and clipped the holster to his belt at the left of the buckle, where the hang of his leather jacket would hide it. Then he selected a dark-handled knife with a six-inch blade and bent over to slip it into the sheath inside his boot top. He dropped the cuff of his trouser leg back over the boot top and stood up.

"He's got no right to be here," said Teena fiercely to the breadboard. "Tourists are supposed to be kept to the museum areas and the tourist lodges."

"He's not a tourist. You know that," answered Kyle, patiently. "He's the Emperor's oldest son and his great-grandmother was from Earth. His wife will be, too. Every fourth generation the Imperial line has to marry back into Earth stock. That's the law—still." He put on his leather jacket, sealing it closed only at the bottom to hide the slug-gun holster, half turned to the door—then paused.

"Teena?" he asked.

She did not answer.

"Teena!" he repeated. He stepped to her, put his hands on her shoulders and tried to turn her to face him. Again, she resisted, but this time he was having none of it.

He was not a big man, being of middle height, round-faced, with sloping and unremarkable-looking, if thick, shoulders. But his strength was not ordinary. He could bring the white stallion to its knees with one fist wound in its mane—and no other man had ever been able to do that. He turned her easily to look at him.

"Now, listen to me—" he began. But, before he could finish, all the stiffness went out of her and she clung to him, trembling.

"He'll get you into trouble—I know he will!" she choked, mufflefly into his chest. "Kyle, don't go! There's no law making you go!"

He stroked the soft hair of her head, his throat stiff and dry. There was nothing he could say to her. What she was asking was impossible. Ever since the sun had first risen on men and women together, wives had clung to their husbands at times like this, begging for what could not be. And always the men had held them, as Kyle was holding her now—as if understanding could somehow be pressed from one body into the other—and saying nothing, because there was nothing that could be said.

So, Kyle held her for a few moments longer, and then reached behind him to unlock her intertwined fingers at his back, and loosen her arms around him. Then, he went. Looking back through the kitchen window as he rode off on the stallion, leading the gray horse, he saw her standing just where he had left her. Not even crying, but standing with her arms hanging down, her head down, not moving.

He rode away through the forest of the Kentucky hillside. It took him more than two hours to reach the lodge. As he rode down the valleyside toward it, he saw a tall, bearded man, wearing the robes they wore on some of the Younger Worlds, standing at the gateway to the interior courtyard of the rustic, wooded lodge.

When he got close, he saw that the beard was graying and the man was biting his lips. Above a straight, thin nose, the eyes were bloodshot and circled beneath as if from worry or lack of sleep.

"He's in the courtyard," said the gray-bearded man as Kyle rode up. "I'm Montlaven, his tutor. He's ready to go." The darkened eyes looked almost pleadingly up at Kyle.

"Stand clear of the stallion's head," said Kyle. "And take me in to him."

"Not that horse, for him—" said Montlaven, looking distrustfully at the stallion, as he backed away.

"No," said Kyle. "He'll ride the gelding."

Kelly Freas

"He'll want the white."

"He can't ride the white," said Kyle. "Even if I let him, he couldn't ride this stallion. I'm the only one who can ride him. Take me in."

The tutor turned and led the way into the grassy courtyard, surrounding a swimming pool and looked down upon, on three sides, by the windows of the lodge. In a lounging chair by the pool sat a tall young man in his late teens, with a mane of blond hair, a pair of stuffed saddlebags on the grass beside him. He stood up as Kyle and the tutor came toward him.

"Majesty," said the tutor, as they stopped, "this is Kyle Arnam, your bodyguard for the three days here."

"Good morning, Bodyguard . . . Kyle, I mean." The Prince smiled mischievously. "Light, then. And I'll mount."

"You ride the gelding, Lord," said Kyle.

The Prince stared at him, tilted back his handsome head, and laughed.

"I can ride, man!" he said. "I ride well."

"Not this horse, Lord," said Kyle, dispassionately. "No one rides this horse, but me."

The eyes flashed wide, the laugh faded—then returned.

"What can I do?" The wide shoulders shrugged. "I give in—always I give in. Well, almost always." He grinned up at Kyle, his lips thinned, but frank. "All right."

He turned to the gelding—and with a sudden leap was in the saddle. The gelding snorted and plunged at the shock; then steadied as the young man's long fingers tightened expertly on the reins and the fingers of the other hand patted a gray neck. The Prince raised his eyebrows, looking over at Kyle, but Kyle sat stolidly.

"I take it you're armed good Kyle?" the Prince said slyly. "You'll protect me against the natives if they run wild?"

"Your life is in my hands, Lord," said Kyle. He unsealed the leather jacket at the bottom and let it fall open to show the slug pistol in its holster for a moment. Then he resealed the jacket again at the bottom.

"Will—" The tutor put his hand on the young man's knee. "Don't be reckless, boy. This is Earth and the people here don't have rank and custom like we do. Think before you—"

"Oh, cut it out, Monty!" snapped the Prince. "I'll be just as incognito, just as humble, as archaic and independent as the rest of them. You think I've no memory! Anyway, it's only for three days or so until my Imperial father joins me. Now, let me go!"

He jerked away, turned to lean forward in the saddle, and abruptly put the gelding into a bolt for the gate. He disappeared through it, and Kyle drew hard on the stallion's reins as the big white horse danced and tried to follow.

"Give me his saddlebags," said Kyle.

The tutor bent and passed them up. Kyle made them fast on top of his own, across the stallion's withers. Looking down, he saw there were tears in the bearded man's eyes.

"He's a fine boy. You'll see. You'll know he is!" Montlaven's face, upturned, was mutely pleading.

"I know he comes from a fine family," said Kyle, slowly. "I'll do my best for him." And he rode off out of the gateway after the gelding.

When he came out of the gate, the Prince was nowhere in sight. But it was simple enough for Kyle to follow, by dinted brown earth and crushed grass, the marks of the gelding's path. This brought him at last through some pines to a grassy open slope where the Prince sat looking skyward through a single-lens box.

When Kyle came up, the Prince lowered the instrument and, without a word, passed it over. Kyle put it to his eye and looked skyward. There was the whir of the tracking unit and one of Earth's three orbiting power stations swam into the field of vision of the lens.

"Give it back," said the Prince.

"I couldn't get a look at it earlier," went on the young man as Kyle handed the lens to him. "And I wanted to. It's a rather expensive present, you know—it and the other two like it—from our Imperial treasury. Just to keep your planet from drifting into another ice age. And what do we get for it?"

"Earth, Lord," answered Kyle. "As it was before men went out to the stars."

"Oh, the museum areas could be maintained with one station and a half-million caretakers," said the Prince. "It's the other two stations and you billion or so free-loaders I'm talking about. I'll have to look into it when I'm Emperor. Shall we ride?"

"If you wish, Lord." Kyle picked up the reins of the stallion and the two horses with their riders moved off across the slope.

". . . And one more thing," said the Prince, as they entered the farther belt of pine trees. "I don't want you to be misled—I'm really very fond of old Monty, back there. It's just that I wasn't really planning to come here at all—*Look at me, Bodyguard!*"

Kyle turned to see the blue eyes that ran in the Imperial family blazing at him. Then, unexpectedly, they softened. The Prince laughed.

"You don't scare easily, do you, Bodyguard . . . Kyle, I mean?" he said. "I think I like you after all. But look at me when I talk."

"Yes, Lord."

"That's my good Kyle. Now, I was explaining to you that I'd never actually planned to come here on my Grand Tour at all. I didn't see any point in visiting this dusty old museum world of yours with people still trying to live like they lived in

the Dark Ages. But—my Imperial father talked me into it."

"Your father, Lord?" asked Kyle.

"Yes, he bribed me, you might say," said the Prince thoughtfully. "He was supposed to meet me here for these three days. Now, he's messaged there's been a slight delay—but that doesn't matter. The point is, he belongs to the school of old men who still think your Earth is something precious and vital. Now, I happen to like and admire my father, Kyle. You approve of that?"

"Yes, Lord."

"I thought you would. Yes, he's the one man in the human race I look up to. And to please him, I'm making this Earth trip. And to please him—only to please *him*, Kyle—I'm going to be an easy Prince for you to conduct around to your natural wonders and watering spots and whatever. Now, you understand me—and how this trip is going to go. Don't you?" He stared at Kyle.

"I understand," said Kyle.

"That's fine," said the Prince, smiling once more. "So now you can start telling me all about these trees and birds and animals so that I can memorize their names and please my father when he shows up. What are those little birds I've been seeing under the trees—brown on top and whitish underneath? Like that one—there!"

"That's a Veery, Lord," said Kyle. "A bird of the deep woods and silent places. Listen—" He reached out a hand to the gelding's bridle and brought both horses to a halt. In the sudden silence, off to their right they could hear a silver bird-voice, rising and falling, in a decending series of crescendos and diminuendos, that softened at last into silence. For a moment after the song was ended the Prince sat staring at Kyle, then seemed to shake himself back to life.

"Interesting," he said. He lifted the reins Kyle had let go and the horses moved forward again. "Tell me more."

For more than three hours, as the sun rose toward noon, they rode through the wooded hills, with Kyle identifying bird and animal, insect, tree and rock. And for three hours the Prince listened—his attention flashing and momentary, but intense. But when the sun was overhead that intensity flagged.

"That's enough," he said. "Aren't we going to stop for lunch? Kyle, aren't there any towns around here?"

"Yes, Lord," said Kyle. "We've passed several."

"Several?" The Prince stared at him. "Why haven't we come into one before now? Where are you taking me?"

"Nowhere, Lord," said Kyle. "You lead the way. I only follow."

"I?" said the Prince. For the first time he seemed to become aware that he had been keeping the geld-

ing's head always in advance of the stallion. "Of course. But now it's time to eat."

"Yes, Lord," said Kyle. "This way."

He turned the stallion's head down the slope of the hill they were crossing and the Prince turned the gelding after him.

"And now listen," said the Prince, as he caught up. "Tell me I've got it all right." And to Kyle's astonishment, he began to repeat, almost word for word, everything that Kyle had said. "Is it all there? Everything you told me?"

"Perfectly, Lord," said Kyle. The Prince looked slyly at him.

"Could you do that, Kyle?"

"Yes," said Kyle. "But these are things I've known all my life."

"You see?" The Prince smiled. "That's the difference between us, good Kyle. You spend your life learning something—I spend a few hours and I know as much about it as you do."

"Not as much, Lord," said Kyle, slowly.

The Prince blinked at him, then jerked his hand dismissingly, and half-angrily, as if he were throwing something aside.

"What little else there is probably doesn't count," he said.

They rode down the slope and through a winding valley and came out at a small village. As they rode clear of the surrounding trees a sound of music came to their ears.

"What's that?" The Prince stood up in his stirrups. "Why, there's dancing going on, over there."

"A beer garden, Lord. And it's Saturday—a holiday here."

"Good. We'll go there to eat."

They rode around to the beer garden and found tables back away from the dance floor. A pretty, young waitress came and they ordered, the Prince smiling sunnily at her until she smiled back—then hurried off as if in mild confusion. The Prince ate hungrily when the food came and drank a stein and a half of brown beer, while Kyle ate more lightly and drank coffee.

"That's better," said the Prince, sitting back at last. "I had an appetite . . . Look there, Kyle! Look, there are five, six . . . seven drifter platforms parked over there. Then you don't all ride horses?"

"No," said Kyle. "It's as each man wishes."

"But if you have drifter platforms, why not other civilized things?"

"Some things fit, some don't, Lord," answered Kyle. The Prince laughed.

"You mean you try to make civilization fit this old-fashioned life of yours, here?" he said. "Isn't that the wrong way around—" He broke off. "What's that they're playing now? I like that. I'll bet I could do that dance." He stood up. "In fact, I think I will."

He paused, looking down at Kyle.

"Aren't you going to warn me against it?" he asked.

"No, Lord," said Kyle. "What you do is your own affair."

The young man turned away abruptly. The waitress who had served them was passing, only a few tables away. The Prince went after her and caught up with her by the dance floor railing. Kyle could see the girl protesting—but the Prince hung over her, looking down from his tall height, smiling. Shortly, she had taken off her apron and was out on the dance floor with him, showing him the steps of the dance. It was a polka.

The Prince learned with fantastic quickness. Soon, he was swinging the waitress around with the rest of the dancers, his foot stamping on the turns, his white teeth gleaming. Finally the number ended and the members of the band put down their instruments and began to leave the stand.

The Prince, with the girl trying to hold him back, walked over to the band leader. Kyle got up quickly from his table and started toward the floor.

The band leader was shaking his head. He turned abruptly and slowly walked away. The Prince started after him, but the girl took hold of his arm, saying something urgent to him.

He brushed her aside and she stumbled a little. A busboy among the tables on the far side of the dance floor, not much older than the Prince and nearly as tall, put down his tray and vaulted the railing onto the polished hardwood. He came up behind the Prince and took hold of his arm, swinging him around.

". . . Can't do that here." Kyle heard him say, as Kyle came up. The Prince struck out like a panther —like a trained boxer—with three quick lefts in succession into the face of the busboy, the Prince's shoulder bobbing, the weight of his body in behind each blow.

The busboy went down. Kyle, reaching the Prince, herded him away through a side gap in the railing. The young man's face was white with rage. People were swarming onto the dance floor.

"Who was that? What's his name?" demanded the Prince, between his teeth. "He put his hand on me! Did you see that? *He put his hand on me!*"

"You knocked him out," said Kyle. "What more do you want?"

"He manhandled me—*me!*" snapped the Prince. "I want to find out who he is!" He caught hold of the bar to which the horses were tied, refusing to be pushed farther. "He'll learn to lay hands on a future Emperor!"

"No one will tell you his name," said Kyle. And the cold note in his voice finally seemed to reach through to the Prince and sober him. He stared at Kyle.

"Including you?" he demanded at last.

"Including me, Lord," said Kyle.

The Prince stared a moment longer, then swung away. He turned, jerked loose the reins of the gelding and swung into the saddle. He rode off. Kyle mounted and followed.

They rode in silence into the forest. After a while, the Prince spoke without turning his head.

"And you call yourself a bodyguard," he said, finally.

"Your life is in my hands, Lord," said Kyle. The Prince turned a grim face to look at him.

"Only my life?" said the Prince. "As long as they don't kill me, they can do what they want? Is that what you mean?"

Kyle met his gaze steadily.

"Pretty much so, Lord," he said.

The Prince spoke with an ugly note in his voice.

"I don't think I like you, after all, Kyle," he said. "I don't think I like you at all."

"I'm not here with you to be liked, Lord," said Kyle.

"Perhaps not," said the Prince, thickly. "But I know *your* name!"

They rode on in continued silence for perhaps another half hour. But then gradually the angry hunch went out of the young man's shoulders and the tightness out of his jaw. After a while he began to sing to himself, a song in a language Kyle did not know; and as he sang, his cheerfulness seemed to return. Shortly, he spoke to Kyle, as if there had never been anything but pleasant moments between them.

Mammoth Cave was close and the Prince asked to visit it. They went there and spent some time going through the cave. After that they rode their horses up along the left bank of the Green River. The Prince seemed to have forgotten all about the incident at the beer garden and be out to charm everyone they met. As the sun was at last westering toward the dinner hour, they came finally to a small hamlet back from the river, with a roadside inn mirrored in an artificial lake beside it, and guarded by oak and pine trees behind.

"This looks good," said the Prince. "We'll stay overnight here, Kyle."

"If you wish, Lord," said Kyle.

They halted, and Kyle took the horses around to the stable, then entered the inn to find the Prince already in the small bar off the dining room, drinking beer and charming the waitress. This waitress was younger than the one at the beer garden had been; a little girl with soft, loose hair and round brown eyes that showed their delight in the attention of the tall, good-looking, young man.

"Yes," said the Prince to Kyle, looking out of the corners of the Imperial blue eyes at him, after the waitress had gone to get Kyle his coffee, "This is the very place."

"The very place?" said Kyle.

"For me to get to know the people better—what did you think,

good Kyle?" said the Prince and laughed at him. "I'll observe the people here and you can explain them—won't that be good?"

Kyle gazed at him, thoughtfully.

"I'll tell you whatever I can, Lord," he said.

They drank—the Prince his beer, and Kyle his coffee—and went in a little later to the dining room for dinner. The Prince, as he had promised at the bar, was full of questions about what he saw—and what he did not see.

". . . But why go on living in the past, all of you here?" he asked Kyle. "A museum world is one thing. But a museum people—" he broke off to smile and speak to the little, soft-haired waitress, who had somehow been diverted from the bar to wait upon their dining-room table.

"Not a museum people, Lord," said Kyle. "A living people. The only way to keep a race and a culture preserved is to keep it alive. So we go on in our own way, here on Earth, as a living example for the Younger Worlds to check themselves against."

"Fascinating . . ." murmured the Prince; but his eyes had wandered off to follow the waitress, who was glowing and looking back at him from across the now-busy dining room.

"Not fascinating. Necesssary, Lord," said Kyle. But he did not believe the younger man had heard him.

After dinner, they moved back to the bar. And the Prince, after questioning Kyle a little longer, moved up to continue his researches among the other people standing at the bar. Kyle watched for a little while. Then, feeling it was safe to do so, slipped out to have another look at the horses and to ask the innkeeper to arrange a saddle lunch put up for them the next day.

When he returned, the Prince was not to be seen.

Kyle sat down at a table to wait; but the Prince did not return. A cold, hard knot of uneasiness began to grow below Kyle's breastbone. A sudden pang of alarm sent him swiftly back out to check the horses. But they were cropping peacefully in their stalls. The stallion whickered, low-voiced, as Kyle looked in on him, and turned his white head to look back at Kyle.

"Easy, boy," said Kyle and returned to the inn to find the innkeeper.

But the innkeeper had no idea where the Prince might have gone.

". . . If the horses aren't taken, he's not far," the innkeeper said. "There's no trouble he can get into around here. Maybe he went for a walk in the woods. I'll leave word for the night staff to keep an eye out for him when he comes in. Where'll you be?"

"In the bar until it closes—then, my room," said Kyle.

He went back to the bar to wait, and took a booth near an open win-

dow. Time went by and gradually the number of other customers began to dwindle. Above the ranked bottles, the bar clock showed nearly midnight. Suddenly, through the window, Kyle heard a distant scream of equine fury from the stables.

He got up and went out quickly. In the darkness outside, he ran to the stables and burst in. There in the feeble illumination of the stable's night lighting, he saw the Prince, pale-faced, clumsily saddling the gelding in the center aisle between the stalls. The door to the stallion's stall was open. The Prince looked away as Kyle came in.

Kyle took three swift steps to the open door and looked in. The stallion was still tied, but his ears were back, his eyes rolling, and a saddle lay tumbled and dropped on the stable floor beside him.

"Saddle up," said the Prince thickly from the aisle. "We're leaving." Kyle turned to look at him.

"We've got rooms at the inn here," he said.

"Never mind. We're riding. I need to clear my head." The young man got the gelding's cinch tight, dropped the stirrups and swung heavily up into the saddle. Without waiting for Kyle, he rode out of the stable into the night.

"So, boy . . ." said Kyle soothingly to the stallion. Hastily he untied the big white horse, saddled him, and set out after the Prince. In the darkness, there was no way of ground-tracking the gelding; but he leaned forward and blew into the ear of the stallion. The surprised horse neighed in protest and the whinny of the gelding came back from the darkness of the slope up ahead and over to Kyle's right. He rode in that direction.

He caught the Prince on the crown of the hill. The young man was walking the gelding, reins loose, and singing under his breath—the same song in an unknown language he had sung earlier. But, now as he saw Kyle, he grinned loosely and began to sing with more emphasis. For the first time Kyle caught the overtones of something mocking and lusty about the incomprehensible words. Understanding broke suddenly in him.

"The girl!" he said. "The little waitress. Where is she?"

The grin vanished from the Prince's face, then came slowly back again. The grin laughed at Kyle.

"Why, where d'you think?" The words slurred on the Prince's tongue and Kyle, riding close, smelled the beer heavy on the young man's breath. "In her room, sleeping and happy. Honored . . . though she doesn't know it . . . by an Emperor's son. And expecting to find me there in the morning. But I won't be. Will we, good Kyle?"

"Why did you do it, Lord?" asked Kyle, quietly.

"Why?" The Prince peered at him, a little drunkenly in the moon-

light. "Kyle, my father has four sons. I've got three younger brothers. But I'm the one who's going to be Emperor; and Emperors don't answer questions."

Kyle said nothing. The Prince peered at him. They rode on together for several minutes in silence.

"All right, I'll tell you why," said the Prince, more loudly, after a while as if the pause had been only momentary. "It's because you're not *my* bodyguard, Kyle. You see, I've seen through you. I know whose bodyguard you are. You're *theirs!*"

Kyle's jaw tightened. But the darkness hid his reaction.

"All right—" The Prince gestured loosely, disturbing his balance in the saddle. "That's all right. Have it your way. I don't mind. So, we'll play points. There was that lout at the beer garden who put his hands on me. But no one would tell me his name, you said. All right, you managed to bodyguard him. One point for you. But you didn't manage to bodyguard the girl at the inn back there. One point for me. Who's going to win, good Kyle?"

Kyle took a deep breath.

"Lord," he said, "some day it'll be your duty to marry a woman from Earth—"

The Prince interrupted him with a laugh, and this time there was an ugly note in it.

"You flatter yourselves," he said. His voice thickened. "That's the trouble with you—all you Earth people—you flatter yourselves."

They rode on in silence. Kyle said nothing more, but kept the head of the stallion close to the shoulder of the gelding, watching the young man closely. For a little while the Prince seemed to doze. His head sank on his chest and he let the gelding wander. Then, after a while, his head began to come up again, his automatic horseman's fingers tightened on the reins, and he lifted his head to stare around in the moonlight.

"I want a drink," he said. His voice was no longer thick, but it was flat and uncheerful. "Take me where we can get some beer, Kyle."

Kyle took a deep breath.

"Yes, Lord," he said.

He turned the stallion's head to the right and the gelding followed. They went up over a hill and down to the edge of a lake. The dark water sparkled in the moonlight and the farther shore was lost in the night. Lights shone through the trees around the curve of the shore.

"There, Lord," said Kyle. "It's a fishing resort, with a bar."

They rode around the shore to it. It was a low, casual building, angled to face the shore; a dock ran out from it, to which fishing boats were tethered, bobbing slightly on the black water. Light gleamed through the windows as they hitched their horses and went to the door.

The barroom they stepped into was wide and bare. A long bar faced them with several planked fish on the wall behind it. Below the fish

were three bartenders—the one in the center, middle-aged, and wearing an air of authority with his apron. The other two were young and muscular. The customers, mostly men, scattered at the square tables and standing at the bar wore rough working clothes, or equally casual vacationers' garb.

The Prince sat down at a table back from the bar and Kyle sat down with him. When the waitress came they ordered beer and coffee, and the Prince half-emptied his stein the moment it was brought to him. As soon as it was completely empty, he signaled the waitress again.

"Another," he said. This time, he smiled at the waitress when she brought his stein back. But she was a woman in her thirties, pleased but not overwhelmed by his attention. She smiled lightly back and moved off to return to the bar where she had been talking to two men her own age, one fairly tall, the other shorter, bullet-headed and fleshy.

The Prince drank. As he put his stein down, he seemed to become aware of Kyle, and turned to look at him.

"I suppose," said the Prince. "you think I'm drunk?"

"Not yet," said Kyle.

"No," said the Prince, "that's right. Not yet. But perhaps I'm going to be. And if I decide I am, who's going to stop me?"

"No one, Lord."

"That's right," the young man said, "That's right." He drank deliberately from his stein until it was empty, and then signaled the waitress for another. A spot of color was beginning to show over each of his high cheekbones. "When you're on a miserable little world with miserable little people . . . hello, Bright Eyes!" he interrupted himself as the waitress brought his beer. She laughed and went back to her friends. ". . . You have to amuse yourself any way you can," he wound up.

He laughed to himself.

"When I think how my father, and Monty—everybody—used to talk this planet up to me—" he glanced aside at Kyle. "Do you know at one time I was actually scared—well, not scared exactly, nothing scares me . . . say *concerned*—about maybe having to come here, some day?" He laughed again. "Concerned that I wouldn't measure up to you Earth people! Kyle, have you ever been to any of the Younger Worlds?"

"No," said Kyle.

"I thought not. Let me tell you, good Kyle, the worst of the people there are bigger, and better-looking and smarter, and everything than anyone I've seen here. And I, Kyle, I—the Emperor-to-be—am better than any of them. So, guess how all you here look to me?" He stared at Kyle, waiting. "Well, answer me, good Kyle. Tell me the truth. That's an order."

"It's not up to you to judge, Lord," said Kyle.

"Not—? Not up to me?" The blue eyes blazed. *"I'm* going to be Emperor!"

"It's not up to any one man, Lord," said Kyle. "Emperor or not. An Emperor's needed, as the symbol that can hold a hundred worlds together. But the real need of the race is to survive. It took nearly a million years to evolve a survival-type intelligence here on Earth. And out on the newer worlds people are bound to change. If something gets lost out there, some necessary element lost out of the race, there needs to be a pool of original genetic material here to replace it."

The Prince's lips grew wide in a savage grin.

"Oh, good, Kyle—good!" he said. "Very good. Only, I've heard all that before. Only, I don't believe it. You see—I've seen you people, now. And you don't outclass us, out on the Younger Worlds. *We* outclass *you*. We've gone on and got better, while you stayed still. And you know it."

The young man laughed softly, almost in Kyle's face.

"All you've been afraid of, is that we'd find out. And I have." He laughed again. "I've had a look at you; and now I know. I'm bigger, better and braver than any man in this room—and you know why? Not just because I'm the son of the Emperor, but because it's born in me! Body, brains and everything else! I can do what I want here, and no one on this planet is good enough to stop me. Watch."

He stood up, suddenly.

"Now, I want that waitress to get drunk with me," he said. "And this time I'm telling you in advance. Are you going to try and stop me?"

Kyle looked up at him. Their eyes met.

"No, Lord," he said. "It's not my job to stop you."

The Prince laughed.

"I thought so," he said. He swung away and walked between the tables toward the bar and the waitress, still in conversation with the two men. The Prince came up to the bar on the far side of the waitress and ordered a new stein of beer from the middle-aged bartender. When it was given to him, he took it, turned around, and rested his elbows on the bar, leaning back against it. He spoke to the waitress, interrupting the taller of the two men.

"I've been wanting to talk to you," Kyle heard him say.

The waitress, a little surprised, looked around at him. She smiled, recognizing him—a little flattered by the directness of his approach, a little appreciative of his clean good looks, a little tolerant of his youth.

"You don't mind, do you?" said the Prince, looking past her to the bigger of the two men, the one who had just been talking. The other stared back, and their eyes met without shifting for several seconds.

Abruptly, angrily, the man shrugged, and turned about with his back hunched against them.

"You see?" said the Prince, smiling back at the waitress. "He knows I'm the one you ought to be talking to, instead of—"

"All right, sonny. Just a minute."

It was the shorter, bullet-head man, interrupting. The Prince turned to look down at him with a fleeting expression of surprise. But the bullet-headed man was already turning to his taller friend and putting a hand on his arm.

"Come on back, Ben," the shorter man was saying. "The kid's a little drunk, is all." He turned back to the Prince. "You shove off now," he said. "Clara's with us."

The Prince stared at him blankly. The stare was so fixed that the shorter man had started to turn away, back to his friend and the waitress, when the Prince seemed to wake.

"Just a minute—" he said, in his turn.

He reached out a hand to one of the fleshy shoulders below the bullet head. The man turned back, knocking the hand calmly away. Then, just as calmly, he picked up the Prince's full stein of beer from the bar and threw it in the young man's face.

"Get lost," he said, unexcitedly.

The Prince stood for a second, with the beer dripping from his face. Then, without even stopping to wipe his eyes clear, he threw the beautifully trained left hand he had demonstrated at the beer garden.

But the shorter man, as Kyle had known from the first moment of seeing him, was not like the busboy the Prince had decisioned so neatly. This man was thirty pounds heavier, fifteen years more experienced, and by build and nature a natural bar fighter. He had not stood there waiting to be hit, but had already ducked and gone forward to throw his thick arms around the Prince's body. The young man's punch bounced harmlessly off the round head, and both bodies hit the floor, rolling in among the chair and table legs.

Kyle was already more than halfway to the bar and the three bartenders were already leaping the wooden hurdle that walled them off. The taller friend of the bullet-headed man, hovering over the two bodies, his eyes glittering, had his boot drawn back ready to drive the point of it into the Prince's kidneys. Kyle's forearm took him economically like a bar of iron across the tanned throat.

He stumbled backwards choking. Kyle stood still, hands open and down, glancing at the middle-aged bartender.

"All right," said the bartender. "But don't do anything more." He turned to the two younger bartenders. "All right. Haul him off!"

The pair of younger, aproned men bent down and came up with the bullet-headed man expertly handlocked between them. The man

made one surging effort to break loose, and then stood still.

"Let me at him," he said.

"Not in here," said the older bartender. "Take it outside."

Between the tables, the Prince staggered unsteadily to his feet. His face was streaming blood from a cut on his forehead, but what could be seen of it was white as a drowning man's. His eyes went to Kyle, standing beside him; and he opened his mouth—but what came out sounded like something between a sob and a curse.

"All right," said the middle-aged bartender again. "Outside, both of you. Settle it out there."

The men in the room had packed around the little space by the bar. The Prince looked about and for the first time seemed to see the human wall hemming him in. His gaze wobbled to meet Kyle's.

"Outside . . . ?" he said, chokingly.

"You aren't staying in here," said the older bartender, answering for Kyle. "I saw it. You started the whole thing. Now, settle it any way you want—but you're both going outside. Now! Get moving!"

He pushed at the Prince, but the Prince resisted, clutching at Kyle's leather jacket with one hand.

"Kyle—."

"I'm sorry, Lord," said Kyle. "I can't help. It's your fight."

"Let's get out of here," said the bullet-headed man.

The Prince stared around at them as if they were some strange set of beings he had never known to exist before.

"No . . ." he said.

He let go of Kyle's jacket. Unexpectedly, his hand darted in towards Kyle's belly holster and came out holding the slug pistol.

"Stand back!" he said, his voice high-toned. "Don't try to touch me!"

His voice broke on the last words. There was a strange sound, half grunt, half moan, from the crowd; and it swayed back from him. Manager, bartenders, watchers—all but Kyle and the bullet-headed man drew back.

"You dirty slob . . ." said the bullet-headed man, distinctly. "I knew you didn't have the guts."

"Shut up!" The Prince's voice was high and cracking. "Shut up! Don't any of you try to come after me!"

He began backing away toward the front door of the bar. The room watched in silence, even Kyle standing still. As he backed, the Prince's back straightened. He hefted the gun in his hand. When he reached the door he paused to wipe the blood from his eyes with his left sleeve, and his smeared face looked with a first touch of regained arrogance at them.

"Swine!" he said.

He opened the door and backed out, closing it behind him. Kyle took one step that put him facing the bullet-headed man. Their eyes met

and he could see the other recognizing the fighter in him, as he had earlier recognized it in the bullet-headed man.

"Don't come after us," said Kyle.

The bullet-headed man did not answer. But no answer was needed. He stood still.

Kyle turned, ran to the door, stood on one side of it and flicked it open. Nothing happened; and he slipped through, dodging to his right at once, out of the line of any shot aimed at the opening door.

But no shot came. For a moment he was blind in the night darkness, then his eyes began to adjust. He went by sight, feel and memory toward the hitching rack. By the time he got there, he was beginning to see.

The Prince was untying the gelding and getting ready to mount.

"Lord," said Kyle.

The Prince let go of the saddle for a moment and turned to look over his shoulder at him.

"Get away from me," said the Prince, thickly.

"Lord," said Kyle, low-voiced and pleading, "you lost your head in there. Anyone might do that. But don't make it worse, now. Give me back the gun, Lord."

"Give you the gun?"

The young man stared at him—and then he laughed.

"Give *you* the gun?" he said again. "So you can let someone beat me up some more? So you can not-guard me with it?"

"Lord," said Kyle, "please. For your own sake—give me back the gun."

"Get out of here," said the Prince, thickly, turning back to mount the gelding. "Clear out before I put a slug in you."

Kyle drew a slow, sad breath. He stepped forward and tapped the Prince on the shoulder.

"Turn around, Lord," he said.

"I warned you—" shouted the Prince, turning.

He came around as Kyle stooped, and the slug pistol flashed in his hand from the light of the bar windows. Kyle, bent over, was lifting the cuff of his trouser leg and closing his fingers on the hilt of the knife in his boot sheath. He moved simply, skillfully, and with a speed nearly double that of the young man, striking up into the chest before him until the hand holding the knife jarred against the cloth covering flesh and bone.

It was a sudden, hard-driven, swiftly merciful blow. The blade struck upwards between the ribs lying open to an underhanded thrust, plunging deep into the heart. The Prince grunted with the impact driving the air from his lungs; and he was dead as Kyle caught his slumping body in leather-jacketed arms.

Kyle lifted the tall body across the saddle of the gelding and tied it there. He hunted on the dark ground for the fallen pistol and returned it to his holster. Then, he mounted

the stallion and, leading the gelding with its burden, started the long ride back.

Dawn was graying the sky when at last he topped the hill overlooking the lodge where he had picked up the Prince almost twenty-four hours before. He rode down towards the courtyard gate.

A tall figure, indistinct in the predawn light, was waiting inside the courtyard as Kyle came through the gate; and it came running to meet him as he rode toward it. It was the tutor, Montlaven, and he was weeping as he ran to the gelding and began to fumble at the cords that tied the body in place.

"I'm sorry . . ." Kyle heard himself saying; and was dully shocked by the deadness and remoteness of his voice. "There was no choice. You can read it all in my report tomorrow morning—"

He broke off. Another, even taller figure had appeared in the doorway of the lodge giving on the courtyard. As Kyle turned towards it, this second figure descended the few steps to the grass and came to him.

"Lord—" said Kyle. He looked down into features like those of the Prince, but older, under graying hair. This man did not weep like the tutor, but his face was set like iron.

"What happened, Kyle?" he said.

"Lord," said Kyle, "you'll have my report in the morning . . ."

"I want to know," said the tall man. Kyle's throat was dry and stiff. He swallowed but swallowing did not ease it.

"Lord," he said, "you have three other sons. One of them will make an Emperor to hold the worlds together."

"What did he do? Whom did he hurt? Tell me!" The tall man's voice cracked almost as his son's voice had cracked in the bar.

"Nothing. No one," said Kyle, stiff-throated. "He hit a boy not much older than himself. He drank too much. He may have got a girl in trouble. It was nothing he did to anyone else. It was only a fault against himself." He swallowed. "Wait until tomorrow, Lord, and read my report."

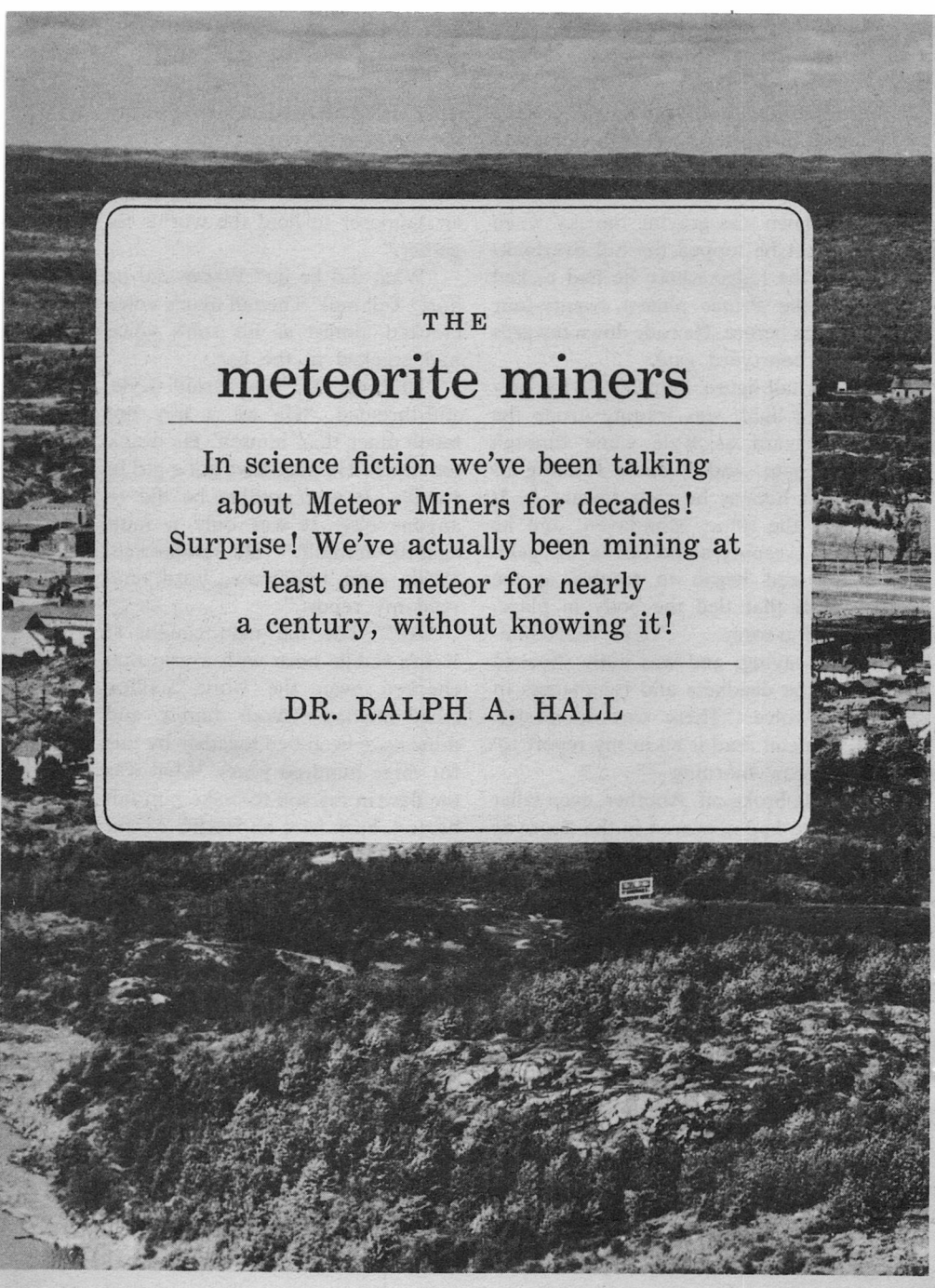
"No!" The tall man caught at Kyle's saddle horn with a grip that checked even the white stallion from moving. "Your family and mine have been tied together by this for three hundred years. What was the flaw in my son to make him fail his test, back here on Earth? *I want to know!"*

Kyle's throat ached and was dry as ashes.

"Lord," he answered, "he was a coward."

The hand dropped from his saddle horn as if struck down by a sudden strengthlessness. And the Emperor of a hundred worlds fell back like a beggar, spurned in the dust.

Kyle lifted his reins and rode out of the gate, into the forest away on the hillside. The dawn was breaking. ■

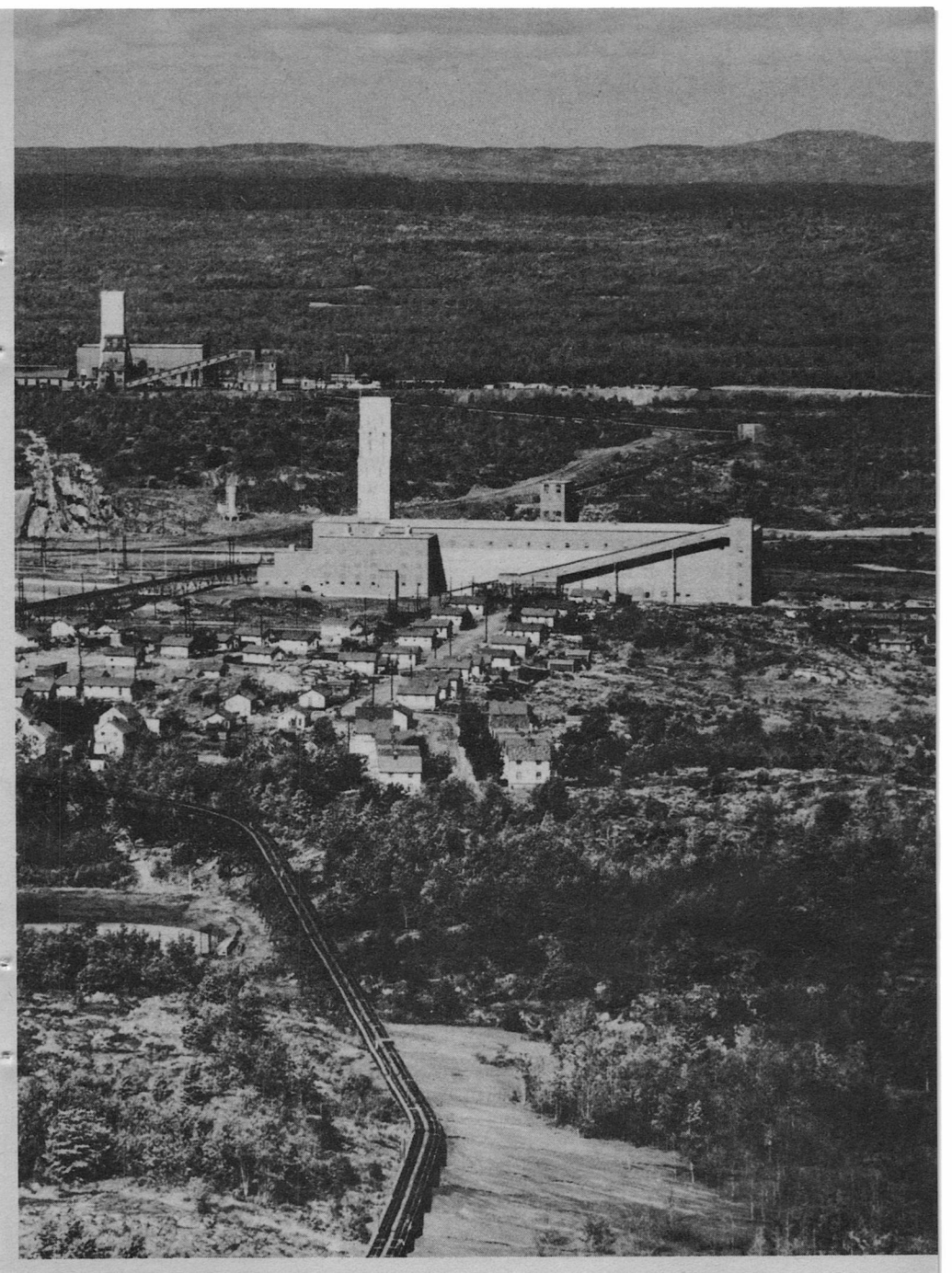


THE

meteorite miners

In science fiction we've been talking about Meteor Miners for decades! Surprise! We've actually been mining at least one meteor for nearly a century, without knowing it!

DR. RALPH A. HALL

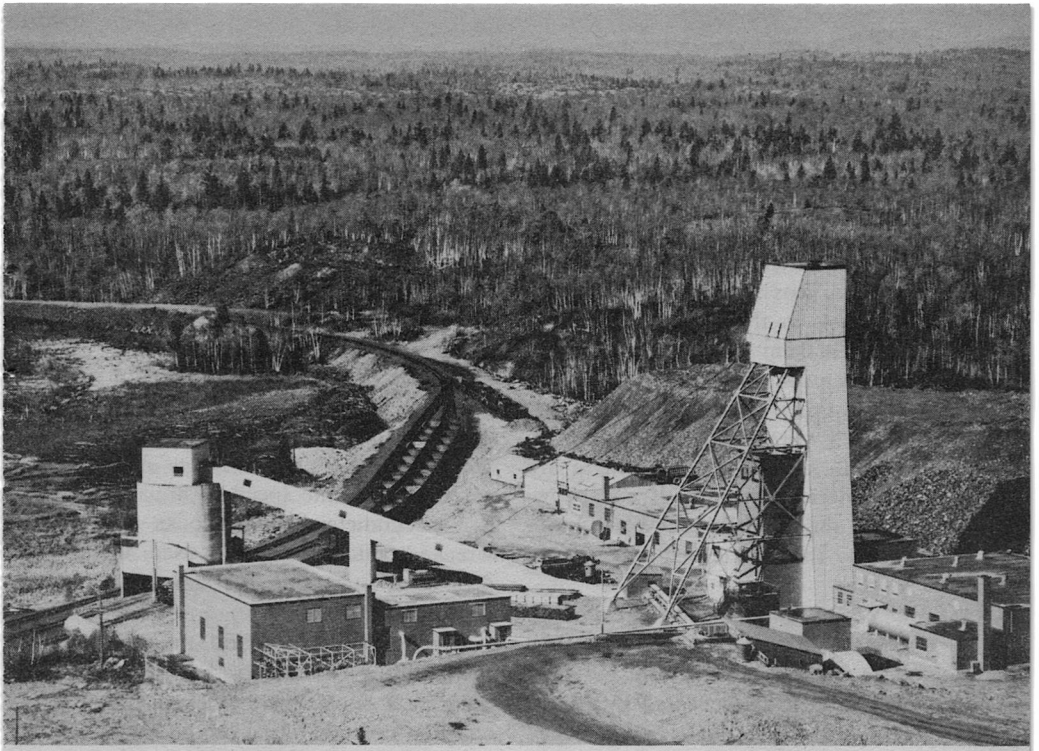


THE METEORITE MINERS

About 1.7 billion years ago an asteroid in acentric orbit playing out its celestial mechanics collided with the Third Planet and made its awful scar in the barren rock. The Third Planet was of no human concern and if it had been, its noxious atmosphere and infertility would have better qualified it as Hell! Its surface was rock and water. On the rock the stinking unpotable mineral waters shone with golden sands of untarnished pyrites. Only at the margins between rock and water in the wetted dust was there tiny promise of life where lightning and volcanic cooking combined and mixed the nitrogenous and carbonaceous gases with the wetted dust. The Creation referred to in the Book was in its inception.

The basic rock occasionally groaned and rumbled, for another celestial event was playing out—the splitting off or capture of a satellite, however it occurred. Something very big had happened in this solar system that left it with ragged asteroid fragments, retrograde satellites of Jupiter, Pluto and Neptune associated or dissociated. Amongst all this was an incident: a collision of an asteroid and a planet. The collision was a small part of a much bigger picture. The importance of that incident was that it left a mark in the Canadian Precambrian Shield. The Shield has survived to this day as the oldest surface on the planet. In the succeeding time the Earth with its fertility and the World with its human concern has developed. Inquiry is an animal trait which in the human is developed to a unique extent. The enigmas, which are of human mind, are measured, weighed, analyzed and finally converted to knowledge.

The scar left by the asteroid finally came under human scrutiny around the 1860's when the pentlandite was discovered to be in commercial quantities and the Sudbury Nickel Mines were started. It was not until a hundred years later that Dr. Robert S. Dietz, already knowledgeable of astroblemes, noted the characteristics of the surrounding



Headframe and surface buildings at the Crean Hill Mine of The International Nickel Company of Canada, Limited, in the Sudbury of Ontario.

terrain and discerned that here, too, were the remains of a celestial collision.

How does one tell people this? Does one step up to the nearest miner and tell him that the nickel ore he has in his mine cart is part of a meteorite? The first reaction would probably be of open-mouthed disbelief. The proper procedure is to back off a respectable distance and write an article to be published in a scientific journal.

Dr. Dietz's article appeared in July, 1964, but like many other bits of information it only raised more problems. Gosh, Gee Whiz, don't you see? We had counted on all that nickel as being of Earthly origin, having been brought to the surface by a volcanic pipe. This had been counted of indigenous origin. Now we have to shift it to the exogenous column. This in turn throws doubt on our concept of observed cosmic abundances of elements and isotopes.

A theory as to how the ore body was formed will be outlined. The theory seems correct because it so

readily explains the craters of the Moon. After that the problem with respect to observed cosmic abundances will be briefly discussed.

Cosmic Abundances are important to such sciences as nuclear physics, geophysics, and astronomy. Scientists in these fields frequently refer to them in their calculations. This is a useful concept and is used as a yardstick. Any talk of changing this yardstick brings up problems in science much as there are in American industry if we change from the English inch-pound system to the metric centimeter-gram system.

With the appearance of Dr. Dietz's definitive paper, what had been regarded as a volcanic pipe was soon to be accepted as a large meteoritic crater. His proof relied principally upon shatter-cones in areas circling the ore body. These shatter-cones are rock formations caused by shock action in homogeneous rock. They require such shock forces that only a meteoritic impact could produce them.

When the meteorite struck at Sudbury, it excavated a crater thirty miles in diameter by nine miles deep. No one really knows what happened that day 1.7 giga-years ago, but we can make a good guess based on recent information.

Meteorites may strike the Earth at any speed between 11 and 72 km. per sec. Eleven km./sec. represents the Earth's escape velocity and 72 km./sec. is the escape velocity from the solar system starting from the Earth. We know from our experience with craters made by other explosives and atomic bombs, that the Sudbury Crater probably represents a 3×10^{29} erg event. We are, as yet, at liberty to chose any speed between 11 and 72. The size of the meteorite is then a factor of the speed chosen. Some day we may discover a speedometer in the wreckage of the crater with its indicator stuck at the speed of impact, as speedometers and clocks in wrecked automobiles are used to give us a clue as to the time and speed of the accident.

Clocks we have found in sediments filling the craters, but not a geological speedometer. Since the collision can take place on the leading surface of the Earth, we can start with the 29 km/sec. Earth orbital velocity and by adding the 11 km./sec. Earth escape velocity easily get up to 40 km./sec. without considering any of the heliocentric orbital velocities of the meteorite. The Sudbury incident gives us a primary meteorite diameter of 1.32 miles and 3.8×10^{13} tons.

When such a meteorite arrives at the surface of the Earth, it is already surrounded by a plasmic coat from the atmosphere so hot that it is radiating X rays intensively.

When it touches the Earth, it begins to burn a hole without hesitating in its pace. Classic writers talk about transmitted shock

waves, but the meteorite is approaching at Mach VIII with respect to the sound velocity in any of the materials involved. This means that any shock wave transmitted to the terrestrial rock or meteoritic iron is overtaken and burned up by the plasma before the wave can get away. For the first few fractions of a second it appears as if momentum takes a holiday, because both the meteorite and the Earth seem to go on their way without hesitation, with their interacting zones consumed in plasmic flame. For that instant, the rate of transfer of energy, that is, ergs per square centimeter per millisecond, is unacceptable to solid, liquid or gas. Only plasma can accept this flow of energy and transfer it. In this same instant the area of pressure spreads centrifugally to cover a greater area until the rate of energy transfer is acceptable to some form of matter other than plasma or gas.

One must realize that, if no direct impact wave is transmitted to the Earth, the energy of impact is being stored inside the crater in compressed plasma until it gets a sufficient shoulder of terrestrial material to push against. This shove that imparts the momentum of the meteorite to the Earth is transferred in a final hiccup of rocketlike blast back into space. This backward blast is visualized as being capable of orbiting fragments of the target as well as the projectile.

In a situation the size of the Sudbury incident during the first .15 seconds there is a sharp margin of reaction between the rock and the plasma, and the meteorite and the plasma. During this time the solids sublimate directly into plasma. At about .2 second the rate of interaction has dropped sufficiently in intensity that a zone of fused material has developed between the plasma and the solid rock. By this time a central plasma cavity of 13 kilometers has formed. Beyond that is a shell of fused rock 2.5 kilometers thick.

Beyond the molten glass the rock is fractured into a fine dust called rock flour. As the shock wave progresses outward, it slows and the splintered rock becomes coarser and coarser. As it slows to a speed a little more than Mach I, any discontinuity in a homogeneous material will form the apex of a shatter-cone by deflecting the slightly hypersonic shock wave to either side of it. Beyond this area the rate of transfer of energy is within the elastic limits of the rock and no further brecciation takes place. Meanwhile a wave of slurry, consisting of a mixture of meteorite and molten rock, plows its way through the rock flour, gravel, and boulders to impact on the walls of the crater. This impacted material is what they are mining today.

The final crater at Sudbury was roughly 30 X 9 miles. Eight miles

of shattered rock underlay the crater. The continental thickness is about twenty-five miles, floating like a huge raft on the plastic material of the inner zones of the Earth. Seventeen of these twenty-five miles was either removed or shattered.

Two effects follow the removal of so much overburden and shattering. This is enough to disturb the isostatic equilibrium and there is a tendency for the underlying layers to well up into the hole. This is also helped by the weakened condition of the underlying rock. From the evidence at Sudbury, apparently a magnetic reaction was triggered and the hole filled up with molten lava until the new floor of the crater came into equilibrium with the isostatic forces at 8,600 feet.

Up to this point, we have not discussed in detail what goes on inside the little inverted heart-shaped cav-

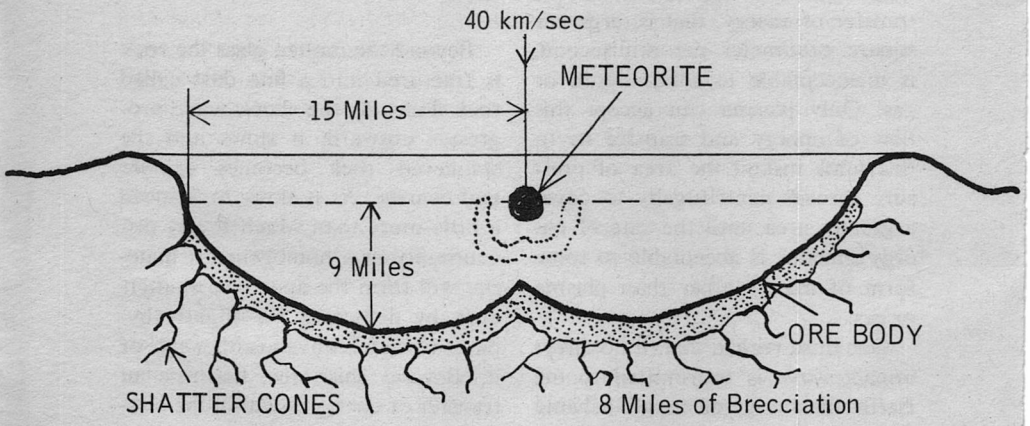


Figure 1: Cross-section of the Sudbury structure immediately after the impact. The basin is 30 X 9 miles. Eight miles of brecciation underlies the crater. The continental thickness is about 25 miles, floating like a raft on the plastic inner rings of the Earth. With so much overburden removed and weakened, the isoteric forces are thrown out of equilibrium and lower strata tend to well up into the crater. This welling up was further enhanced by a magnetic reaction or lava flow. The central block of original rock, surmounted by a mega shatter-cone, tends to rise with the tide. The ore body, which is a mixture of meteorite and fused rock, is plastered on the inside of the crater and intruded into the radial cracks.

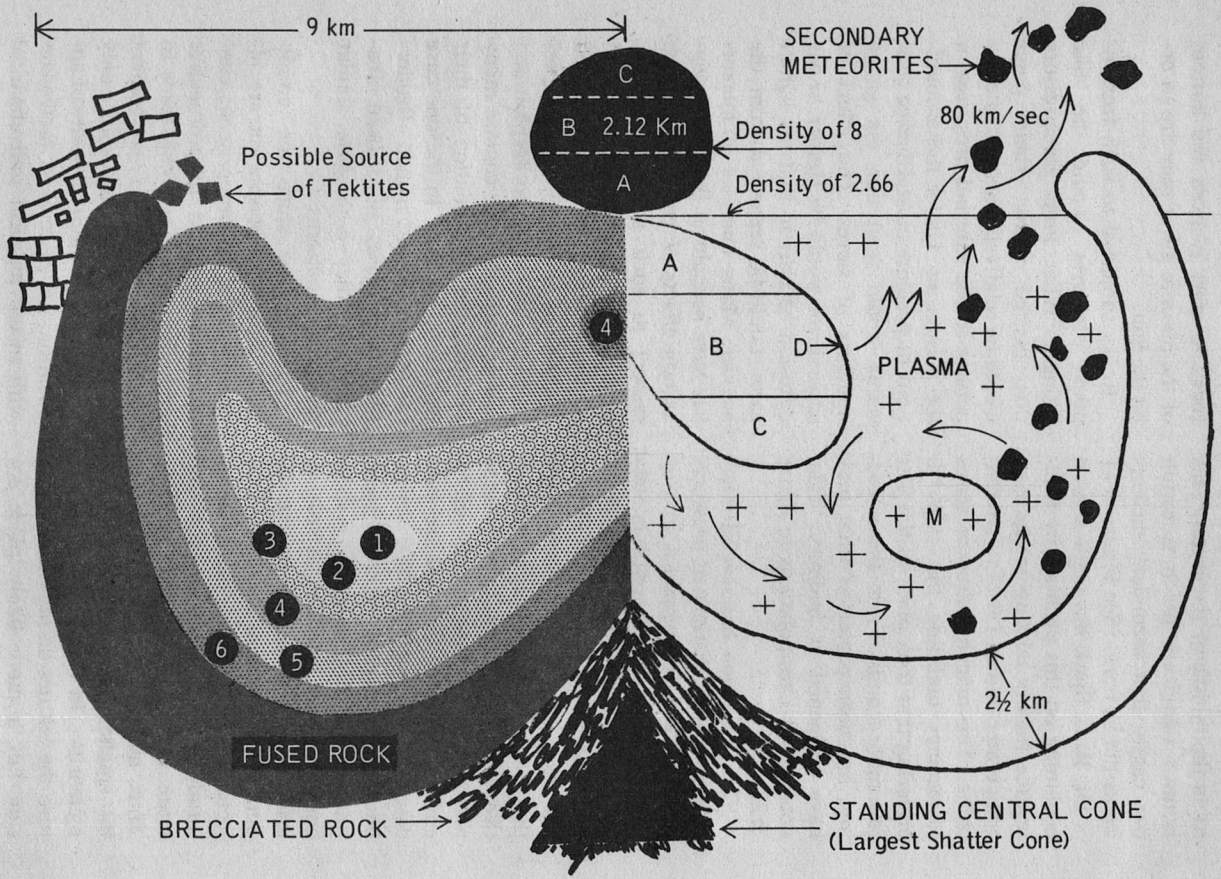
ity in the middle of the crater. This is most significant for it is within this cavity that secondary meteorites could be born. (See Figure #1)

Dr. R. L. Bjork has made a good beginning on this problem by feeding the factors relating to the Arizona crater into an I.B.M. 7090 machine. The machine drew a series of tracings outlining the steps in cratering that took place in the first few milliseconds. From these tracings has been projected what may have happened at Sudbury. Take note of our extrapolations in figure #2.

This projection has several interesting features. Estimated pressures start at 15 X 10^4 megabars in area (1) (A Mbar being approximately 10^6 atmospheres) and grade down to 1.4 Mbars in area (6) at the inner face of the fused rock. Note that while the meteorite traveled two diameters of 4.2 km., some plasma traveled 9 km. Areas of reenforced plasmic currents are indicated. It is pointed out that veritable lakes of molten rock and enormous blocks of stone caught in these currents could be lofted as secondaries into orbit, possibly around the Sun. Molten rock or any liquid subjected to accelerations of any magnitude tend to break up and spin more readily than solid particles. Thus, tektites are generally quite a bit smaller than secondary stone meteorites. In our diagram we picture the tektites taking off from the rim, but a more likely place for rocks to start is from the bottom of the plasmic pit, if they are to orbit the Sun.

Rocks subjected to such tremendous pressures would be like sponges. What little gas pressure that existed within their pores would be relatively vacuous in comparison to the external pressures in the plasma pit. Under those conditions of pressure crystal lattice constants would read like the gauge numbers of sieves. The effect of such sieves would be similar to gas diffusion barriers in that the lighter gases would be separated from the heavier. Many analyses of meteorites have brought to light these separation effects of gas infusion with respect to such gases as helium, neon, argon, krypton and xenon. In the fewer cases where the refined analyses of the isotopes were performed with respect to krypton and xenon, both of which contain many isotopes, the fractionation of their isotopes is evident. In the one case of the meteorite named Bruderheim both gases have been analyzed and they both show similar gas infusion patterns.

Furthermore, since the conditions within the plasma pit are inhomogeneous, inhomogeneous conditions are applied to prospective secondary meteorites. This leads to anomalous patterns of gas content within the meteorites. Not only would there be inhomogeneity of application, but in cases of meteorites with mixed physical and chemical


9 km
C
B 2.12 Km
A
Density of 8
Density of 2.66
SECONDARY METEORITES
80 km/sec
Possible Source of Tektites
A
B
C
D
PLASMA
M
4
3
1
2
4
6
5
FUSED ROCK
2½ km
BRECCIATED ROCK
STANDING CENTRAL CONE
(Largest Shatter Cone)

conditions within their structure, there would be mixed reactions to the applied forces. Evidence of these mixed reactions has been repeatedly demonstrated in that separate physical conditions within the same meteorite contain different gas concentrations.

While we are on the subject of inhomogeneous conditions within the plasma pit we may pause for a moment to consider the effects of electric inhomogeneities. Our experience with atomic bombs suggests that these electromagnetic effects would be considerable. The case of a nearby strike would make havoc in radio and TV communications. Magnetic tape would have a sudden permanent lapse of memory. Gone would be information stored in computers. Arcing would punch "holes" in transistors so that an electronic brain would suffer a schizophrenia that would render it useless. In general, much mischief would occur in electrical equipment.

Shock reactions, themselves, have a peculiar faculty for selecting and affecting substances with different constants of elasticity so that shocks will violently upset one inelastic fraction within a rock and leave an adjacent elastic fraction practically untouched. This is evident in a carbonaceous meteorite called Murray, where we see evidence of tiny pieces of quartz having been melted and altered to olivine while adjacent organic materials are barely charred.

These inhomogeneous factors of gas infusion and shock together with volatilization, dehydration, and reduction that would occur within the plasma pit can only result in extremely bizarre secondary meteorites that could only be unraveled by astute scientists using the most sophisticated modern analytical methods. These types of data are only now becoming available for contemplation.

It should be noted in passing that Dr. Louis Walter using an electron probe recently identified coesite in

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Figure 2: The Sudbury meteorite 0.2 second after impact. This is an idealized schematic modified after R. L. Bjork, who used a computer to draw similar diagrams for the Arizona incident. Areas outlined are as follows: (1) 15 X 10^4 Mbar (A Mbar is about 10^6 atmosphers) (2) 10^3 Mbar, (3) 10^2Mbar, (4) 10 Mbar, (5) 2 Mbar, (6) 1.4 Mbar. M in the diagram is a magnetic core. (Left hand rule for positive ions) A, B, C are zones of the meteorite, note that the meteorite virtually turns inside-out as it enters the target. While the metorite travels 4.2 km. some plasma travels 9 km. These coordinates give a vector 65° from a norm to the surface. Whether or not a central mega-shatter cone is left standing is a function of the size of the crater and a relation of the speeds of the meteorite and the shattered particles.

tektites from Indo-China. Coesite is a crystal phase of quartz that so far has only been identified with tremendous shocks of meteoritic impacts. This evidence gives enormous strength to the belief that tektites come from meteoritic impacts.

The pressures and shocks to which these secondary fragments would be subjected are almost beyond belief. Pressures at the center of the Earth are estimated at 3.4 Mbars. At the interface between the mantle and the liquid core the pressure is estimated at 1.2 Mbar. This is also the estimated pressure between area (6) and the fused rock in the meteoritic crater.

To reduce this problem to its simplest terms we may say that during the first phases of the impact, in the face of such tremendous forces, the strength of materials is an insignificant factor. We are dealing primarily with the collision of two elastic gases of different densities with the added factor that both gases are ionized and will create and be affected by electromagnetic forces which ordinarily would be negligible.

Another fascinating thought is that at these speeds many of the interactions follow the laws of light in accordance with DeBroglia's wave theory of matter. One obvious parallel is that a ray passing from a denser to a less dense material is refracted away from the norm to the interface. Many other detailed analyses follow these rules as the process is developed, but we will not elaborate on them here.

We have visualized the Sudbury incident as having produced a central mega shatter-cone.

The ratio of the velocities of the projectile and the shattered particles to produce a central cone should be such as to produce a resultant vector about 50-70° off center. At the same time the dimensions of the crater and cone must be sufficiently large so that the shear strength of the target cone is great enough to withstand the secondary reflected shocks toward the center of the crater. From surveys of the Moon, craters with central cones can be found when the crater diameters exceed five miles.

Effectively a circular vortex ring is formed as the forces of momentum are spread over the surface of the target sufficiently for the target to react to the momentum of the hypersonic projectile. A circular crater with a central cone is a fossil imprint of this vortex ring.

From close attention to what happens to the impacting meteorite, we see that the meteorite virtually turns inside out as it enters the target, for the leading surface explodes first and this first explosion is followed by a continuous blast as the rear portions of the meteorite passes through it. Once this principle is understood, a hypersonic projectile could be designed to give any conceivable shape to a crater. In dia-

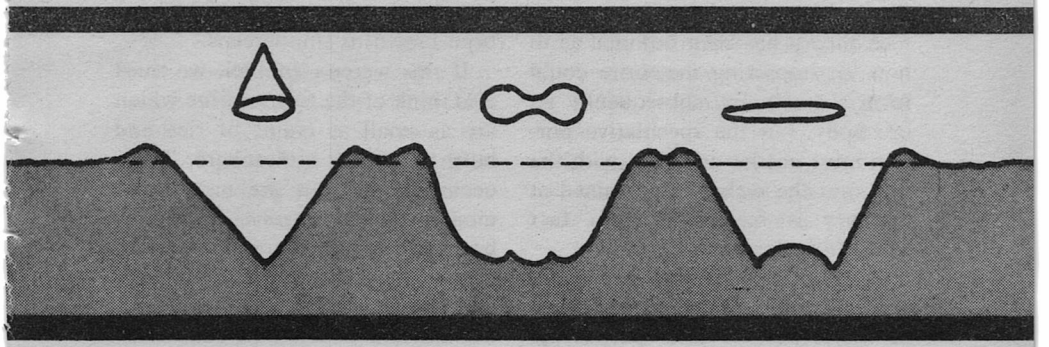

Figure 3: Missiles traveling at such a hypersonic speed that they would be converted into a gas effectively turn inside out. The leading surface explodes first. The rear portions of the meteorite pass through this first explosion and continue the explosion with the hindmost portions exploding last. An engineer could design a meteorite to give any shape to the resulting crater he desired. Irregularities of the missile would be smoothed out in the reaction. Above are some of the examples possible in explaining the variety of Moon craters that have puzzled some observers.

(A) A meteorite shaped like a teardrop would produce a crater with an inverted cone shaped floor; Thebit, for example.

(B) A lobular meteorite would produce multiple standing shattercones on the floor of the crater. There are many examples of this with up to seven cones seen on the Moon.

(C) A meteorite shaped like a pancake would produce a crater remarkably similar to a pingo. The Moon crater Alpetragius is a specific example. You may note that the explosive force accumulates proportionately to the square of the distance from the center of the pancake.

This concept of cratering action reduces the problem of crater formation on the Moon to a single mode. This proposition no longer poses the question of why so many shapes to the craters, but instead, more-or-less, demands that there be these shapes to accommodate all the possibilities.

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gram 3 we see some designs of meteoroids that would result in some of the known forms of craters on the Moon.

The cratering action tends to smooth out any irregularity of the projectile so that a circular crater with a central cone could be formed equally well by a sphere, cube, or right cylinder; all such instances of

nearly equal vertical and horizontal dimensions.

A theory has been outlined as to how an impacting meteorite could form a crater and subsequently an ore body, but the speculative portion must not be confused with the fact that the nickel being mined at Sudbury is meteoritic. This fact leads to a larger problem.

A large part of the determination of cosmic abundances is based on meteorites. A lesser part is determined from the surface of the Earth. One can sense immediately that the estimate of the abundance of nickel in the Earth's surface must be readjusted by shifting a large quantity of Sudbury nickel from the indigenous column to the exogenous column.

Previous to Dr. Dietz's studies the Sudbury nickel was considered to come from the interior of the Earth by way of a volcanic pipe. This, if it could be limited to the Sudbury Mines, might be a minor factor.

If we related the history of the Earth to that of the Moon and Mars, and calculate the incidence of cratering by meteorite impact on the Earth, we find that it must have occurred well over a million times.

If all these occasions, which happened over several billion years, were to be brought together in four years, the Earth would have looked like a terrible no-man's-land with forty atomic bombs exploding every hour, many of them a gigamillion times as large as Russia's largest. All the continents would have been blown to smithereens.

If this weren't enough, we must also think of the tiny meteors which are as small as grains of rice and burn up in our atmosphere. These occur nightly, but are more common in certain seasons. They have been traced pretty certainly to the debris along the tracks of comets, and appear unrelated to the meteorites that have fallen to Earth, for meteorites with one or two exceptions have fallen at other times apart from the meteor showers, and unrelated to known tracks of comets.

After the meteors burn the gases and metallic parts are trapped by the Earth's atmosphere and are gradually accreted to the surface. It is estimated that from one to five million tons a year are thus added to the Earth and have been plowed into its surface by geological forces for billions of years. There is some evidence that meteoritic impacts on the Earth have taken place for only 1.7 billion years, but there are reasons to believe that meteor accretion has taken place during the entire existence of the Earth. This all adds up to confusion in the role that the Earth's elemental abundances play in determining the solar and galactic abundances.

Let us turn again to the meteorites which have played such a tremendous role in the determination

of "observed elemental abundances in the solar system." These are meteoroids that have passed through the meteor stage and have fallen to the ground. The various species of meteorites that have been recovered by collectors can be lined up with rather pure nickel-iron content at one end of the row and grading into stones at the other end with only a trace of nickel-iron. This grading of the meteorites tempts one to think of them as a continuum. If one wishes to separate these meteorites into primaries and secondaries, one is puzzled as to just where to draw the dividing line and say all before this point are primaries; all after it, are secondaries.

Two theories have taken domi- One, have usually been considered nance in the field of meteoritics: to be primordial in origin, being the leftovers after the planets and satellites were made. Another theory regards them as fragments of a fractured planet or planets which originally orbited in the region of the asteroid ring.

Most of us have a great deal of respect for established theories on how things came about, but we also believe that a healthy honest doubt should be kept alive and alternative ideas should be considered. More thought could be given to the possibility that a large percentage of stone meteorites may have originated as secondaries from the Earth-Moon system. By this we mean that large nickel-iron primaries slamming into the Earth or Moon could have exploded fragments back into orbit around the Sun. These fragments of the Earth or Moon as well as fragments of the primaries that went back into orbit would be considered secondaries.

An object in orbit around the Sun travels in an ellipse in a single plane. The intersection of this plane with the plane of the Earth's orbit is a straight line which includes the ascending node, the Sun, and the descending node. Part of the object's orbit is above the plane of the Earth's orbit, and part is below.

Since the planes of secondary meteorites would tend to have high angles of incidence with respect to the plane of the Earth's orbit, otherwise known as the ecliptic plane, they would tend to ride in very stable orbits with a nodal point, or point of intersection with the ecliptic plane near their site of origin. Most of their course would be far from the perturbations by other planets.

The net result is that if a secondary should ever have a collision, it is most likely to collide with the planet or satellite from which it came. Since the Earth and Moon occupy essentially the same orbital space, secondaries from either would probably fall on one or the other.

If the primary should chance to fall directly on the equator of the target with respect to the ecliptic plane, the secondaries would follow

orbits nearly in the ecliptic plane. There they would be subject to perturbations by other planets and return to the target area would be less likely. From this thought has been developed a theory of panspermia. (See Analog, June, 1962.)

This speculation concerning the origin of secondary meteorites is not without some support, if one considers the following line of reasoning:

If a large enough primary struck the Earth or Moon and splashed secondaries into orbit, they would start out in a shotgun like cluster. If the primaries have a greater tendency to strike the dark morning side of the Earth, the secondaries would start away from the Sun in an orbit more normal to the surface of the target. Each fragment would follow similar but separate orbits which would focus at the nodal point of origin. For a time, nearly all the fragments would pass through the nodal point at nearly the same time. As time goes on, however, due to slight differences in the speeds of the particles, they would change their timing until they passed through their nodal point of origin almost continually. This continuous phase would later be replaced by a phase of regrouping as their time in orbit approached a common denominator for all the orbital periods.

In the case of the clustered secondaries the Earth would intercept the cluster only when the Earth's period of revolution had a common denominator in number of years with the period of revolution of the cluster. Under the condition that the secondaries are passing through the nodal point of origin continuously, the Earth would tend to intercept the meteorites nearly every year.

The orbit of the secondary meteorites would be direct. The 29 kilometer per second direct motion of the target would be imparted to them almost regardless of their direction of takeoff. Furthermore, the secondaries would tend to intercept the Earth by overtaking it on the light afternoon side.

What was first thought to be weak, but nonetheless sophisticated, evidence has been presented by Harrison Brown and Irene Goddard who took the data on five hundred twenty-six observed meteorite falls and punched them on machine processing data cards. The calculator then affirmed that the usual time of fall was indeed on the light afternoon side of the Earth. The calculator then dismissed any ideas of weakness in its conclusions by including a bit of information which the authors admittedly did not understand. Once one takes note of this detail, one cannot but escalate his respect for the machine's reliability. This small, but important, fact reported by the machine was that the meteorite strikes tended to be every 364.46 or 366.10 days in-

stead of 363.24 solar days that it takes the Earth to orbit the Sun.

This apparent discrepancy of 0.78 on the approaching side and 0.86 on the retreating side is possibly due to a gravitational lens effect not unlike the magnetic lens of the electron microscope, only that the gravitational lens disperses the particles instead of converging them. The inverse square law of a gravitational field does not form a single focus but rather an imperfect retrograde binodal focus through which the meteorites would pass on their next turn around the Sun. On the Earth's approaching side the node is crowded and on the retreating side it is stretched.

The machine detected evidence of five separate orbital paths, two of them with meteoroids in clusters. The other three were of the type where the meteoroids are more evenly spaced around their orbits.

Unlike the stones, the irons do not contribute much to our argument. The observed falls of irons are too few; none of them have been large. They probably all are secondary fragments of the primaries and fall on the light afternoon side.

If these secondaries, irons and stones, are misinterpreted as mill-ends from the construction of the solar system, they would be placed in the Earth's exogenous instead of the indigenous column in the determination of cosmic abundances.

Whatever one's feelings for this subject, one must realize that there *are* secondary meteorites, and a collision of only a moderate sized primary with a small satellite would scatter many fragments into orbit. The problem is: of the 1,500 stone meteorites we have recovered, what percentage are secondaries? Is it a fraction of one per cent as most would like to believe, or is it nearly one hundred per cent as others suggest? In either case are 1,500 samples adequate to determine cosmic abundances for the solar system? I mean, even if they all had been carefully analyzed instead of just a few hundred as the true case happens to be. Thank goodness, none of the secondaries seems to have come from an area like Franklin, New Jersey with its high zinc content; or such places as Climax, Colorado with its molybdenum; or Almaden, Spain with its mercury. No mining company would make an investment on the basis of so few test drillcores! The scientific community, however, has made a tremendous intellectual investment in what may have been an ill-begotten concept that all meteorites are primordial!

The rapidly increasing number of stone meteorites that are found to contain fossil hydrocarbons which identically match in composition and distribution the fossil hydrocarbons found in ancient rocks of the Earth is very friendly to the argument for a large percentage of secondaries from this Earth.

The known and factual parameters upon which this theory, or any theory, on the origin of meteorites can be based are so scattered that many subjects must be studied to bridge the gap. The problem is to find a theory that will unify all these facts, and not need a major revision each time something new is outlined. To this test the theory on secondary meteorites seems to stand up. To this test it will continue to be subjected. It is an alternative, and the field is not closed. Authorities hold major objections to it, but no less important are the objections to the other theories. If the meteorites are primordial, how is it that they contain hydrocarbons which so closely mimic biological hydrocarbons on this Earth? If the meteorites come from a break up of a planet in the asteroid ring, how is it that they appear to be grouped in well defined orbits? To all objections there are partial answers. The continued search for answers is a valid cause.

The science of meteoritics must be brought into proper perspective. If, as we think, nearly all of the stone meteorites are secondaries, then the scientists may have inadvertently fallen into a modern type of entrail reading: cutting open and looking into cosmoliths for the secrets of the universe. Currently, the entrails of meteorites are fundamental in the estimation of cosmic abundances.

Meteorites are also the isochron for lead isotopes in the determination of the Earth's age and the age of the solar system. Scientists have been assuming that meteorites are closed systems: "Little planets formed at the same time as the Earth." The lead isotope ratios in meteorites are considered to be the ultimate. Stones that contain lead isotope ratios higher than those found in meteorites are labeled anomalous and their age determinations are discarded.

Metamorphic rocks recently discovered to have lead isotope ages of 4.5 billion years are little comfort to anyone, for this requires a remodeling of the Sun and recalculating its time table. On the present time scale the Sun would have been too cold 4.5 billion years ago to awaken the metamorphic forces on Earth from their frozen stillness. Dr. Dietz has been heard to say: "Every day the Earth grows a million years older."

The ratios of uranium and thorium to lead isotopes in meteorites are considered to be the proper relationship of these isotopes and have been used in determining the rates of degeneration of uranium and thorium. In some cases work by scientists on lead isotopes has been discredited when it was found that their results did not coincide with current measurements in meteorites.

In discussions of the thermal history of the Earth frequent reference is made to the value of radioactive heat generation of chondrites

pegged at 1.6×10^{-7} joules/gm./yr. This figure is very handy, but would be quite a monkey on the back of science if its significance has been misinterpreted.

Other scientists have calculated elemental and isotope abundances on the basis of the nuclear theory, developing the "r" and "s" processes to obtain their results. These were only accepted after a finagle factor of 0.4 was introduced to bring them into line with observed abundances in meteorites.

Cracks have developed in the facade of confidence covering the primordial theory of the nature of meteorites.

Dr. Harold C. Urey, himself, has pointed out that the ratio of iron to silicon in meteorites is much higher than can be calculated from spectrograms of the Sun and stars. This same ratio is certainly much higher than can be detected in the Earth's crust.

Further aberrations have been detected in the spectrograms of stars. Zirconium has been found in excess abundance in S type stars. Titanium is unusually prominent in M type stars. Technitium, once thought to be only man made, has been detected in the spectra of S, M, and N type stars. Elemental abundances on planets around these stars might appear quite bizarre to us.

Furthermore, if most stone meteorites are secondaries, then they are being studied from the wrong point of view. Instead of studying them to discern the history of the universe, they should be studied from the more practical standpoint of what happens to various materials under tremendous shock and pressure.

As yet few things we know about meteorites have been so practical as a nickel mine in Canada. Perhaps some reorientation of our thoughts with regard to meteorites will lead to other practical applications.

ACKNOWLEDGMENTS: I wish to acknowledge the dialogues with Warren Meinschein, Robert Dietz, and Alexander Knoll in which criticisms and material contributed much to this paper.

REFERENCES:

*Bjork, R. L.: Analysis of the formation of Meteor Crater, Arizona, a preliminary report. *Journal of Geophysical Research,* Vol. 66, #10, Oct. 1961

*Brown, Harrison; Goddard, Irene: A study of some nonrandom aspects of the frequency of meteorite falls. *Isotopic and Cosmic Chemistry,* North-Holland Pub. Co., Amsterdam, 1964.

*Dietz, R. S.: Sudbury structure as an astrobleme, the *Journal of Geology,* Vol. 72, #4, July 1964.

*Donn, William; Donn, Bertram; Valentine, Wilbur: Oldest rocks suggest greater age of the Earth. *Geological Society of Am. Bul.* (76:287)

*Innes, M. J. S.: The use of gravity methods to study the underground structure and impact energy of meteorite craters. *Journal of Geophysical Research,* Vol. LXVI, #7, July 1961

*Johnson, George; Talbot, Richard: A theoretical study of the shock wave origin of shatter-cones, Air Force Institute of Technology, School of Engineering, Wright-Paterson Air Force Base, Ohio, August, 1964.

*Meinschein, Warren; Barghoorn, Elso; Schopf, J. W.: Aspects of the geology, organic geochemistry and paleontology of a Precambrian shale. Esso Research and Engineering Co. 1965

*Merrihue, Craig: Excess xenon 129 in chondrules from the Bruderhein meteorite. *Journal of Geophysical Research* 68;325 1963

*Shoemaker, Eugene: Impact mechanics at Meteor Crater, Arizona, prepared on behalf of U.S. Atomic Energy Commission July, 1959

*Walter, Louis: Coesite discovered in tektites. *Science,* February 26, 1965, Vol. 147, No. 3661, Pgs. 1029-1032.

TITANIUM — THE WONDER METAL

That titanium had magnificent properties for a structural metal was obvious from its low density (4.5 vs. 7.8 for iron and 2.8 for aluminum) high tensile strength—about equal to that of stainless steel, twice that of the best aluminum alloys. Moreover, titanium retained that high strength at temperatures where aluminum was a puddle, and under oxidizing conditions where iron would have burned away. Titanium is enormously plentiful—the ninth most plentiful of all elements in Earth's crust, and fourth most plentiful metal. Only iron is both a useful structural metal and more plentiful.

It was, in consequence, being billed as "the wonder metal" shortly after WWII—but in the last decade, it's been more a case of "Wonder what happened to the metal?"

Several things caused trouble; it's plentiful as an ore, without doubt. But winning the metal as a solid, ductile metal from that oxide ore is not quite so simple as is the case with copper, iron, nickel, and more familiar metals. Titanium is a "reactive metal," which means, in part, that handling instructions include the statement that, if it does start burning, the thing to do is step out of the way and try to keep other things from starting. You can't stop the titanium. Ti is the one metal which, when burned in air, combines with the nitrogen as actively as it does with the oxygen; the "ashesa" are about 80% titanium nitride.

However, it isn't easy to start; it made fine turbine blades for use in jet engines, because it could run at the white-hot temperature of

the inside of a jet-engine indefinitely and hold its strength and shape.

What really killed the metal, however, were two factors: not even tungsten carbide tools could cut it economically, and if you try to make a machine with titanium running against titanium, it tears itself to pieces rapidly. The Ti metal "galls" badly—that is, if Ti is rubbing against Ti, minute projections on the surfaces actually weld on contact and tear loose chunks of metal as the parts move. This consumes power frantically, and rapidly tears the two metal surfaces to shreds. It would work all right in bronze or steel bearings. But, if bronze or steel would stand the conditions involved—they were both cheaper than titanium by a long shot—why use the Ti? The chemical industry wanted Ti because it will stand up to chloride corrosion, which stainless steel won't withstand appreciably better than plain iron. Ti matches platinum and iridium for chloride resistance! For pumping highly corrosive chloride solutions, the stuff would be wonderful—if it didn't insist on chewing itself to shreds. And didn't insist on tearing the edge off of every tool you tried to shape it with.

Its tool-chewing tendencies stem from a combination of characteristics. 1. It's a remarkably poor conductor of heat, for a metal. Even graphite is a better heat-conductor. 2. It's a highly reactive metal, when hot. 3. It has a high coefficient of friction, and oils don't help much. The combination meant that the cutting edge of the tool got hot, because of the high friction, got still hotter because the heat wasn't carried away—as it would be in steel, which conducts heat well—and raised the temperature very locally to a temperature where the Ti would react. Being so reactive a substance, it could take the carbon away from iron or tungsten . . . and the hardened steel became soft, hot iron, while the tungsten carbide became powdered particles of tungsten metal. It could ruin the edge of a tungsten carbide tool in one pass on the lathe. What it did to drill bits was a shame.

Titanium could be shaped economically only by casting—and that required vacuum casting, because of its savage hunger for oxygen and/or nitrogen; also hydrogen, water vapor, or carbon dioxide, monoxide, or hydrocarbon vapors. Any of which reduced the titanium to a brittle, fragile material.

The net result was that titanium, for all its unarguable potential as a structural material, simply couldn't be shaped economically. On top of which, some of the early titanium alloys, rushed onto the market a bit too rapidly, turned out to have highly undesirable aging properties. Massive one-inch titanium-alloy bolts suddenly showed up so weakened that they could be broken in a man's fingers, after aging for a year or two.

Things have happened since. At the time, the reason for the rapid ruination of tools wasn't understood; the fact was obvious, but the cause was most obscure. The aging trouble showed up just about the time manufacturers were becoming very thoroughly disgusted with the "wonder metal" because of its extremely cantankerous behavior. For many of them, that trick put the final straw on the hoodoo metal. Titanium sales hit a sudden and extreme collapse.

Most of the trouble stemmed from trying to do too much too fast. Stainless steel was, when it first appeared, almost equally cantankerous. It, too, ruined tools. It, too, galls severely when run as stainless-against-stainless. It, too, has nasty ways of behaving when machined; some of the best of the corrosion-resistant chemical industry steels, for instance, come near to being as rough on tools as titanium itself. Like titanium, some of the stainless alloys do not behave at all gracefully to being rolled, coined, upset or slit.

But those quirks of stainless steel men had grown up with, and learned to work with. The really sour iron-nickel-chromium-plus-other-elements alloys of stainless steel had been spotted and kept off the market, because the development program wasn't under such frantic pressure.

Gradually, titanium's worst problems have been worked out, as development continued at a more reasonable pace. The incomparable advantages of titanium as a chemical-industry material assured it of a steady market. Even if it was cantankerous and vicious to work with, its extreme lightness-per-strength and high-temperature resistance made it invaluable for supersonic aircraft. (Beryllium metal is far superior to titanium—lighter even than aluminum, somewhat stronger

even than titanium; with a melting point higher than that of steel, beryllium is unmatchable. It's also the metal whose principal ore is aquamarine, a semi-precious stone. It costs $75 a pound in metallic form, and is practicable only in such things as Minuteman missiles and space vehicles where every pound in orbit costs $10,000 or so.)

The tool-destroying characteristics of titanium were considerably tamed by the discovery that *flooding* the cutting area with water and an emulsified oil helped enormously. I've drilled titanium quite satisfactorily with standard high-speed steel drill bits in an ordinary drill press—by doing the drilling in a pan of water, with the titanium submerged. Titanium may not conduct heat, but water sure does.

The alloy problems have been worked out; there simply isn't any substitute for waiting . . . until someone comes up with a time machine.

Finally, General Electric Company—which was one of the original users of titanium in jet engines—has found the secret of lubricating the metal. And, in the process, found how to lubricate stainless steel, and a number of other hitherto galling metals.

The trick is astonishingly simple. All it takes is a little iodine in an oil-soluble carrier. The iodine attacks the exposed surface of the titanium (or stainless steel) and combines with any free metallic surface, forming a diiodide. Titanium diiodide forms laminar crystals that stack up on each other like the pages of a book—or like graphite crystals. The diiodide crystals are themselves a highly effective lubricant; aided by an ordinary good grade of oil, the gallin, extremely high friction, and overheating all abruptly cease.

As a cutting lubricant, this iodized oil makes ordinary machine tools carve titanium as readily as more familiar stainless steel alloys. (It's still a remarkably tough metal—but that's what you want, isn't it? If you want something soft and easy to work, try brass or aluminum.)

The problem with titanium wasn't half so much the titanium, as the ignorance. It *is* a wonder metal. The trouble was—"Wonder how to handle this new material?"

Now, they seem to have found most of the tricks. It should be showing up a lot more commonly.

Negative feedback is used by engineers to correct sloppy or undesirable performance—but to be effective, it must be prompt. And what prompt negative feedback could do in at least one industry . . . !

BY CHRISTOPHER ANVIL

TWO-WAY COMMUNICATION

Cartwright, April 16. The Cartwright Corporation, manufacturer of electrical specialties, is reported on the brink of ruin today, after a disastrous plunge into the communications field. Word is that Cartwright research scientists had developed a new type of radio receiver, that the corporation backed it heavily, and that the equipment has now proved to have a fatal flaw. It is reported that Nelson Ravagger, the well-known corporation "raider," has now seized control of the company. Ravagger is expected to oust Cyrus Cartwright, II, grandson of the corporation's founder.

Nelson Ravagger ground his cigarette into the ultramodern ashtray and looked Cyrus Cartwright, II, in the eye.

"When," Ravagger demanded, "did it finally dawn on you that you had a mess on your hands?"

Cartwright glared at Ravagger. "When you walked in that door and told me you had control of the company."

Ravagger smiled. "I'm not talking about that. I'm talking about this Cartwright Mark I Communicator. That's the cause of this trouble."

Cartwright said uncomfortably, "Yes—the communicator."

Ravagger nodded. "I'm listening."

"It dawned on us we had a mess," said Cartwright, "when the Mark I receiver broadcast through the microphone of the local radio station. Up to that time, the thing looked perfect."

Ravagger frowned. "What was that again?"

"The Mark I receiver," said Cartwright patiently, "broadcast through the local radio station's microphone. That's when we knew we were in trouble."

"The *receiver* broadcast through the microphone of the *transmitter?*"

"That's it," said Cartwright.

Ravagger looked at him in amazement. "How did that happen?"

Cartwright spread his hands. "It's a new principle. The circuit isn't a regenerative circuit. It's not a tuned R-F circuit. It's not a superhet. It's a . . . ah—Well, they call it a Cartwright circuit."

"Did you invent it?"

"I don't know anything about it. I took the Business Course in college. You know, economics, mathematics of finance, and so on. Management is all the same after you get to the higher levels."

Ravagger smiled at him wolfishly. "Let's get back to this communicator. You don't know anything about it?"

"Not technically. I could see, from a business viewpoint, that it could be a very good thing for us."

"Why?"

"Well, we *had* been selling to manufacturers. Quality switches, circuit breakers, things like that. What we needed was a broad approach to the consumer himself. That's a much bigger and less demanding market."

Ravagger lit up another cigarette and studied Cartwright with a look of cynical disbelief. "In other words, the quality of your product had been falling off, and sales were going down, so you figured you better get into something else?"

Cartwright squirmed. "Well, competition was getting pretty stiff."

"So you decided to turn out this communicator. All right, what was *it* supposed to do?"

"It is an all-purpose communicator. You have AM, FM, shortwave, longwave—*everything*—all in one package."

Ravagger showed no enthusiasm.

"In other words, a luxury receiver. I suppose it was portable?"

"Oh, yes." Cartwright got a little excited. "We were going to turn it out in a nice leather case, with three colors of trim."

"Naturally. And, of course, with an antenna you can pull out three feet long." He added sarcastically, "You were really going to skim the cream off the market with this thing. There must be a dozen different makes out right now."

Cartwright shrugged, "No antenna. It didn't need one. Besides, in a shirt-pocket radio, an antenna that pulls out seems to me to be a nuisance. If you've *got* to have it, then you're stuck with it, of course. But we were going to advertise that ours didn't *need* an external antenna."

Ravagger blinked. "Shirt-pocket size, eh? And it worked?"

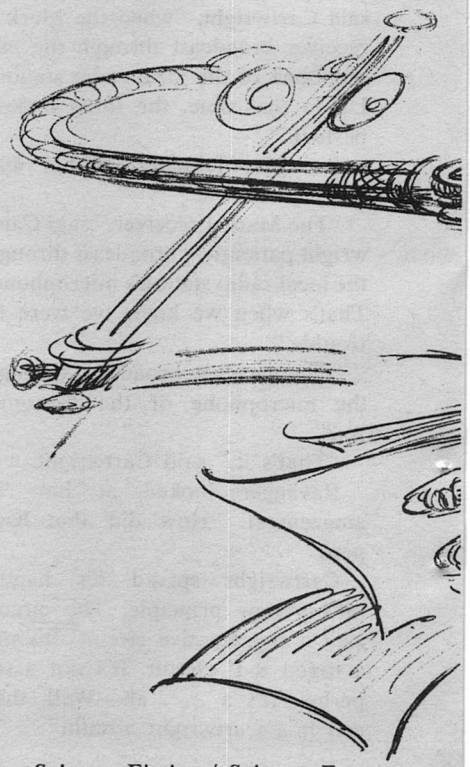
"Except for the little shortcoming I just mentioned."

"This thing was to be called a Cartwright Mark I *Communicator.* Why not just Mark I *radio,* or *receiver?* Why *communicator?* Just because the name sounded good?"

"It sounded good to us at first. That was our original reason. Then we got a bright idea. Why not build it so it could really *be* a communicator? You know, two-way. Then we could turn out a citizen's band set, and a walkie-talkie. It could be everything. An all-purpose communicator. If it's broadcast, this could pick it up. Longwave, shortwave, amateur, police, the sound from TV programs, AM, FM, foreign, domestic—" Cartwright ran out of words, and took a deep breath. "It was an all-purpose, universal communicator that would—"

"Wait a minute." Ravagger was staring at him. "All this in a *shirt-pocket radio?*"

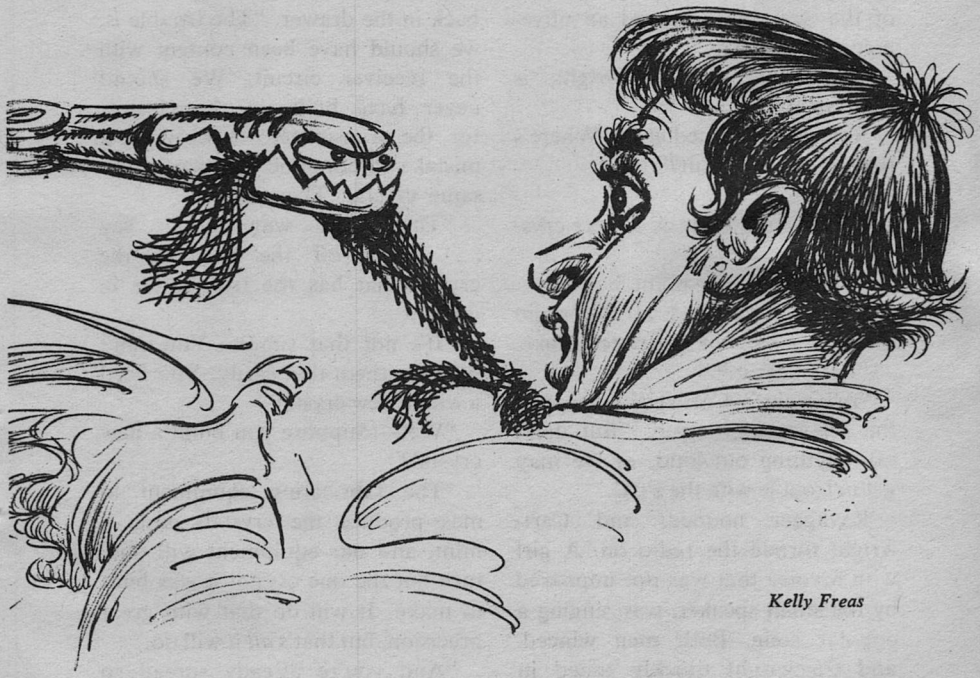
"Yes. Oh, there's no problem there. It's just a question of building it differently. If you consider it, it's *obvious* that eventually we'll have sets as small as that on the consumer market. Take a look inside the average portable receiver these days. Compare it with the size



of the sets ten years ago, twenty years ago, thirty years ago. We're moving toward very small sets. We —here at Cartwright, I mean— happened to get the principle for the next advance first, that's all. Now, to make a transmitter is admittedly more of a size problem, even with our new manufacturing process. But there was enough room in the case, and it could be done. So we thought, why not do it?"

"All right," said Ravagger, scowling. "Now, if I understand this correctly, what you're saying is that you had a shirt-pocket set that could receive AM, FM, and short-wave broadcasts, could transmit and receive on citizen's band, and—"

"No. It had the *potentiality,* if we chose to make the necessary connections, to use citizens' band. But we'd have to make connections to the right points on the unit crystal. This initial set was to be purely a receiver. Later, we'd bring out the Mark II, Mark III, and so on, which would be transmitter-receivers. And *still* shirt-pocket size. The point was, that for a few thousand bucks more on the fabricating equipment, and a few cents more



Kelly Freas

on each unit crystal, we could have the potential to raise the price twenty to forty dollars a set later on, and *still* give the customer a break."

Ravagger frowned at him. "What's this 'unit crystal'?"

Cartwright pulled open a drawer of his modernistic desk, and took out a small portable radio in dark-blue leather with gold trim, with a line of gold knobs down one side, and a tuning dial with so many bands that it covered the entire face of the radio. He unsnapped the back, took out the solitary penlight battery, pulled the little speaker out of the way, and exposed an olive-colored metal can.

"Inside that," said Cartwright, "is the crystal."

Ravagger squinted at it. "Where's the rest of the circuit?"

"That's it."

"The whole thing is in one crystal?"

"Sure. That's the point."

Ravagger scowled at the radio through a haze of cigarette smoke.

"Let's hear it."

"All right." Cartwright snapped the set together again. "But don't say anything out loud, or we may get in trouble with the FCC."

Ravagger nodded, and Cartwright turned the radio on. A girl with a voice that was not improved by the small speaker, was singing a popular song. Both men winced, and Cartwright quickly tuned in a recorded dance band, a news report, a voice talking rapidly in French, and then an amateur who was saying, ". . . Coming in very clear, but I didn't quite get your handle there . . ."

Ravagger said, "Do you mean to tell me—"

Cartwright said angrily, "Quiet!"

The radio said, "Wyatt? *Wait a minute!* I could have sworn—"

Cartwright snapped off the set. "I *told* you not to say anything!"

Ravagger stared at him. "You mean to say, this set will let you *talk to any station you can receive?*"

Cartwright took a deep breath, nodded glumly, and shoved the set back in the drawer. "The trouble is, we should have been content with the receiver circuit. We should never have built up the circuits for the transmitter. It was a big mistake to combine the two in the same crystal. They interact."

"There's no way to . . . say . . . break off the part of the crystal that has the transmitter in it?"

"It's not that simple. You can't separate them that easily. You need a whole new crystal."

"Well—Suppose you build a new crystal?"

"The fabricating equipment to mass-produce the crystals costs a mint, and our equipment will only turn out the one crystal it was built to make. It will do that with great precision, but that's *all* it will do."

"And you're already spread so

thin you can't afford to buy new equipment?"

"That's it."

"Hm-m-m." Ravagger leaned back. After contemplating the ceiling for a while, he sat up again with a bang. "Now, as I understand this, Cartwright, the broadcast . . . ah . . . the transmission *you* send out turns up at the broadcaster's *microphone*. Is that right?"

"That's right."

"How could *that* happen?"

Cartwright squirmed uneasily. "The boys in the Research Department have an explanation for it. It has something to do with the 'carrier wave.' Let's see, the crystal is energized by the carrier wave, resonates, transmits in precise congruity with the carrier wave, and then the mike at the transmitting station 'telephones' and the sound comes out. If you want me to get them up here—"

Ravagger waved his hand. "They know *why and how it happens*. But what I'm interested in is *what we can do with it*."

Cartwright said drearily, "I haven't thought of anything."

"It would make a good walkie-talkie."

"Only if it were a transmitter, too. To make it a transmitter would require another stage in the manufacturing process. As it is, it's *not* a transmitter—except in this one freakish way."

Ravagger frowned. "How many of these sets have you got?"

"We've got a warehouse full of them. Naturally, when we first tried them out, this never entered our heads. We only stumbled onto it by accident."

"Hm-m-m." Ravagger leaned back and looked thoughtfully at Cartwright. "If it hadn't been for this thing, you'd have been raking it in by the barrelful."

Cartwright brightened. "By the truckload. We could eventually get the cost of the whole set down to about nine dollars a unit. We could charge any price within reason."

"And nobody could have predicted this trouble?"

"At least, nobody *did* predict it."

"Yes, I see." Ravagger knocked the ash off the end of his cigarette, ground out the butt, and looked at Cartwright. Ravagger's expression was a peculiar blend of calculation and benevolence. "As long as I'm cleaning out fools who should never have been in charge of companies anyway, what do I care if they say I'm a pirate and pronounce my name 'ravager'? I'm performing a useful function. If I start cleaning out *first*-raters, I'm not doing any good. Now, you had a good setup here. You *should* have made money. You were smart to switch over to this portable set. No one could blame you. You made the right moves."

Cartwright looked dazed.

Ravagger leaned forward. "I'm not going to take over this company. I'm going to get you off the

hook. I aim to see to it that every one of these sets *and the fabricating equipment* are bought at your cost."

Cartwright was dumbfounded. "But—"

Ravagger waved his hand. "No buts. My job here is to get you off the hook. I'll profit, you'll profit, the stockholders will profit, and the whole country will profit. This situation has possibilities."

For an instant, Cartwright seemed to see a halo around the financial pirate's head.

"Anything you say," said Cartwright gratefully.

Cartwright, May 5. Cyrus Cartwright, II, president of the Cartwright Corporation and grandson of the corporation's founder, today beat off a formidable attempt by business buccaneer Nelson Ravagger to gain control of the company.

The Corporation had been rumored to be in serious difficulties, due to failure of a revolutionary manufacturing process. But Cyrus Cartwright today revealed the sale of the entire stock of merchandise and related manufacturing equipment to Hyperdynamic Specialty Products, a recently-formed distributing firm.

New York, June 2. Trading on the Big Board was heavy today. Among the most active stocks was the Cartwright Corporation.

New York, June 4. An astonishing advertisement has been running for the past week in several leading New York papers.

This reporter visited the showroom mentioned in the ad yesterday, picked up one of the devices advertised, and spent a truly delightful evening at home.

The advertisement is as follows:

ARE YOU
SICK
OF
DULL
COMMERCIALS
?

Strike back at silly announcers with revolutionary device that enables *you* to talk to *them!* Introductory price of $29.99 for new Electronic Miracle. You can set it beside your radio or TV and blast moronic announcers and admaniacs to your heart's content. THEY WILL HEAR YOU! Haven't you suffered in silence long enough? Call at Hyperdynamic Showroom today!

New York, June 10. Rumors current for the past week were confirmed today by Harmon Lobcaw, president of NBS Radio, who admitted that "a serious situation has arisen in the broadcasting industry."

Mr. Lobcaw stated that voices have been heard, coming from microphones, accusing announcers of "stupidity, bad taste and a number of other things I don't care to repeat."

Mr. Lobcaw was unable to explain how this could be, but insisted that "It is a fact. Government action," he said, "is imperative."

New York, June 11. Saralee Boondog, popular singer, was removed from the NBS studio by ambulance today, and rushed to the hospital for treatment of shock. Cause of Miss Boondog's illness was "loud hisses and boos coming from the microphone" while she was singing the popular favorite, "Love You, Love You, Love You, Honey." Miss Boondog's manager has threatened to sue the person or persons responsible."

New York, June 11. The Nodor Antiperspirant Spray Co., Inc., has temporarily suspended its radio and TV commercials due to "abusive comments from the microphone, threatening the persons of the actors." A spokesman for the company warns that the company will seek damages.

New York, June 12. Hubert Bawker, veteran local disc jockey, abruptly announced his retirement today. Mr. Bawker refused to give any reason.

New York, June 12. Attempts to locate the whereabouts of a concern called Hyperdynamic Specialty Products, rumored to be distributing radio sets of unusual properties, have so far proved futile. The firm's showroom was vacated before police arrived.

Havana, June 14. Julio Del Barbe, Special Communications Commissar, today blasted "Yankee imperialism" in a lengthy speech, interrupted a number of times as Mr. Del Barbe smashed his microphone. Mr. Del Barbe, among other things, angrily accused "a cutthroat Yankee CIA cover agency called Hyperdynamic Specialty Products" of selling his organization a case of expensive "special electronics equipment," which blew up on arrival.

Moscow, June 18. The Soviet Government has delivered a stiff protest to Washington, charging that "voices with American accents" are interrupting Soviet news and cultural broadcasters, with comments from the microphone such as "Lies, all lies," and "Communism is the bunk." Moscow demands that these "crude provocations" cease at once.

Washington, June 19. At the same time as the Russian note was received here, word got around that an official of the Russian embassy here recently paid $2,500.00 for a portable back-talk radio set such as is sold on the black market here for about $50.00. The back-talker was reportedly flown to Moscow on the very fastest jet transportation available.

Washington, June 20. The President was interrupted several times last night by caustic comments from the microphone. The Russians are believed responsible.

New York, August 1. Harmon Lobcaw, president of NBS Radio, announced today the installation of a system of "remote live broadcasting" which "strains out" microphone back talk before it reaches the announcer. Mr. Lobcaw also said that there is now a "crying need for announcers," as an estimated four hundred have recently quit their jobs. Asked why they quit, Mr. Lobcaw said, "Their self-confidence was shattered."

Washington, August 2. Following several nasty comments from the microphone, Senator William Becker has summoned Cyrus Cartwright, II, to testify before his committee regarding the Cartwright Corporation's connection with the mushrooming sales of back-talk radio and TV devices. Mr. Cartwright has stated that he will appear, and has nothing to hide.

New York, August 3. The price of Cartwright Corporation stock plummeted today, as rumors spread that the Government is determined to punish the company.

Washington, August 8. Cyrus Cartwright, II, today won a clean bill of health from Senator William Becker's investigating committee. The committee is now looking for Nelson Ravagger, the well-known speculator and corporation-raider.

New York, August 9. Cartwright Corporation stock rose sharply today.

Washington, August 11. In a stormy, shouting session financier Nelson Ravagger defended himself against charges of Senator William Becker's committee that Ravagger is responsible for distributing radio-TV back-talk devices. Mr. Ravagger asserted that he had not purchased the devices, but that they had been sold to a firm run by his business associate, Skybo Halante. Mr. Halante is now being sought.

New York, August 11. Cartwright Corporation climbed to a new high as it was learned today that the corporation developed and is now selling the cheapest and most effective system for "filtering" back talk and "sorting and storing" it for program-improvement purposes. Development of this device was reportedly instigated by financier Nelson Ravagger, who has emerged as apparently the major Cartwright stockholder following a series of complex market operations reported to have netted him millions.

Washington, August 16. In a furious session before the Becker Backtalk-Investigating Committee, business-

man Cyrus Cartwright, II, and speculator Nelson Ravagger defended themselves against renewed charges of "mulcting the public, deceiving this committee, and attempting to destroy the communications industry in this country." Skybo Halante, Mr. Ravagger's long-sought business associate, appears to have evaporated into thin air. Grilled about this, Mr. Ravagger replied, "How should I know where he is? I'm not his chaperon." The search for Mr. Halante is continuing.

New York, August 17. Price of Cartwright Corporation stock fell sharply today as it was learned that damage suits totaling upwards of one billion dollars are to be brought against the corporation.

New York, August 19. Price of Cartwright Corporation stock rose sharply today as word was received of a fantastically cheap and effective Cartwright portable radio entirely free of back talk.

New York, August 22. The bottom fell out of Cartwright Corporation stock today as the rumor spread that the new-model portable radio produces back talk.

New York, August 24. Cartwright Corporation stock made a dramatic recovery and rose to an unprecedented high as the first of the new Cartwright portable receivers found their way into circulation today. The portables, extremely attractive and entirely free from back talk, are made to sell at a very reasonable price.

New York, August 25. Trading in Cartwright Corporation stock has been suspended, pending completion of an investigation to determine whether the recent sharp rises and falls have been due to behind-the-scenes manipulations. It has been rumored that speculator Nelson Ravagger and a small group of associates have made enormous profits from Cartwright's erratic behavior.

Washington, August 26. Cyrus Cartwright, II, was again called to the stand as the Becker Committee attempts to unravel the facts concerning the reported transfer of a huge quantity of back-talk radio sets from Cartwright Corporation, by way of Nelson Ravagger, to the still missing Skybo Halante. In a savage exchange, Senator Becker today called Mr. Cartwright a "bold-faced liar." Mr. Cartwright had just described the alleged circumstances surrounding the original sale of the back-talkers.

New York, September 25. Cartwright Corporation stock, following completion of the investigation into price-manipulation by insiders, continued to rise sharply this week, despite sporadic rumors that Nelson

Ravagger and associates are now unloading most—if not all—their holdings.

Washington, September 29. The Becker Committee has closed its investigation into the Cartwright Corporation back-talkers. Cyrus Cartwright, II, pale and drawn, grimly told reporters, "The last few months have been the most terrific experience in my life." Asked what he intended to do now that the investigation was over, Mr. Cartwright said, "Sleep."

Budapest, October 2. Officials here have admitted for the first time that back-talkers are in fairly common use. They refuse to call their use a problem, however, saying that, thanks to the devices, people "let off steam," and "sometimes we get good suggestions." Several announcers have been sacked because of pointed back-talk comments.

New York, October 4. Cyrus Cartwright, II, today announced that he was stepping down as active head of the Cartwright Corporation, though he will remain on the Board of Directors. Mr. Cartwright said he wished to "sort things over in my mind. I have the sensation that I have just stepped off a combined merry-go-round and Ferris wheel." Mr. Cartwright refused to criticize Mr. Ravagger, who is reputed to have effective control of the corporation.

New York, October 5. Wall Street opinion is divided as to whether Nelson Ravagger actually controls large holdings of Cartwright stock at the moment. "It depends," a well-known speculator is reported to have said, "on whether the stock goes up or down. If it skyrockets, it will turn out that Ravagger has a big chunk of it. If it falls through the floor, we'll know for sure that he dumped it some time ago. You can't keep up with that guy. You can only reconstruct things afterward." Trading in the stock continues at a high level.

Washington, October 6. A broadcast lecture by political economist Sero Kulf, on the "continuing iniquitous aspects of an unsocialized philosophy" was interrupted today by comments, getting through the filtered microphone, of "Crank," "Cretin," "What do *you* know about it?" and by Dr. Kulf's own replies, which unfortunately got through before the program was cut off the air. Stronger filtering systems are reported to be in production against bootleg back-talkers.

Washington, October 12. The uproar about back-talk radio sets seems to be gradually starting to die down. Senator William Becker remarked to reporters that "for the first time in fifteen years," he had listened to the radio the other day, and found it enjoyable. Mr. Becker feels that manufacturers are now

getting the word about the more offensive commercials, and that the new system of filtering and registering complaints has led many stations to cut down on too frequent advertising. "This mess may," said the senator, "prove to have its compensations."

New York, October 24. At a meeting of the Better Radio and TV Association, president Jack M. Straub today awarded the association's Distinguished Service Plaque to Cyrus Cartwright, II, and Nelson Ravagger, for "distinguished efforts which have resulted in vastly improving the dismal standard of radio and television broadcasting, by enabling listeners and viewers to record their actual feelings spontaneously and directly, rather than through the doubtful intermediary of sampling procedures."

Mr. Straub said that he will give an even bigger and better plaque to missing financier and reputed bootleg-manufacturer Skybo Halante, "if someone will locate him for us.

"Communication," Mr. Straub added, "generally needs to be two-way to be effective." ■

THE ANALYTICAL LABORATORY

FEBRUARY 1966

PLACE	STORY	AUTHOR	POINTS
1.	The Searcher	*James H. Schmitz*	1.37
2.	The Switcheroo Revisited	*Mack Reynolds*	2.71
3.	An Ornament to His Profession	*Charles L. Harness*	2.90
4.	Minds Meet	*Paul Ash*	3.06

THE EDITOR

Under the Wide and Starry Sky . . .

Sooner or later—human devising being what it inevitably is—one of the astronauts is going out, and one little thing is going to go wrong. And that's all it takes—one little thing . . . .

BY JOE POYER

Illustrated by Leo Summers

Jennings folded the top sheet of paper back over the clipboard and bent again to finish the form. The explosion sounded in his earphones like a sharp burst of static, then silence. Startled, he looked up, at the same time reaching for the transmit switch to MSC.

"Bob, what was that?" He waited for the reply, then, "Gemini Control, this is GT 9, we've got trouble."

He half stood in the cramped cockpit and reached over to latch down Wyart's right hand hatch. Seated again, he activated the rendezvous radar and anxiously watched the scope, ignoring for the moment, the questions pouring in from Gemini Control in Houston.

Jennings tried the intercom again, calling Wyart over and over. He glanced from radar to chronometer —two minutes had passed.

"Gemini Control, we've got trouble," he repeated. "I've lost Wyart on both radar and intercom."

The glowing radar screen continued its search. Jennings went on answering questions from MSC, almost absentmindedly as he peered first at the screen, then through the narrow port in front of his eyes. Angrily, he jerked open the hatch above his head and levered himself half out, realizing the futility of a visual search. But he could not bring himself to sit still doing nothing. He knew it would be almost impossible to see Wyart. He would be a glowing dot against the multicolored starfield. Jennings ducked back to peer at the radar screen, then out again to search the area where Wyart had been working. The casing of the Agena glittered sixty yards ahead but no sign of Wyart.

Below, Earth spread before him in a panorama of blues and greens. They were directly above the spattered dots of the Marshall Islands and the sun glowed in a long white blaze west of the islands across the mainland of China. He could hear the excited chatter between the Hawaii tracking stations and Houston. An aero-med was stringing terms together, but Jennings could not make out what he was saying over the many voices and the static.

The module began to roll under him, and swearing, he ducked back into his seat to switch to fly-by-wire. He sat hunched forward tensely, watching the scope complete two more sweeps. Then, reaching a decision, he unbuckled his safety harness and cut in on the jabbering below.

"Gemini Control, I am switching the module over to you. On fly-by-wire now and will remain in communication through the module." Before they could interrupt, he hurried on. "I'm going over to the Agena," and he cut the transmission and lifted himself out. He could imagine the consternation he was causing on the ground.

Jennings' feet swung up and he held onto the hatch coaming as he snapped the nylon safety line to the Gemini and oriented himself towards the Agena. He fired his reaction jet and drifted away from the module, stomach muscles momentarily tightening as he cleared the Gemini and swept out across the yawning chasm reaching to the Pacific one hundred eighty miles below. Ahead, the cylindrical Agena loomed until suddenly, he was too close to brake with the reaction jet. He landed heavily and bounced, but managed to snag a handhold. Breathing hard, he worked his way aft to the engine nozzle where Wyart had been working and paused to let his heart slow. Traces of mist on the faceplate vanished quickly as the oxygen flow sped up.

"No, I haven't found out what happened yet," he said shortly in reply to a query from Gemini Control. He heard loud voices arguing, then someone shouted "Shut up!"

Jennings had reached the stern and was swinging himself around the far side, when he saw Wyart's safety line, snapped off about twenty feet along its length. For a moment he thought he was going to vomit.

"Major Jennings?" a voice queried.

"Wait a minute," he said hoarsely. He reached out and pulled the line in. Its snap lock was still fastened to the Agena, but the far end was frayed, as if it had been ripped apart. He stared at the line a moment then his eyes were drawn in spite of himself to the depths at the end of the nylon rope.

"Who am I talking to?" he asked finally.

"This is Gilberth, NASA Program Director. We've shutdown all

transmission links except this one. Can you give us a status report yet?"

Jennings snorted. "Yeah. I've lost Wyart. I'm on the Agena and I've found his safety line. It's been snapped in half."

"Snapped in half!" Gilberth cried. "How the devil could that have happened?"

"How should I know. You people have the tapes. Play them back. I heard a loud noise and when I looked up he was gone."

Except for the rattling of static, there was silence on the other end of the distant communication link.

"Major Jennings . . ."

"Just a minute," Jennings muttered. He flipped the dark visor up and peered hard at the Agena's curving side.

"Gilberth, there's something here . . . yeah, wait. It looks as if something has taken a piece of metal out of the side of the Agena. There's a shallow scratch, almost . . ."

"A meteor, possibly . . ." Gilberth interrupted.

"Not likely. Just above it there's a hazy patch, wait . . . yes it rubs off. I'll bet it's frost."

"Frost, where would that have come from?"

"You've got me. Do you have anything on radar yet?"

"No, nothing."

"All right, I'm going back to the module." Jennings held the reaction gun a waist level and pushed the trigger forward. It spurted briefly and stopped. Disgusted, he let the empty gun drift away, drew his safety line taut and began pulling hand over hand away from the Agena.

The Gemini module was silhouetted directly against the Pacific, making it hard to see against the intense glare of the noon sun reflecting from the Pacific and he pulled the gold visor back down. Directly below, all details were lost in a shimmering halo of sunlight. Away toward the eastern horizon the water was a pale blue, spattered with local cloud cover. The west coast of North America was just coming into view. Even through the dark filter, the glare was intense, and the flashing beacon on the Gemini was almost lost. Shortly, Jennings had the bulk of the module between himself and the Pacific and he was able to flip up the dark visor. He paused momentarily to let his eyes readjust, then continued in and lowered himself back into the pilot's seat.

Jennings slumped down into the seat and snapped a single strap across his waist. The soft green glow of the radar screen was still empty except for the pulsing beacon of the Agena. Wyart's own beacon should be standing out on the screen large enough to be seen up to fifty miles.

Jennings sat staring at the screen, thousands of possibilities racing through his mind. Suddenly, he sat

up, swearing. Even the background chatter from the various tracking ranges to Houston stopped at his outburst. Ignoring them all, Jennings reached up and slammed his hatch shut and snapped his safety belts into place. The pulsing beacon of the Agena and its radar image were shadowing Wyart—what else? If that scratched and frosted patch on the Agena had anything to do with Wyart, it was on the far side of the hull from the Gemini.

While he was thinking, Jennings was pitching the Gemini to the left. He counted five seconds and fired the forward thrusters, shoving the module above the Agena. Almost immediately, a second blip appeared on the screen, separating from the Agena as the angle between the two vehicles widened.

"Gemini to MSC, I have a radar contact here, please acknowledge." Jennings, reaching through the bulkhead to the copilot's seat and grunting with effort, punched co-ordinates into the calculator. The readout on his panel began to flicker as the electronic numbers set up. *Range 8,640 feet and opening.*

"Wyart," he shouted into the suit intercom. "Wyart, answer me . . ."

Jennings reached for the extra safety lines, then stopped, swearing at himself for his panic. Wyart was over a mile away and as he watched, dumbfounded, the distance opened quickly. The readout showed Wyart dropping behind the module at twelve feet per second. Three minutes later he was ten thousand eight hundred feet behind. The readout comparing fuel and distance showed Wyart already well out of range of the last dregs of fuel in the Service Module's maneuvering tanks.

With an effort of concentration, Wyart looked at the gauge. The needle had passed the quarter mark and was skirting the red danger curve. The asphyxiation tab clipped to his ear was beginning to show a bright danger flush in the small mirror over his eye as the exhaled carbon dioxide mounted and was trapped in the suit. He struggled to clear his mind and forced himself to look at the stage spreading before his eyes to eternity. Eternity, a funny word . . . what was eternity?

The modified Gemini "E" suit that he wore carried enough oxygen for four hours. Wyart had no way of knowing how long he had been unconscious. The broken oxygen gauge needle trembled against the peg past the empty mark. At least there was some air remaining in the tanks.

He could feel the blood trickling down his thighs as the pain began to course up and down his back in needle-pointed thrusts. Something had slammed heavily against his back, ramming into his spine and he had blacked out.

A thick mist was filling his helmet. A thought struck him as funny

and suddenly he began to laugh, almost hysterically. The moisture from his breath and body was condensing in his spacesuit—it seemed a ghoulish race to see which way he would finally go . . . drown or suffocate. His lungs pumped spasmodically and his entire chest seemed to be on fire with pain that flickered through his body and into his brain.

His body had swung away from the intense light of the sun and the gold filter on his helmet served to accent the brilliant sharpness and color of the stars that relieved the black fabric of night. So deep and quiet, he thought—like looking over the side of a small boat into the clear, green depths around the Bahamas where he had loved to skindive. He could almost throw himself into the tunnel of blue-green waters. He wondered what stars were out there, what civilizations were rising and falling, which stars were being born and which were dying. He wondered if somewhere in space around one of those far distant stars, there was not someone else waiting for death. It occurred to him with a start, he would be the first human being to die in space. That was one small consolation anyway . . . the first of many astronauts to lose their lives so that—A brief burst of static shattered the stillness. Wyart jerked into full consciousness, his fog-shrouded mind protesting the interference. Better to die in peace than listen to that racket.

"Wyart, can you hear me? Do you read me Wyart?" Jennings' voice interrupted by static sounded from far down the tunnel.

"Wyart, answer me. You're not dead yet. Answer me." Dimly Wyart heard the voice again, the fog closing in to shroud his mind, to insulate his senses from his body. Jennings' voice smashed through the ascending static again, filtering through the gelatinous haze.

"Wyart, Wyart, hear me. You can't be dead yet."

"Jen," he said thickly, "I can hear you. Where are you?" Wyart still retained enough of his fast ebbing understanding to fumble with his oxygen pressure switches, trying to gain a little more of the precious fluid to clear his mind.

The switch turned easily, but the gentle, sibilant hissing did not change. The oxygen gauge needle still wavered on Empty, but Wyart, staring at it, decided dully that the gauge was broken and the regulator damaged. The static increased momentarily in his earphones, then Jennings' voice cut through again.

"Wyart, are you all right? Answer me . . ." Wyart tried to take a deep breath, striving to clear the fuzziness out of his mind.

"Jen . . . I don't know . . ." his mind began wandering off. He raised a hand as if to wipe his face.

"Wyart . . . what's the matter with you? Answer me."

"Something happened . . . I don't know what . . ." A jumble of

images floated through his mind. He gagged on the excess of carbon dioxide, gagged again and the universe spun until he seemed to be in a black, floating cloud of mushroom softness. Jennings' voice sounded somewhere in the cloud, far off and tinny and he opened his eyes.

"Wyart, can you hear me, do you understand what I am saying?" Jennings' voice was insistent.

"Yes," Wyart answered. Suddenly his mind was abnormally clear, as clear as if he were breathing fresh spring air from his native New England hills. He wondered somewhere in the depths of his mind if this was the final symptom of asphyxiation. He felt a curious lightness as if he had the energy to climb unaided to the stars. He let out a rebel warhoop and stretched the muscles of his arms and legs. All pain was gone, the mist was still there, but he did not notice it.

"Major Jennings, this is Gilberth. What's going on up there. Is that Wyart screaming?"

Jennings, listening to Wyart's screams worked faster with the computer, ignoring the questions. The answer produced a hot sinking feeling in the pit of his stomach.

"Gilberth," he said slowly, "I've located Wyart. He's injured and it sounds as if he's out of his head. According to my radar he's nearly four miles behind and opening fast."

"Can you . . ." The rest was lost in a burst of static.

"Gilberth, please repeat message."

"Can you reach him from where you are?"

"No. I've got less than two per cent fuel left and I need close to three hundred feet per second to get to him."

"Do you have any idea what happened? How the devil did he get out there?"

Jennings' face was haggard in the soft glow from the instrument console and black with two weeks heavy growth of beard. His teeth felt gummy and his mouth like the inside of a moldy cotton bale. He watched the radar screen, seeing Wyart draw farther away with each second. Various possibilities occurred to him and he discarded each just as quickly.

"Just a minute," Gilberth said, his voice roaring over the VHF radio. "Here's the result of the tape analysis." Jennings could hear the rustle of paper, then Gilberth's voice was back.

"They think there was some kind of explosion. The tapes show a sharp noise picked up by Wyart's microphone, a scream of pain, a hissing noise almost obscured by the scream, then silence except for the slight gurgling noise when the static is low. So they suspect, that although the LSS is working, the oxygen pressure is extremely low. This rules out an explosion of one of his oxygen tanks and indicates that perhaps his regulator is damaged."

Jennings listened in silence, then

interrupted to ask about the biomedical sensors attached to Wyart's body.

"We aren't receiving any input from there at all since the explosion, if that's what it was. In fact, it rather makes us think that in some way, the reaction jet was responsible. The transmitter link to the module is mounted on the back pack directly above the jet."

"Well," Jennings said with heavy finality, "we know that he's alive, or that he was up to two minutes ago. The question is, how do we get him back?"

"That we are already working on. There is no chance of getting another Titan booster and Gemini ready and they haven't even begun the countdown on the third Apollo-Saturn shot yet. We have a call into Moscow to see if there is anything they can do, but our Intelligence says they have nothing near enough ready to be of any use."

"All right," Jennings shouted. "Let's quit playing around and get going here. We can't just let him die out there." Jennings overrode Gilberth's attempted interruption and kept on shouting, then caught himself and sat back, forcing his body to relax.

Gilberth said something soothing which Jennings did not hear and signed off. He realized that Jennings was nearing the ragged edge. Two weeks sitting cramped into the tiny Gemini module, working at a forced rate and living in the close confines of a full pressure suit, only to have his best friend and copilot facing a slow and horrible death only hours from the end of the mission . . . Gilberth flipped the off-switch and with a troubled face, turned to his crew in the quiet control room and ordered them to get cracking.

Jennings' thoughts were following much of the same lines as he watched the blip that was Wyart receding at a slow but steady rate. Looking through the narrow port only inches from his face, the full hostility of space gripped him for the first time. This was his second trip and he had spent a total of four hundred and fifty hours so far in space, longer than anyone else. Eight of those hours were outside the spacecraft and its relative safety, working in a full pressure suit with only the thin nylon line and the reaction jet to tie him to Earth. He had never really thought of space as hostile, but more as an entirely different environment where you could move and work with relative ease and minimum resistance, once you had learned its ground rules.

This second flight involved extensive rendezvous maneuvers with the Agena. For hours they had wandered around the parameters set by the flight plan, changing orbits by as much as fifty miles vertically. They were also testing a new simplified reaction-jet maneuvering unit mounted on the back pack.

Jennings had been performing some last minute checks on the Agena and Wyart was putting the unit through its last set of paces after they had detached the nearly empty vehicle, when . . .

Jennings sat up, his daydreaming suddenly gone. Of course. He scrambled for the log and flipped back through the heavy pages. Ideas formed so quickly in his head that he almost panicked. He called MSC and got on to Gilberth to outline his plan.

The Agena might still have enough fuel left to get him close to Wyart. He was sure of it. The only hitch was getting the Gemini mated to the Agena again. His fuel load was so low that only enough remained for minor steering corrections before he would have to begin cutting into his retrorocket supply. If that happened, then oxygen and food would have run out long before their orbit decayed enough for reentry.

He thought furiously as he set up his calculations, feeding the equations to Gilberth for checking at Marshall.

The results showed that he could come within four thousand feet of Wyart before the Agena tanks went dry. If he took the chance and used part of the retrorocket supply, he could cut the distance to close to three hundred feet—that was stretching it—and no more. But he would have to uncouple the Agena; and Wyart might well pass him by before he finished. Frustrated and angry, he slammed his fist onto the console, then set about rechecking his calculations, searching for some method.

He examined his orbit in relation to Wyart's as projected by the computer, calculating again the fuel needed to boost him that extra four thousand feet. Eighteen minutes had passed since Wyart's screams tore through his earphones. He was now three quarters of the way across the southern United States at the high point of this pass.

At the farthest distance Wyart would reach from the module, sixty-four miles would separate them. Their respective velocities were now 138,270,588 and 137,795,834.-88 ft/per sec. But Jennings' calculations showed that Wyart's orbit was less elliptical and would almost intersect with the module's orbit at two points, directly opposite, but still some three miles would separate them. He could bring the Gemini's orbital period to ninety-six minutes to almost match Wyart's ninety-seven minute orbit—which meant a difference of seven feet per second velocity. Wyart's orbit was about a minute slower and the Gemini would reach the intersect point about fifty-three seconds ahead of Wyart—a distance of 371 feet per second.

It could be done if he could couple the Agena to the Gemini, then uncouple again, but the remaining

fuel in the Gemini would allow only the barest rendezvous maneuvers with the Agena.

His breath caught in his throat. The tension was building up so quickly that his movements were becoming jerky, uncoordinated. He shook his head angrily and pounded the armrest with his fist to relieve the strain. There were just too many things against them. Still the figures showed the gap of 371 feet. He tried to raise Wyart again, tried again and again.

"Wyart do you read me?" He listened for a moment, then repeated. He heard a choked murmur, then Wyart's voice, slow and muffled. His words were slurred horribly as he answered.

"Jen, help me . . . I can't breathe . . ." The hoarse gasping sliced into Jennings' mind. Wyart's breathing was magnified by the microphone and static into a raucous, tearing sound as if his lungs were shredded and torn, but still fighting to pump oxygen into the blood.

"My oxygen system shot . . . air almost . . . gone . . . pressure less than . . . pound . . . can hardly breathe . . ."

"Wyart, listen to me," Jennings shouted, speaking slowly and distinctly to make him understand.

"Turn on your emergency oxy pack, first of all. I think we've got a way to get to you. You are behind and below me. Before we finish another orbit, I'll pass close enough to you to be able to reach you. Can you hold out for another forty minutes?"

Jennings repeated the message, then waited for Wyart's reply. A full minute went by and he was beginning to lose hope when Wyart's voice slightly stronger, came through.

"I understand you Jen . . . I've switched to my emergency oxygen pack . . . using it in short bursts. I don't know how long . . . " his voice was broken by static and faded. Jennings tried furiously to reestablish contact. The radar showed Wyart nearly ten miles behind.

He reported in to Gilberth that Wyart was still alive but that he had lost contact.

"Your figures come out," Gilberth said. Jennings could feel the tiredness in his voice and suddenly felt sorry for the man. "Your big problem is still getting the Gemini and the Agena mated. How do you intend to do that?"

"I'm not sure if what I have in mind will work, but I've got about thirty-five minutes to find out."

Jennings examined the Agena's blip on the screen. Approximately two hundred feet now separated the two vehicles.

He could see its striped bulk, painted fluorescent red and white with the two strobe beacons on either end. It was rolling slowly, about one revolution every thirty seconds. The sunlight flashed on its steel nozzle momentarily.

Gingerly, ignoring the radar, he aligned the module with the Agena, using the steering rockets so that the Gemini module was pointing at the center of the rolling craft. Then opening the hatch, he scrambled out with two long safety lines, both of which he tied to the recessed parachute shroud guide in the center of the nose. Jennings made sure his safety line was fastened securely, then flexing his knees, he jumped straight out for the Agena. He let the two nylon lines pull along behind while he braked himself with his own.

Jennings wished heartily that he could get at his face to wipe the sweat out of his eyes. The suit temperature was approaching 88° F. He turned the oxygen pressure up but the relief it brought was short lived. He had only another fifteen minutes or so and his twelve minute reserve. Jennings cut the pressure down again and the temperature shot back up quickly.

The Agena had turned so that he was now almost on the other side from the Gemini. He ran the two safety lines through the handhold and snugged them up tight, praying that his improvised winch would work. As the Agena rotated, the two vehicles would draw toward each other. Once the module and the Agena began to close, he planned to cut the line and use the steering jets to maneuver into a normal docking.

Jennings worked himself around to the top of the Agena where he could watch the line come in. Already there was one complete turn of rope wound round the Agena. He put a gloved hand down to feel the doubled line, rigid as a steel bar as it drew the seven thousand pound vehicle in. Jennings waited for a few minutes until he judged the Agena to be moving steadily. The spacecraft moved so slowly that it was hard to tell how fast it was closing. The featureless void, with no frames of reference made it almost impossible to judge distance or relative speed.

He grasped the rope and pulled, letting his hand slide along until he was able to swing his feet down on the nose of the Gemini. He waited as the Agena drew nearer, trying to get an idea of its forward speed relative to the Agena. Four minutes went by and he realized with a start that he was nearer than he had thought. Quickly Jennings cut the two lines with his screwdriver knife and clambered into the cockpit. He did not waste time closing the hatch but examined the radar. Less than thirty feet separated the two vehicles. The Gemini showed on his analog simulator as moving into the final maneuvering zone. He grabbed the control stick and fired a short burst with his port side steering rockets that yawed him around until he was closing on the nose of the Agena and the basket-socket. Riding the control stick with short bursts, he lined up as quickly as pos-

sible. The Gemini moved inexorably closer, too fast for a safe docking. Swearing, he fired a brief burst from the nose rockets lowering his forward motion from five feet per second to two and a half—still too fast. The nose of the Gemini was offset and he fired a quick burst to center it, braking again violently.

He glanced up quickly and the rocket in the Agena yawned at him. The nose swung past center to the right, caught the edge of the steel basket, slammed around, carooming off the other side and smashed into the socket.

Jennings was thrown forward into the control panel and the open hatch slammed down, clouting the back of his helmet.

Jennings extricated his helmet and sat back. The chronometer showed fifteen minutes to contact. With a heartfelt groan he shoved open the hatch, hoping mightily that no damage had been done to the Gemini by the hard docking.

He lowered himself out and moved forward to make sure the two vehicles were secured by the electromagnetic clamps in the Agena.

Ten minutes later he had the shackles set and control lines locked up and was tentatively trying the controls. The mated vehicles moved in response and satisfied, he stopped before he wasted too much fuel.

Jennings put a call through to MSC and got Gilberth immediately. He was now moving up over the South China Sea and the hookup from Woomera was tinny and full of static.

He finished his explanations and waited through a strong burst of static, then Gilberth was wishing him luck. The Flight Control Officer gave him a countdown for firing sequence then he was alone again. He settled back to wait, the computer marking time soundlessly as the readout ticked down—three minutes, forty-three seconds to go.

Wyart woke slowly, disoriented. How much time had passed he did not know. His faceplate had misted again with exhalation. The pressure was too low for the exhaust vents to work properly. The interior details of his helmet were fuzzy, unseeable as the hypoxia mounted, affecting his sight, his nerve centers. He knew that he was less than half alive, did not know whether he was awake or dreaming. The pain in his chest had passed on across the threshold into higher realms and he no longer felt anything. His mind worked in fits and starts and a soundless roar filled his ears.

Wyart half sat, half crouched in the peculiar fetal position of the relaxed human body in free fall, half sitting, arms and legs bent, head forward. All sensation, except for the unidentifiable roar, gone from his body.

In a moment of awareness he set out to examine this non-noise, but

lost the thread . . . he drifted. Wyart became aware of a soft light that flooded his head. Darkness closed again. Later, years later, the light came again and he drifted through it until he was suffused, until his whole world became that pale gold light that filled his being and the cold foggy blackness that alternated.

He drifted . . .

A soft sigh passed, singing high in his mind, then again and Wyart heard it. Again the sigh, sharper, more pronounced. From somewhere he dragged a tiny fragment of consciousness, from the golden light perhaps, then another and the sigh resolved into a word, a name he struggled to hear. Later, the name again and he realized it was his own. He opened his eyes and consciousness crashed around him, disjointed, surf pounding, smashing, pinwheeling stars exploding and he was awake to hear his name. Blackness surrounded him and he whimpered.

"Wyart . . . Wyart answer me," the singing whispered . . . Wyart forced his lips, his tongue to shape a word. He identified the neutral patterns from the brain root to the tip of his tongue; they stood out blood red against the pastels of his nervous system. The computed path was there but nothing would flow, would not move. "Try again," his brain said, softly, "try again." He tried and his tongue moved, a sound issued, a long drawn out ahh . . . Once more, as the pattern began to fade and the sound came—"Jennings"—the golden light disappeared.

Jennings smashed at the coupling with the alloy wrench until it snapped. A short gush of fuel rushed out to vaporize instantly.

He scrambled back in as the two vehicles drifted apart. Feverishly he strapped down and armed the controls. Jennings pitched the module away quickly and recklessly fired the retrorockets. Two, three, four seconds, he fired, daring to stretch the precious reserves.

The rendezvous radar clicked away faster in his earphones as Wyart's slowly revolving body moved closer. His mind was filled with Wyart's only word, his name choked out as if he were drowning, a long drawn out gurgle of blood. He cut the retrorockets savagely and waited, tense, staring ahead, then angrily slammed the hatch open to stand on the seat.

Against the background of stars, one single speck moved. He fastened on it as if his eyes would be torn from their sockets rather than lose the tiny mote of light. He waited, his free hand opening and closing jerkily to relieve tension. He watched the radar readout, the distance was down to eight hundred yards, then six, then down to five hundred feet and the speck resolved itself into an undefined shape.

He waited no longer, not even to

check his line in his anxiety. More than three hundred feet would separate them. He had to be there waiting. He clutched an emergency bail-out bottle of oxygen and jumped straight out with all of the power in his legs, the snapped together safety lines running behind him. As the line ran out, he braked himself with his gloved hand until he was as dead in space as he could get at the end of the line, relative to the Gemini.

Minutes passed. His own oxygen gauge was nudging Empty. All he could do was hope that it would not run out too soon.

He could see Wyart now, unmoving and silent ahead of him about a hundred yards. He glanced back along his safety line, stretching straight out behind. The Gemini module had caught up and was beginning to draw him along as it passed. He had miscalculated and braked too soon. If the module got too far ahead of him, it would pull him down and behind Wyart.

Wyart was approaching him more swiftly now. He called to him again. Silence. Not even the sound of his breathing over the suit radio, only the rumbling of static.

He pointed the oxygen bottle and waited, his hand on the valve. Wyart was closer now and he cracked the valve and began moving out again from the module. Carefully, he opened the valve more. Twenty feet separated them, but he was moving too slowly. Wyart's body was passing beyond him. He opened the valve full, taking the kick of it in his stomach, not even feeling it. Wyart loomed and they slammed together. Jennings clutched at Wyart's helmet, missed and caught his fingers in the parachute harness. He had him!

An insistent buzzing filled his helmet, his oxygen alarm indicating empty tanks. He ignored it pulling Wyart along until he could reach out and grasp the lifeless hand. He drew Wyart to him, crying unashamedly, trying to brush the fogged faceplate clear.

Pulling himself together, he quickly plugged his own emergency unit into Wyart's helmet and twisted it on full. Then he turned Wyart around and saw the wreckage of the Life Support System. It had been the reaction jet as Gilberth had suggested. It had exploded, splitting apart its steel canister and rupturing an oxygen tank. Pieces of steel had ripped into the backpack, denting the second oxygen tank and cracking the fiberglass cover. The diaphragm regulator housing was dented inward and glazed with ice, probably jammed almost shut.

He tied Wyart to him with a length of line and without stopping to see if the emergency pack was having any effect, began pulling himself back along the four hundred foot line. His oxygen was exhausted and he was now breathing the wasteladen air trapped in the suit. His head seemed ready to ex-

plode in a welter of blood and he felt himself slipping into unconsciousness. Finally, he could stand it no longer and attached the emergency pack to his own helmet and filled his suit with fresh oxygen.

Jennings continued on, exerting all of his willpower to keep from fainting. The glowing stars beyond his visor swam sickeningly and the entire universe concentrated in the slender strand of nylon sliding slowly through his fingers. Jennings no longer had the strength to pull them along the line and so let his forward momentum carry them both on. His suit became an inferno, a breathless oven, constricting his chest and clamping a vise around his heart. The thin nylon line stretched into eternity. He was moving through a viscous liquid that shimmered before his eyes.

He forced his hand to tighten, his arm muscles to contract, but the feeble effort only served to slow them more. He dared not remove the oxygen hose from Wyart's helmet again. Then his hand touched something and his leg cracked painfully against the hatch.

Slowly, he lowered Wyart's body into the seat and slammed the hatch shut. Then he clambered blindly into his own seat, almost too exhausted to close his own hatch. He managed to get the hatches latched tight and sealed, though how he did, he never knew. Weakly, he leaned forward and tried to sort out the emergency pressurization switch from the jumble of lights and fog on the control panel.

Jennings watched the pressure indicator as he readied the oxygen mask and tank. Every movement was an effort requiring his total concentration. He could barely see and was moving in a murky fog that slowed his body until he was not sure that he was awake or asleep.

When the needle showed pressure, he cracked open his visor and sucked in great lungfuls of the cold, thin oxygen. Gradually, the dizziness began to leave him and he could make out his surroundings again. His first thought was for Wyart. He opened the misted visor and pressed the oxygen mask to the pale face. Then he reached through the support brace, awkwardly, to pump Wyart's chest as best he could through the deflated pressure suit.

Jennings watched the pressure indicator out of the corner of his eye as it passed the three point nine psi mark, the normal cabin pressure, to four, then five. At eight psi, twice normal, he stopped it. Three minutes had passed and still Wyart had not moved. In the combination of strong reading light and the light reflected from Earth, Wyart's skin and lips assumed a deep, greenish cast. Jennings could not make out even the barest flicker of a movement, could not even be sure that Wyart was still alive. He dared not take the time to remove his own glove to search for a pulse.

Desperately, he rummaged in the medicine kit with his free hand, batting various pieces of equipment out of the way and into the cabin, until he found the ampule of adrenalin. He tore the plastic wrapping off with his teeth . . . then hesitated a moment. He had planned to insert the needle into a vein in Wyart's wrist, but precious seconds would be wasted getting the sleeve off and the undergarment sleeve worked up. With a low, or nonexistent heartbeat the adrenalin would not get into the heart muscle from the extremity to do any good.

Jennings hesitated only a fraction of a second more. He let go the mask and reached through Wyart's visor, pushing his friend's head as far to one side of the helmet and down as far as possible. Then he shoved the needle into Wyart's neck, aiming at the jugular vein.

Wyart's face suddenly covered with sweat and a sick feeling shot through Jennings' stomach. Too much adrenalin could be fatal—would give the heart too severe a jolt. But it was Wyart's only chance. He had been too long without free oxygen in his blood and the osmotic pressures that made the lungs work—the exchanging of free oxygen through the cell walls for the waste carbon dioxide from the blood, pumped from the heart for purifying—would reverse, forcing water and carbon dioxide in the opposite direction. Wyart would literally drown as water formed in his lungs. Jennings hoped against hope that the combination of adrenalin to force the heart muscle to contract, the pumping of Wyart's chest, and the pure oxygen cabin atmosphere at eight psi would offset the carbon dioxide poisoning of the past eighty minutes or so. Coupled with the low barometric pressure to which Wyart had been subjected, Jennings wondered already whether it was not too late. Whatever the external barometric pressure, the body's internal pressure was some forty millimeters lower—Wyart's lungs might already be filled with water.

Jennings put the mask back to Wyart's mouth and nose and resumed pumping his chest. He continued for three minutes more before Wyart moved, moaned softly, and tried to roll his head away from the mask. Then he was breathing greedily, sucking the oxygen deep into his starved lungs. Shortly, Wyart opened his eyes and looked around. He caught sight of Jennings peering closely at him and the taut muscles of his face began to relax again.

He put his hand to the mask and grasped Jennings' hand weakly, holding it for a long moment, then took the mask.

Jennings sank back, exhausted, but elated. He flipped the communicator switch. Through the port, the Earth in full phase rolled by, swollen and glistening along the dawn line bisecting Lower California and the Pacific.

The dazzling blue of the ocean merged into the browns and greens of the California coast; the mountains and deserts beyond. In the deep shadow cast by the late afternoon sun, the scar of the Grand Canyon stood out in bold relief. To the north, the lush greens of the Colorado—Kansas midlands and the jagged peaks of the Rockies swelled and rose, seeming gentle from a hundred miles.

Jennings looked across at Wyart, slumped in his seat—like him staring greedily at home, but with more gratitude than he, Jennings, would ever know. Wyart's face was still deathly pale and his breathing was shallow and ragged—but he was alive. The back injury would have to wait for the ground.

Jennings touched the control stick, using the last burst of fuel left in the steering rockets to keep Earth centered in the view ports.

The crackling of the radio filled the cockpit and Jennings picked up the hand microphone.

"GT 9, go ahead MSC."

Gilberth answered immediately.

"This is Jennings. We have Wyart back aboard, alive but in serious condition . . ."

At first Jennings thought static was interrupting the transmission, and then he realized that it was cheering from the MSC Control Room.

"Cut us the fastest orbit home." He had to shout to make himself heard.

"And we're down on retro fuel, so make it good." He grinned at Wyart. "Next time you decide to go off on your own, let someone know where you are going, damn it." He laughed and the reaction set in, and he went on laughing because he knew that if he stopped it would be to cry. ■

GRIM THREAT

Plaque to be installed on all computers:

"I WILL DO WHAT YOU SAY."

The Alchemist

Since everybody knows-for-sure that alchemy doesn't work—just think of the fun an alchemist could have with unpatentable things nobody could duplicate—or even work, without his consent!

CHARLES L. HARNESS

Andrew Bleeker, research director of Hope Chemicals, had more than once referred to his laboratory as "the soap opera," "the sideshow," or "the country club." He took instant umbrage, however, if anyone else ventured any jesting synonyms for his group of some five hundred people in the cluster of red brick buildings at Camelot, Virginia. Ordinarily, therefore, he would have been mildly incensed when Conrad Patrick, the Hope patent director, stuck his head in the door and told him that a three-ring circus was about to start down in Silicon Compounds, with Pierre Celsus in the center ring. But the circumstances were not ordinary. For the past two days, at the request of the United States Government—who, the Chairman of the Board had bluntly reminded him, was Hope's biggest single customer—Bleeker had been turning the lab inside out for the benefit of Alexei Sasanov, Minister of Technology for the Peoples Republic, and for the past several hours had listened patiently to a comparison of decadent American chemical research and burgeoning socialistic research. The interruption offered a chance of respite, and his heart leaped. Nevertheless, appearances had to be maintained.

"What's Celsus up to?" he growled.

"He's going to try to start the silamine unit," said Patrick.

Bleeker's voice rose sharply. "Silicon Compounds has been trying to start that crazy thing for two months. I told them yesterday to junk the project. It's *dead*."

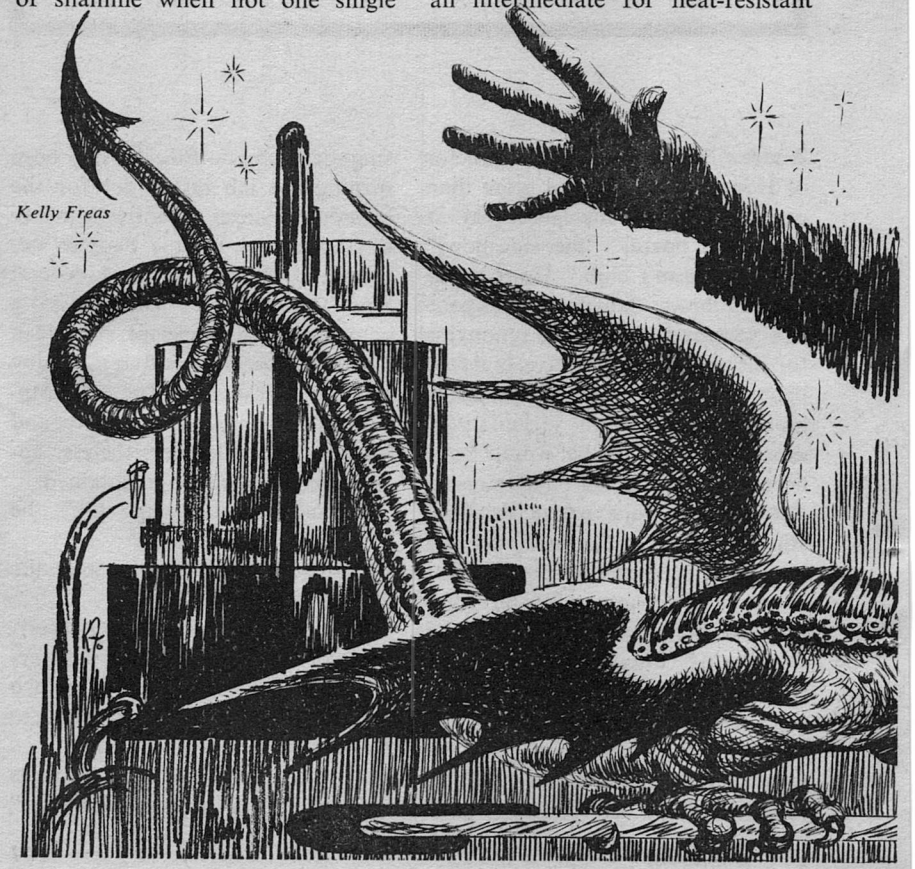
Patrick laughed. "Old projects never die. They just smell that way."

Bleeker snorted. "How does Celsus intend to do it?"

"He wants to try to synthesize *one* molecule of silamine in the reactor. He says the reaction should be autocatalytic and once seeded, the fluidizer will start making more silamine. There'll be a little picric acid in the receiver, which ought to throw down a yellow silamine picrate within seconds, if it works."

"But that's idiotic! How can he *seed* the reactor with one molecule of silamine when not one single molecule of silamine exists anywhere on earth?"

Bleeker's distinguished visitor spoke up. "I quite agree with Mr. Bleeker." On the face of a less complicated man, the faint smile that played briefly about Sasanov's mouth might have been interpreted as a sneer. "It is a technical impossibility. Our central laboratories in Czezhlo have spent hundreds of thousands of rubles attempting to synthesize silamine. We want it as an intermediate for heat-resistant



Kelly Freas

silicon polymers for missile coatings. We offered great incentives for success."

"And penalized failures?" murmured Bleeker.

Sasanov shrugged delicately. "The point is, where the most efficient, the most dedicated laboratory in the world has failed, it is hardly likely that a commercial American laboratory can succeed."

Patrick felt his red moustache bristling. He ignored the warning in Bleeker's eyes. "Would you care to make a small wager?"

Sasanov turned to Bleeker. "It is permitted?"

It was Bleeker's turn to shrug. "You have diplomatic immunity, Mr. Sasanov."

"So. A small wager then. If you make any silamine, the Peoples Republic will give Hope Chemicals a contract for a plant design, with a handsome running royalty for every pound of silamine we make."

"At twenty-five cents a pound," said Bleeker quickly.

Sasanov thought a moment. "Exorbitant, of course. But agreed."

"This will have to be approved by Hope management," said Bleeker carefully. "We've heard complaints, you know, about the . . . ah . . . slow royalty payments to other American firms who have designed plants for your country in the past."

Sasanov spread his hands expressively. "Vicious lies. Surely you trust the Peoples Republic?"

Bleeker coughed.

"This contract isn't much of a stake," objected Patrick. "That's between your government and the Hope corporation, not between you and me."

"Readily remedied," smiled Sasanov. "What is the classic consideration in your English common law? A peppercorn, isn't it? Well then, I offer the contract and a jug of vodka, to be sent direct to you here at the lab, if I lose."

"Against the rules," said Bleeker. "Spiritous liquors can't be brought into the lab."

"Make it sweet cider," said Patrick.

"Certainly, sweet cider," said Sasanov. "The best in the world. Cider from your Winchester apples is a poor thing in comparison."

Bleeker set his jaw. "All right, your stake is a contract and a jug of cider. What's *our* stake?"

"*Our* stake, Mr. Bleeker? I think Mr. Patrick suggested the wager. The matter is, therefore, between him and me. And Mr. Patrick can readily provide his stake."

"Such as what," demanded Patrick.

"Your desk."

"My . . . desk?" repeated Patrick stupidly.

"You don't have to do this, Con," said Bleeker quietly.

"Well, I don't know . . ." As Patrick considered the matter, his throat began to contract. His desk was a "rolltop," over a hundred years old, and one of the few remaining in the country that had never been used by Abraham Lincoln. It had caught his eye when browsing through the junk shops of Washington, and its entire pan-

orama of possibilities opened up to him instantly. He bought it on the spot. He himself had carefully removed the ancient peeling finish by dint of solvent, scraper, and sandpaper, and had then slowly refinished it over a period of months. Finally he had moved it to his office at the lab. The pigeonholes were semi-filled with rolled documents, bound with genuine red tape that his London patent associates had found for him. He had patinated the papers with a light layer of dust recovered from his vacuum cleaner. His intercom and dictating machine were installed in the side drawers and a tiny refrigerator in the lower left-hand cabinet. A kerosene reading lamp—converted to fluorescent in the Hope maintenance shop—sat on the upper deck of the desk, and a brass cuspidor gleamed in the lower right-hand cabinet. As a final touch, he had captured and imprisoned one small, bewildered spider, who, after a shrug of its arachnid shoulders, had gallantly garlanded a few of the more remote pigeonholes with sterile, dust-gathering strands.

For a time, Patrick's rolltop had been the talk of the lab; soon after its arrival dozens of people found it suddenly necessary to confer with Patrick on all kinds of patent problems. And now, even after the fine edge of novelty was gone, Hope people visiting from out of town still came in to see it. More importantly, as Patrick now realized with a chill, Comrade Sasanov, after his introduction to the patent director on the first day of his visit, had since dropped in to Patrick's office several times, for no apparent reason, and had stared thoughtfully at the desk.

There was no comparison in his desk and a jug of cider.

Still, a man had to have faith. And he had faith in Pierre Celsus.

"It's a bet," said Patrick.

The three men pushed their way through the spectators surrounding Pierre Celsus and the silamine setup.

Celsus, a slight nervous figure, largely hidden in an unlaundered lab coat, was evidently finishing up his preparations. He checked the fluidizer, which was a two-inch-diameter glass tube about one-third full of silica gel, then the Variac control on the resistance heater wound around the tube, then the ammonia inlet at the bottom of the fluidizer, then the glassware leading to the condenser—a two-neck glass flask venting to the hood. Finally he turned on the ammonia pre-heater and slowly opened the flow meter. The silica gel in the column shuddered slightly as a "bubble" of ammonia vapor forced its way up through the bed. Celsus opened the ammonia valve wider and turned up the pre-heater further, his eyes flickering from the column to the thermocouple readers and the flow meter and back again. Not once did

he look at the collector, where the ammonia flowing into the flask was already sucking the water back, with intermittent gurgles, into the gas beaker. Finally he seemed satisfied. He stopped adjusting things and stood back a moment.

Patrick heard strange sounds. Celsus was muttering in a queer rhythm.

The room grew instantly still.

Patrick realized that the man was *chanting . . . to the equipment.* The patent director tugged at his red moustache uneasily. Goose pimples began to flow in waves over the nape of his neck.

Celsus now donned a pair of white asbestos gloves and stroked the fluidizer column as he sang.

Bleeker and Sasanov exchanged glances. Sasanov looked faintly bewildered. Bleeker felt the same way, but was determined not to let it show.

Patrick looked about him. There were at least fifteen people there—group leaders and senior chemists, mostly. A couple of people from his own department were there: Alec Cord and one of the women attorneys, Marguerite French. They were both completely oblivious to him. Marguerite was moving her eyes continuously back and forth between Celsus and something metallic she held in her hand. Patrick recognized it with a start. It was a stopwatch.

It then occurred to Patrick that there was something strangely familiar in Celsus' urgent intonations, and in the manner in which he stroked and caressed the equipment. But he couldn't quite identify it.

Suddenly Celsus stepped back, right arm raised, and cried: "Silamine! Exist!"

And instantly Patrick had it. Celsus was like a "hot" gambler who had just thrown the dice.

Silent seconds passed, broken only by the shuffle of shoes as Bleeker and Sasanov edged in closer to the bench.

Patrick stole a glance at Marguerite French, who was leaning forward as though hypnotized by the bubbling liquor in the collection flask. Suddenly a yellow cloud appeared in the flask, and Marguerite's arm jerked. Patrick knew she had pushed the timer on her watch. She looked down at the watch, and her face began to turn white. Patrick, concerned, started over to her, but just then, Bond, Silicon Compounds Group Leader, called out: "That's enough! Let's take a sample for infrared!"

"Go ahead, Prufrock," said Celsus.

A. Prufrock Prentice, Celsus' technician, who until now had been hovering in the background, now stepped forward, removed the vent assembly in the collector with a swift expert gesture, and drew out a few cc. of the slurry with a pipette. He dropped the sample into a bottle and then disappeared out the door.

Patrick forgot momentarily about Marguerite French. He turned to the bemused Sasanov with a grin. "Efficient, aren't they? We'll know in a minute what it is."

Sasanov shook his head. "How can it be efficient when they were ordered not to do it?"

"You've got a point, Comrade," grumped Bleeker. "You don't see them stumbling all over themselves on a *scheduled* run."

"Of course not, Andy," smiled Patrick. "But this was a *bootleg* run. You ought to institute a required schedule of bootlegs."

"Bootlegs?" queried Sasanov. "What are these bootlegs, please?"

"Just a decadent American laboratory custom, Comrade. When you have orders to stop trying, but you know it will work if you try one more time, then you just go ahead and do it. Sneaky, isn't it?"

Sasanov sniffed.

Patrick was in high spirits. He looked about for Marguerite. She had disappeared. That surprised him. After all that business with the watch, didn't she really want to know whether Celsus had made it? Or—the thought hit him hard—was she so sure he *had* made it, that there was no point in staying for the i.r. report?

The phone rang. Bond grabbed it. The conversation was brief. Bond replaced the phone and turned around, his eyes searching the room. "Where's Pierre?" he demanded.

But Celsus, too, had gone.

"Was it silamine?" called Patrick. He turned to face Sasanov.

"It was silamine," said Bond.

Sasanov's face was a mask. He bowed low to Patrick. "I will send the contract and the cider, as soon as I arrive at the chancellery in Czezhlo. And now, if you will excuse me, I have a plane to catch."

The lab was the slave of fad and fashion, and news of a new discovery flashed through the bays faster than the speed of light and with an audience saturation that dwarfed Bleeker's Management Bulletins. A new catalyst discovered in Inorganics in the morning was likely to be warming up in the test tubes in Polymer that afternoon. A new herbicide found effective in the Biology Bay in the afternoon would probably be followed up by a new synthesis in Organics the next morning. Currently, however, thanks to Pierre Celsus, the rage had now become that lovely child of the petroleum refinery, the fluidized reaction, in which hot gases having composition A streamed up through a turbulent mass of tiny catalyst particles, while simultaneously suspending that mass, to emerge at the top of the bed with composition B.

During the entire previous year, there had not been a single fluidized experiment at Hope. But within the hour following Celsus' silamine run, Group Leaders were holding conferences behind closed doors with their chief assistants as to how to

reconstruct the chemistry of tried and true reactions so as to make them amenable to fluidization. Overnight the senior chemists were talking knowledgeably of "slide valves," "strippers," "regenerators," "standpipes," and "suspensoid"; and within a very few days they would go on to "bed viscosity," "Nusselt number," and "voidage at incipient slugging." The Library was promptly stripped of all books remotely touching on fluidization, and even the "F" volume in the sacrosanct *Kirk-Othmer Encyclopedia* disappeared from the reference shelves for several days. Miss Addie, the librarian, posted stern notices on all bulletin boards. Overnight, the volume was returned, sheepishly, by Andrew Bleeker.

Bleeker didn't fight the new trend. He knew it would do no good, and besides, the new thinking both intrigued and amused him. It intrigued him because it was a new and potentially useful approach, not only for a silamine design, but also for a number of other research problems of long standing. It amused him because he knew from long experience that a number of project shifts would now be inevitable. Programs on supersonic reaction initiation, free radical mechanisms, photocatalysis, and selective adsorption would be quietly, even surreptitiously, phased out. In some ways, his people reminded him of a cohesive group of teen-agers, with the same compulsion to conform in dress, thought and behavior. The minority that he would force to continue on their old projects would probably be apologetic to the lucky ones launching into the new fluidized techniques. Bootleg runs meanwhile would become the order of the day, with glassware fluidizers of all shapes and sizes springing up all over the lab like wildflowers in May. He made a mental note to contact the Budget Committee immediately for a decent bench unit. He had a good excuse. Sasanov had already opened negotiations from Czezhlo. They'd be needing some good bench equipment in a matter of days.

In fact, to handle the expected volume of requests for bench runs, he might need as many as three columns—stainless steel, of course, twelve feet high, and heavy. They'd need a basement foundation. There was just the place for them, downstairs in Building V. He'd call it the Fluidizer Bay.

Two days later the Safety Committee investigated a minor explosion in Silicon Compounds. There was no damage, beyond a wrecked hot plate, and nobody was hurt. As the Committee noted in their written report to Andrew Bleeker, the explosion was the expected result of an experiment by Pierre Celsus, done in the hood behind shatterproof glass, all in approved and careful fashion. One gram of ful-

minate had been heated on the hot plate to 145° C., then detonated—by touching it with a feathertip.

Explosions, controlled or otherwise, made Bleeker uneasy. He called Bond on the phone. "What fulminate was it?" he demanded.

"I don't know," said Bond candidly.

"Find out," said Bleeker.

The group leader called back in a few minutes. "It was gold fulminate." He sounded uncertain. "It's not a true fulminate, not a salt of fulminic acid. It's made by reacting auric oxide, water, and ammonia. When dry, it's highly unstable . . . detonates by light friction."

"Why was Celsus working with it? How does it relate to anything in the silamine program?"

Bond coughed. "I asked Celsus about that—"

"And?"

"It has something to do with a new silamine catalyst." Bond sounded defensive.

Bleeker started. "Good heavens! Gold fulminate . . . a *catalyst?*"

"I don't think so. But I'm not really sure. As Celsus explained it, the real catalyst won't be gold, but rather one of the rare earth oxides. Terbium, I think. I know this sounds rather strange, Andy. It's probably my fault for not understanding Celsus." Bond's voice trailed away unhappily. "Sometimes, it's difficult to communicate with him."

Bleeker paused. Finally he said, "Let me know if you find out anything further."

After he replaced the phone, Bleeker began swinging his chair in slow oscillations, eyes narrowed and brows knotted. "Nobody," he thought grimly, "ever tells me anything." He swung around toward the window. "And why? Because nobody in this lab ever tells anybody anything. And it's getting worse every day. No organization. Maybe Sasanov was right." He swung back around and stared through his open office door. As he peered, he caught a serio-comic vision of the lights going out, one by one, all over the lab. He suppressed a shiver.

From test tube to commercial plant at Hope Chemicals classically proceeded through four well-defined steps. Step one was "in glass"—generally with a glass one-liter reaction vessel with a train of glass accessories, all stock equipment, with parts out of the cupboard. Celsus' first silamine run had been "in glass." Step two was the "bench unit." Nearly all parts were metal, and many were specially designed or ordered out of the special chemical apparatus catalogs. The bench unit was supposed to "prove out" and "optimize" the glass setup. The pilot plant was next. From its operation the engineers were able to draw up thermodynamic data and could analyze feed, recycle, purification, and effluent streams, all of

which were absolutely essential in designing a commercial plant, which was the fourth and final step. Each of these steps was vital, and none could safely be omitted. They were like links in a chain. If one failed, the whole sequence of events came to an abrupt halt, never to be revived. Although each phase was essential, everyone at the lab, from Bleeker on down, knew very well that one certain phase was more essential than the others. For sad history had shown that if a project were going to die, it nearly always picked the bench unit for its coffin.

In his Monthly Project Report on his work "in glass," the less experienced chemist might report loftily, that, although yields in glass were perhaps a little low, they could be expected to improve with the adequate temperature control available in a bench unit; or that by-product contamination would not be a problem in a bench unit, where a purge would operate continuously. And then the bench unit would be built, and he would have to eat his predictions on a stainless steel platter. So chemists at Hope were generally quite chary of predicting the performance of a projected bench unit. At best, they would answer Andrew Bleeker's inquiries with, "It seems to have a good chance." "Certainly worth a try." "Something similar worked at Du Pont."

Bleeker complained about it to Patrick. "Weasel words! Nothing but weasel words! You'd think they were a bunch of patent lawyers."

Patrick grinned slyly. "Not all of them. Look up Celsus' Project Report on Silamine."

Bleeker did. His eyes nearly fell out of his head.

He read: "Yields were poor in glass because the process was necessarily limited by the heat input. The reaction is extremely endothermic, requiring a thermal outlay heretofore attainable only in nuclear reactions. In the existing setup the necessary heat cannot be supplied through the reactor walls because of the low heat transfer coefficient available for a fluidized system. The same difficulty applies with respect to internal heaters. Nor can the requisite heat be supplied by pre-heating the ammonia, since NH_3 cracks back to N_2 and H_2 at 600-700° C. The only way to provide the necessary heat is to create it *in situ* on the silica gel particles. This may readily be done by adding terbium oxide with a little xerion to the silica. This system will, in fact, create a substantial thermal excess, requiring a cooling jacket on the reactor. At the end of the run—disappearance of terbium—spent catalyst, while still wet, must be immediately discharged into alkahest. Yield of silamine, based on SiO_2, should be substantially quantitative."

Bleeker shook his head vigorously, like a dog shedding water. He studied the report again, as if hop-

ing the words would rearrange into sentences he could understand. But there wasn't any change.

The Research Director reflected a moment. Should he ask Celsus to report and explain? Celsus, being a senior chemist, had no group leader, and instead reported directly to him, Bleeker. Yet, somehow, he felt that any such conference could only lead to further confusion. But now a crafty thought occurred to him.

The Patent Department. It was the job of the patent attorneys to understand these new inventions. They were supposed to file on important cases within a few days after the thing had been reduced to practice. The application had to explain the invention in intelligible terms, or else the Patent Office in Washington would rule the disclosure fatally defective. There was certainly no dishonor in asking the attorney in charge of this invention to step in to his office and explain Celsus' report. It would be like the judge in a trial asking the court reporter to repeat some testimony the judge had missed. And no need to bother Con Patrick.

He buzzed his secretary: "Miss Sally, look at the Patent Department organization chart and get hold of the attorney responsible for Pierre Celsus' work. But don't bother Mr. Patrick."

As events developed, this was a mistake. While the Patent Department organization chart clearly showed that Alec Cord handled the inventive affairs of Pierre Celsus, Cord happily informed Miss Sally that all that had changed. Somebody else was now responsible. Additional phone calls established the apparent fact that, for the moment, at least, nobody was writing cases for Celsus.

This puzzled Bleeker. He knew that Patrick loved order, organization, and the predictable flow of life, and that when Patrick had taken the Patent Department of Hope Chemicals, he had drawn an organization chart to define precisely the areas of contact of each of his attorneys with each group in the Research Division.

This was all very true; in fact, during the early days Patrick had kept the chart current, showing every assignment change. But Patrick had been in office less than a year when the Nitrogen Group had their breakthrough in acrylonitrile, and it had been necessary for him to reshuffle all Patent Department assignments drastically until he could get the Nitrogen docket back to normal. While the dust was settling, Research formed the new Polymer Group, and the Budget Committee —after much muttering and review of Patent Department efficiency— finally let Patrick hire two new attorneys for the new Group. Meanwhile, Foams and Fibers were screaming, so one of the new polymer attorneys was assigned to them. And then Nitrogen insisted that Cord be assigned to them perma-

nently, because he was the only man in the lab who could beat Dr. Fast at the chessboard—it being well known that Fast would talk about his inventions only in a losing position. The second new polymer man got clewed in to Mining and Metallurgy on an emergency job when it was discovered that he had worked summers on a barytes washer in Missouri. When he finished the emergency case, M & M refused to release him.

And that was when Patrick stopped revising the chart. From then on he kept everything in his head, like a general in the midst of shifting battle lines. He developed an exquisite facility in matching attorney to project, project to attorney, attorney to inventor. His manning assignments never failed. Except for Pierre Celsus. Nobody could understand Celsus. His few cases had been written personally by Patrick.

Bleeker discovered all this in slow fragments. Then he put in a call for Patrick.

After ten minutes in Bleeker's office, Patrick finally convinced him he knew no more about silamine than the research director. Following which, point by point, sentence by sentence, they went through the Project Report together.

"And listen to this," groaned Bleeker. "He's proposing some kind of dispersant for the residual silica."

"Why would he need a dispersant?" asked Patrick. "Why not just flush it direct to solids disposal?"

"I haven't the faintest idea. But that's not my point. Listen to what's in it:

Vitriolated tartar
Butter of antimony
Libavius' fuming liquor
Sal mirabile
Magnesia nigra . . .

And the whole thing, he calls"—Bleeker looked at the report—"the *alkahest*." He looked up helplessly at Patrick. "*What* is the man *talking* about?"

"Alkahest?" Patrick looked troubled.

"Maybe I'm not pronouncing it right."

"No, you had it right. Except—I thought . . ."

"You thought what?"

"The term hasn't been used in earnest in over five hundred years. It's an alchemical term. It means 'universal solvent'. It dissolves anything you put in it."

"Alchemical? Solvent?" Bleeker looked blank.

"It might really dissolve the silica," ventured Patrick. "Although I can't see any reason why it would be necessary, technically."

"Alchemy . . ." muttered Bleeker. "What century does he think this is?" His chair began to swing slowly. "That man needs help. He ought to see Siegfried Walters."

"I understand he's been in therapy with Walters for some months," said Patrick. He added quietly:

"Does this mean you won't approve the bench run?"

"No. It doesn't mean that. I'm going to approve it. In fact, the Board of Directors insists that we develop a process we can sell to the Peoples Republic. That twenty-five cent royalty has them hypnotized. Anyhow, the new Fluidizer Bay will be finished in a few days. The runs can start then. Put one of your best men on it. If it works, get a case on file as soon as you get that madman translated into basic English."

"Of course, Andy."

"And now," said Bleeker, "what do I do with Celsus?"

"Nothing," said Patrick. "Leave him alone. Maybe you and I don't have what it takes to understand him."

"Nor does anyone e!se," declared Bleeker. "And that's the whole problem. Any chemist in corporate research has got to be one hundred per cent clear to the rank and file that have to translate him into a tonnage plant. His thinking has to be something our run-of-the-mill people can take and break down into its elements, its unit processes."

"I think he's some kind of a genius," said Patrick stubbornly.

"Maybe he is, but in this business, his kind of genius is not an asset; it's a disaster. What happens when he explains something? Do you understand it? You do not. I don't understand it. Nobody understands it. A few days ago he made the silamine process work for the first time. Four separate teams had already given up. And how does he explain it?"

"He just needed one seed molecule to initiate it," said Patrick. He added quickly, "And don't ask me where he got it."

"But I *will* ask you. Where *did* he get it—a thing that had never before existed?"

Patrick shrugged his shoulders helplessly.

"Maybe you're right," said Bleeker thoughtfully. "Perhaps we're not mentally equipped to understand him. Perhaps we should examine our own capacity for comprehension of novel technology. It's like Willard Gibbs and the phase rule. He published in 1876, but nobody in America was capable of understanding him until Ostwald explained him in German. For a long time, if you couldn't read German, you couldn't understand the phase rule. Is something like that happening here? Maybe *we* can't be communicated with. Maybe *we* need to be examined. There are firms that do that, you know—management evaluation firms . . . research evaluation firms."

Patrick nodded absently. "Suppose he has something the rest of us don't have—but we just won't let him use it. We don't know *how* to listen to him. We see him as a freak. Are *we* freaks to him?"

"But *alkahest*, Con, *really*. I suppose next we'll get a Project Proposal for making gold." He shook

his head. "All I remember about alchemy was my undergraduate course in History of Chemistry, at State U. Frederick of Wuertzburg reserved a place of distinction, a position of great elevation, for each and every alchemist who visited the realm."

"What was that?" asked Patrick.

Bleeker said grimly: "The highest gallows in all Europe."

When Patrick had gone, Bleeker sat swiveling slowly at his desk for a long time. Was Sasanov right? Maybe the lab *was* a little disorganized. *Something* was wrong, out-of-joint. Was it Celsus? The administration?

Bleeker prided himself on knowing everything that went on in his laboratory. (He almost did know.) He knew who was coming up with the ideas that might be commercial five or ten years from now. He knew the misfit who would have to be reshuffled. But no matter how bad the incompatibility, in the past his operations were big enough to find something which, if it did not completely match the talents of the transferee, at least kept him at something useful to the company and to himself.

But now, for the first time in thirty years, he felt truly baffled. Sasanov, he suspected, would never encounter this problem, or, if he did, it would be solved with prompt and drastic measures.

Bleeker chose a different way, gentler, but equally definitive.

He buzzed his secretary. "Miss Sally, get me Arnold Gruen, Gruen Associates," he said grimly.

Later, he explained it all to Patrick.

"Gruen Associates is unique in several respects. They're the oldest in the business, for one thing. For another, right now they're the only management-survey group equipped to look at research labs, although I dare say it's just a question of time before they lose *that* monopoly, what with so many billion dollars being spent on research in this country every year."

"Gruen is unique, you were saying?" nudged Patrick gently.

"I was explaining that," said Bleeker testily. "Well, Gruen brought in another outfit to study them, show them how they could tighten up their analysis techniques, rely on smaller samples, reduce study time and the overall cost of their surveys. Sort of like a psychiatrist getting himself psychoanalyzed, so he'll be a better doctor. Well, Gruen had this done to *them*, and they seem to be the only *surveyed* surveyors in the business. That's how they developed their 'Unit Profile', where they pick one man who has nearly all the faults of the research laboratory they're trying to correct."

"But wouldn't it be *still* better," said Patrick blandly, "if we could be surveyed by a group who had been straightened out by Gruen? Then

we'd be surveyed by a *surveyed* surveyed group. Hope uses only the very best, you know."

"The point came up." Bleeker was equally bland. "But good sense prevailed."

Both men were silent a moment. Each seemed to be waiting for the other to speak. Patrick knew then that the same thought must be on Bleeker's mind. So Patrick, being the junior, said it. "What happens when they find Pierre Celsus?"

The first session with Gruen Associates took place in the Executive dining room, an intimate, expensively appointed room down the hall from the large lab cafeteria.

Patrick had long ago noted that Bleeker liked to conduct important discussions at the luncheon table. The theory was that Yankee pot roast following cocktails loosened a man's tongue and evoked basic truths, or at least turned up any latent disagreements, all of which might require excessive time and money to discover in other ways. Furthermore it was the simplest and quickest way to get to call a man by his first name, and everybody agreed this helped communication and delayed the development of paralyzing differences of viewpoint. But whatever the reasons, Patrick always liked a good meal with experts in their own fields.

While coffee was being poured, they finally got down to business.

"I want to make one thing clear," said Bleeker. "This is not a criticism of anyone, except possibly myself. Arnold Gruen and his people are here to determine whether I can improve the operation of the lab. Arnold's staff, Joe and Ben, here, will come in, starting tomorrow, and they'll be talking to a number of us. They'll talk to all our group leaders and to a number of our chemists and technicians at all levels. They'll make appointments ahead of time. Work them in, somehow. Within a few weeks, Arnold will put together a report, and then I'll decide whether we ought to change some of our procedures. Arnold, perhaps you can explain the mechanics of your survey, exactly what you intend to accomplish, and how you will do it."

"Of course, Andy. It's really quite simple. We at Gruen have one basic objective—increasing the dividend to the shareholders. We continue to exist because we have been able to help our clients meet this objective. Now, there's a fundamental corollary to our main objective, and that is, that industrial research, such as you have here at Hope, exists for the sole purpose of making money for the company, and to make this money as quickly as possible. To accomplish this, every man in the lab must recognize that he is part of a *team*. No man in a modern laboratory can work alone. He must recognize roadblocks instantly, and call in help immediately. He must be able to analyze and explain, or his project

will bog down. He must *communicate*. That's the key word: *communicate*. And it must be *instant*." He turned to Patrick. "Con, your department has a vital function in all this. The life of a United States patent is seventeen years. Our studies show that, up until recent years, only the last five to seven years of a typical patent are of any use in protecting a basic new invention. Why? Because it so often takes ten to twelve years to proceed from the first experimental work to the first commercial plant. One of our aims is to cut this idle patent time. We do this by cutting the development phase to three years." Gruen took a sip of coffee and smiled. "Do I hear incredulous murmurs? I repeat: three years. It can be done. And it's all in *communication*. Everybody knows what everybody else is doing. Problems will be recognized instantly. But here I am, still talking in generalities." He turned to Kober. "Ben, will you explain what you and Joe Marel are going to do, starting tomorrow?"

"Certainly, Arnold. My function —and Joe's—is to interview some of your key people. We've already drawn up a list. This was based on a study of several hundred project reports written by approximately fifty different bench chemists, senior chemists, and group leaders. Con, we'll include one man in the Patent Department, probably you. We will interview each of these people. As a result of these interviews we will develop a further sampling of six or eight chemists who offer most in the way of a challenge to the Gruen technique. We will then hope to be able to boil this list down to one man. This man, if our survey is valid, will constitute a walking summary of all that we hope to recommend be corrected here."

Arnold Gruen looked over at Patrick. "You lawyers have your 'reasonable man'. We are looking for the 'unreasonable man': a compendium of errors—our Unit Profile."

"Profile?" asked Patrick. "You mean something like the Bernreuter or Thurstone personality profiles for executives?"

"Something like that," said Gruen. "Except that the Bernreuter profile provides a *positive* model for the up-and-coming executives of our large mail order houses—a real inspiration, too, if I may say so!—whereas the Gruen profile is *negative*. When we establish it, we offer it to the client as something to be shunned by all right-thinking employees. Another difference is, the Gruen profile is personified; it is drawn from one actual man, a case history. In fact, our main effort in the study is to find that man." He nodded toward Bleeker. "And when we find him, our bill for services will follow shortly."

Patrick was eternally amazed by

his women attorneys. Marguerite French was a case in point. Hired fresh out of State U. with straight A's in chemistry, he had first put her on novelty searches in the Patent Office in Washington. She had picked up the patter almost overnight. ("I'll be in the stacks tomorrow, Mr. Patrick, flipping the bundles for that new polymer." But when she dictated her search report, she had the good sense to call it "information retrieval.") She soon knew the Patent Office Search Manual by heart, and better still, most of the chemical patent examiners on a first-name basis. They told her what subs to check in the Search Room and pointed out unofficial "shoes" in their own offices that cut her search time to a minimum. Examiners had been known to hover over her shoulder, helping her through their soft copies, to find a "dead reference."

A couple of years after hiring her, Patrick learned by accident that she had passed the Patent Agent's exam—the dreaded Patent Bar—on her first try (Patrick had failed it the first time) and was halfway through law school at night. That was when Patrick started her on writing patent applications. In good time she had finished law school and had become a full-fledged attorney, in most respects as good as any of his men. And in one particular respect she excelled any man in the department. This was her ability to work with certain of the more refractory male chemists. Whatever their inability to write an intelligible project report, she somehow was able to analyze, define, and summarize the most involved reactions that any of them ever brought forth. When working with her, they suddenly became expressive, articulate, even voluble. ("Maybe they're all in love with her," mused Patrick. But that was too simple. "She's a kid sister to them," he thought once. No, that wasn't it, either. "She appreciates them." Yes, he felt he was getting warm.)

Well, no matter what it was, he had made up his mind as to who was to be assigned to Pierre Celsus. If Celsus could be persuaded to talk to anyone, he would talk to Marguerite French.

Patrick drew the structural formula on his office blackboard. "Silamine. As you probably know, Celsus' new synthesis is somewhat analogous to the commercial process for making urea from ammonia and carbon dioxide, except that we use SiO_2 instead of CO_2. In other words, we react ammonia and silica, and we get silamine and by-product water."

"It's strange that it should react at all," said Marguerite. "Silica is one of the most unreactive oxides known."

Patrick smiled. "That's the general impression, all right, and that's

why we think we may have something patentable. Actually, we don't use plain old silica sand—the low surface area makes it too inactive. We use an extremely porous, high surface area silica, five thousand square meters per gram. That means a thimbleful—if you could spread it out—would cover two or three football fields. And this means that it is thousands of times as reactive as sand, because a given weight of high surface silica can make contact with thousands more ammonia molecules than plain sand."

"I gather there's more to it than that. Certainly ammonia and high-surface silica have been brought together before without making silamine."

"Yes, Marguerite, as you very well know, there's more to it than that. Firstly, the silica contains a new catalyst, terbium oxide, one of the rare earths. Celsus proposed this after his first successful run, back in Silicon Compounds." He looked at her. "You were there."

She replied noncommitally. "Yes, I was there."

Patrick sighed. She was not going to volunteer anything about the stopwatch. In a little while, he'd have to ask her.

He continued. "Next, Celsus adds a thing he calls 'xerion'."

" 'Xerion'?"

"Don't ask me what it is. Some kind of co-catalyst, I think. It's your job to find out. Celsus contends his new system provides extremely high temperatures right in the fluidizers, so much heat, in fact, that the columns have to be cooled. He cools by heat-exchanging with incoming liquid ammonia, which goes next to the base of the columns, where it serves as both reaction gas and suspending medium for the silica gel."

"What happens to the by-product water?"

"Some gets stripped out with silamine product, but some stays on the silica. Celsus seems to think it's very important that some stay on the silica. He wants the silica to be 'wet' throughout the reaction. I don't know why. Again, this is something you should ask him about. Also, he runs the residual silica into a tank of something he calls 'alkahest'—some kind of solvent or dispersant. Find out why the stuff can't simply be dried and carted off to waste. Is it dangerous, or what?"

Marguerite looked up from her notebook. "There's still one very basic thing I don't understand. This terbium-xerion thing . . . how does the combination make heat?"

Patrick shrugged his shoulders helplessly. "You'll have to ask Celsus."

"Do you think he will tell me any of this?"

"I don't know, Marguerite."

"What about his Project Reports?"

"He's made several. They're all

different. But don't try to reconcile them; it's impossible. So it boils down to this: Celsus knows, or thinks he knows, how to make the thing work. But he hasn't been able so far to explain it to his own people. This is where you come in. Defining technical data is your job, as a patent attorney. You're better at it than his brother chemists. Also, you"ll bring a new outlook."

Marguerite French closed her notebook. "Is that about it?"

"One more thing." Patrick eyed her speculatively. "The other morning, at that first silamine run, you had a stopwatch. What was all that about?"

The girl hesitated. "I don't think you will believe me."

"Tell me anyway."

"I timed the reaction. With the stopwatch. All I had to do was calculate the space velocity of the ammonia. From this you get the time it took to move the first silamine product from the reactor to the collector, where it immediately gave the picrate test. This was 38.6 seconds. When Pierre called on the silamine to exist, I started the watch. When the picrate showed, I stopped it." She opened her purse. "I've been carrying it around—it's still stopped. I don't know what to do with it. Suppose you keep it a while." She handed the watch to Patrick. He took it dubiously. It read 38.5 seconds. Experimental error? Not, he suspected, Pierre Celsus'.

"I think it was telekinesis," said Marguerite.

Patrick studied the girl with widened eyes. Her face was pale, but she was staring back defiantly. The man tugged at his moustache, his brows creasing. He remembered Celsus' behavior at that now notoriously successful run, crooning, whispering, exhorting, caressing the flask. Like a "hot" gambler talking to the dice. And then the throw. Some gamblers were supposed to have this power, this control of inanimate matter. TK. Psi.

He said hoarsely, "Is it possible?"

"I think it is. With some chemists. Pierre isn't the first. He won't be the last. If he's different, it's only because he can do it better, and because he *knows* what he can do."

Patrick's mind raced ahead. The implications . . . were staggering. He suppressed a shiver. "But that isn't chemistry. It isn't science. It may even be against the law."

"It was the *first* chemistry," said the girl curtly. "It is alchemy."

"Now wait just a minute," protested Patrick, struggling back to firmer ground. "If Celsus were a real genuine alchemist, he'd be making gold, wouldn't he? Is he making gold? Of course he's not. But again, suppose he could make gold, how would you explain it to the United States Mint and the F.B.I.?"

"You miss the point entirely,"

said the girl. "He's not trying to convince anybody he's an alchemist. It's the other way around. He's trying to *hide* it. He wants to be just a plain ordinary Twentieth Century chemist. If he could make gold, he'd keep it a secret. So it's pointless to argue that since he hasn't made any gold, he's not an alchemist. The alchemist uses his powers to supply the requirements of his patron. In the Fifteenth Century, the big requirement was gold. In a modern laboratory, it could be anything from plastics to lasers to silamine. And finally, what's so wonderful about gold? Today dozens of fine chemicals sell at more per ounce than gold."

The man groaned. "But the patent application . . . what will the Patent Office do when we file an application on an alchemical process? And how will the main claim read? Can we say, 'In the process of reacting silica and ammonia to form silamine, the improvement comprising telekinetically first forming one molecule of silamine, thereby to autocatalyze the reaction'? How is that going to sound to the Examiners in Class 23?"

"It is sufficient if those skilled in the art can reproduce the invention," said Marguerite. "Maybe that means other alchemists."

Patrick fought for control over the gurgle rising in his throat. "Others? God forbid!"

The girl waited in quiet sympathy.

At last Patrick said lamely, "Well . . . see what you can do—"

When Marguerite had gone, Patrick sat staring at the pigeonholes of his desk and tugging glumly at his moustache. There wasn't anything he could do. He couldn't go in to Andrew Bleeker and say, "Andy, your man Celsus has TK. He's a psi. And that's why he got silamine, and that's why his processes are not reproducible." Patrick shook his head sadly, remembering what Bleeker had said to the applicant from California who claimed he had seen a flying saucer.

The intercom shattered his musings. Joe Marel of Gruen wanted to interview him.

Joe Marel stared at the rolltop desk for several seconds.

Patrick said finally, "You wanted to review some Patent Department procedures, you said."

"Oh, of course. Forgive me for staring. I've never seen anything quite like it—the desk, I mean."

"Biggest phony in the lab," said Patrick genially.

"I wouldn't know. Well, suppose we start with your infringement opinion on the new silamine process."

"Certainly."

"You say here, 'This patent does not present a serious risk of infringement.' Do you mean it is not infringed?"

"Not exactly. No one can predict with certainty what the courts

will do with a given patent. It's always a guess. We simply try to assess the degree of risk."

Marel looked at him curiously. "You mean, then, it's *probably* not infringed?"

"In a sense, yes. But bear in mind, it's not a thing that admits of calculating percentages."

"But I gather that when your management reads that, they will understand that the patent situation is in the clear?"

"Well, not inevitably, and not necessarily. But it very well *could* have that effect."

Marel was silent a moment. He ran his finger around his collar, then continued. "Well, then, you go on to say, about another patent, 'At the appellate level, the defense of patent invalidity would probably be affirmed.' Does that mean the patent is invalid?"

"No, here again we simply try to crystal ball what the courts will do with a given patent question. No lawyer can advise his client whether a patent is valid or invalid. Only the courts can do that. If the courts have not spoken, then at best the lawyer can only state how he thinks the courts would rule, if and when they should get the question. And you realize, of course, that the courts in different federal circuits could come up with different answers. The patent could be held invalid in Maine, but valid and infringed in California. And then there are other reasons we might not want to come right out and say a patent is invalid. For example, some day we might buy the patent, and then we might want to continue the litigation, except that we'd now be on the other side."

Marel blinked his eyes rapidly. At last he said: "Then why not just pick up the phone and tell whoever in management wants to know? Why have a written opinion at all?"

"Oh, there has to be a written opinion—something for dozens of people in Hope management to look at, as well as people outside. The banks and insurance companies that provide the financing for the proposed new plant—*their* lawyers want to see the patent opinion. Now, lawyers have their own special language when they talk to each other. They never say 'yes' or 'no.' If our lender's lawyer gets an opinion that says 'yes' or 'no,' he might regard it as incompetent, and then we might not get the financing. The same thing is true for our own sub-licensing. When we sell the process for use in England or West Germany or Japan, or wherever it may be, we have found that *their* lawyers place more confidence in one of my twenty-page opinions than in a categorical clearance from the President of Hope Chemicals."

"I see. I mean, I *think* I see. You mean you can't just say 'yes' or 'no' . . . ?"

"Exactly," said Patrick. "Too deceptive, by far. Wouldn't be crick-

et." He became expansive. " 'Yes' and 'no' are the two most dangerous words in the English language. Each inherently means something that is by definition impossible. Each, as ordinarily used, is accompanied by a protective cloud of implied qualifying conditional clauses. Problems arise when the speaker and his listener fail to achieve a coincidence in qualifications implied and qualifications inferred."

Marel shifted nervously.

Patrick continued. "Now that you are studying patent opinions, perhaps a little basic theory is in order. To start with, what is the object of a good patent opinion?"

"Tell me," said Marel.

"The object is," said Patrick, "that the opinion turn out to be correct, no matter what happens after it is written. Is the company sued for infringement? The opinion says this is a possibility. Do we lose the suit? We said that our chances were better than even. They were, but we provided for the possibility of loss, because 'better than even' *could* mean only fifty-one per cent —in other words, we should expect to lose nearly half of such cases. But then we take a final appeal, and win. In the opinion we find our conclusions apply to decisions at the appellate level. And of course, there's a strong suggestion in the opinion that we settle on a reasonable basis if we get into real trouble."

Marel stared at the patent director in fascination.

Patrick continued smoothly. "In other words, as history unfolds, day by day, and month by month, you should be able to reread the opinion and find that nothing in it is inconsistent with subsequent events. In this sense, it should resemble a prophecy out of Nostradamus, which becomes completely clear only *after* the occurrence of the prophesied event."

"I guess that's why most people find a patent opinion hard to read," said Marel.

"Granted," said Patrick. "However, let us not confuse readability with clarity. Actually, there's generally an inverse relationship: the more readable, the less precise; a real literary masterpiece is so honeycombed with ambiguities as to be incomprehensible. Take Coleridge's 'Xanadu'. Would you consider that a masterpiece?"

"Certainly."

"But can you tell me where the dome was going to be built?"

"The dome? Oh yes, the pleasure dome. How does the thing go?" Patrick quoted from memory:

" 'In Xanadu did Kubla Khan
A stately pleasure-dome decree:
Where Alph, the sacred river, ran
Through caverns measureless to man
Down to a sunless sea.'

"Now, then," said Patrick, "where was the dome to be built?"

"In Xanadu," said Marel.

"Then where was Kubla Khan when he decreed the dome?"

"Oh. In Xanadu? I see the problem. Well, then the dome must have been on the Alph River."

"It's a long river. Where on the river? In the caverns?"

"I shouldn't think so."

"Nor on the shores of that sunless sea?"

"Probably not."

"You see my point, Joe. In the arts, when a thing is incomprehensible, it helps it to be a masterpiece. But not in the law. If a lawyer had written 'Xanadu,' these ambiguities would never have cropped up. He would have made the thing crystal-clear."

"No doubt," smiled Marel. "Con, what does Andy Bleeker do when he gets your patent opinions? Say, like this silamine opinion?"

Patrick looked at Marel carefully. He said: "You raise a very interesting point. He's a very busy man, you know . . . excuse me, I think this is Bleeker on the intercom. No, don't leave." He flipped the switch. "Yes, Andy?"

Bleeker's voice came in strongly. "Con, this silamine opinion . . . I don't know when I'll get time to go over it thoroughly. Just tell me whether we're clear or not."

"We're clear, Andy."

"That's what I thought. Thanks, Con."

The intercom went off. Patrick looked at Marel. "It was a masterpiece," he said coolly.

An hour after Marel left Patrick, the patent director got another call from Bleeker.

"Con, I thought you'd be interested. Marel and Kober are sitting here with me. They think they've found their man for the Profile."

"So soon? I didn't realize they'd already interviewed Celsus."

"They haven't. But they see no need to continue the study."

"Why that's fine . . . I guess." Patrick was puzzled. "Who is he?"

He heard Bleeker exhale slowly.

"It's confidential. However, Con, I'm suggesting to Kober and Marel that they skip the patent department in their survey."

"I'm sorry to hear it, Andy. We'd hoped to get a lot of help from them."

"It could run into a lot of time and money," said Bleeker. "Also, I'm not sure they have the necessary background to study . . . a patent man."

"That's a shame," said Patrick. "I liked Marel."

"He likes you, too, Con. In fact, you . . . ah . . . fascinate him." Bleeker's voice seemed to lose strength.

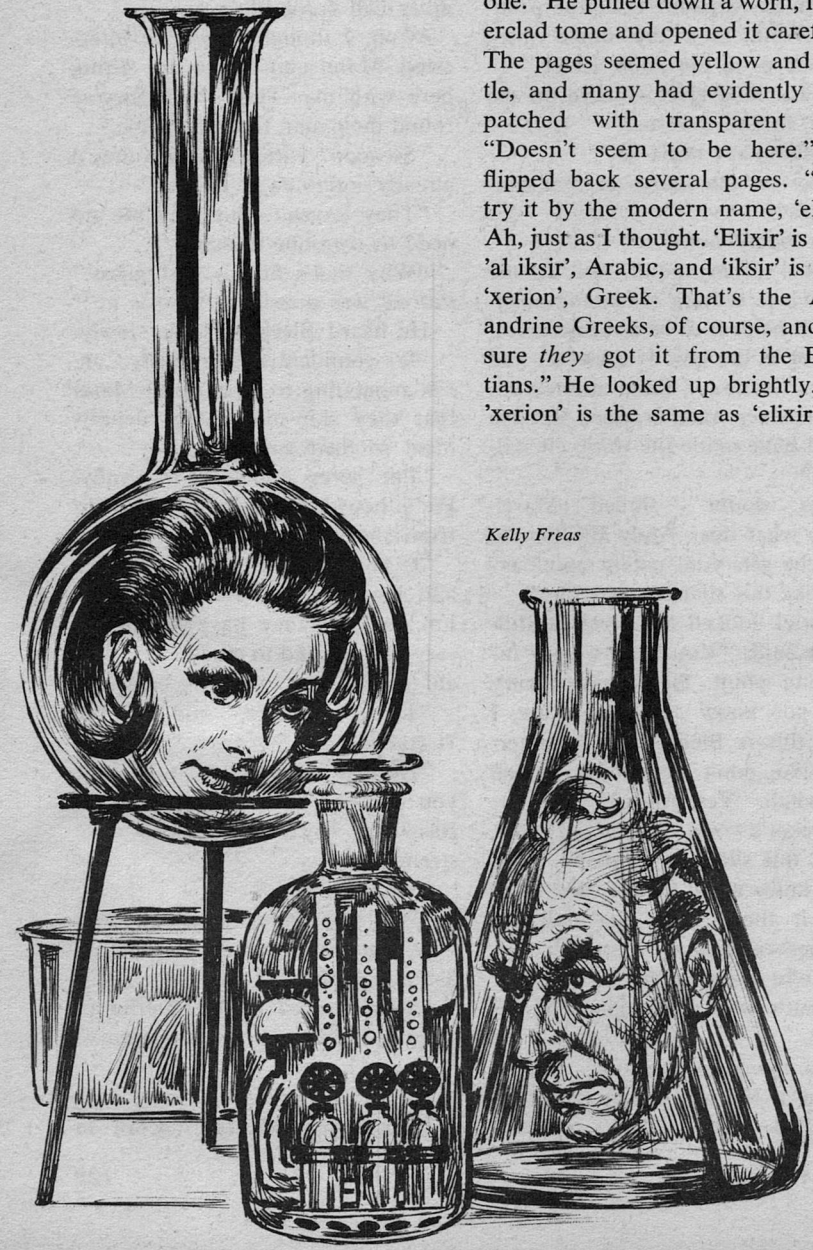
"Will you explain to me, Pierre, why you use so many words that are not in the dictionary?"

Celsus looked at Marguerite in surprise. "Not in the dictionary? Such as what?"

"Such as 'xerion'."

"Hm-m-m. Let's see." Chin in

hand, Celsus studied the volumes in his little book case. "Let's try this one." He pulled down a worn, leather-clad tome and opened it carefully. The pages seemed yellow and brittle, and many had evidently been patched with transparent tape. "Doesn't seem to be here." He flipped back several pages. "Let's try it by the modern name, 'elixir'. Ah, just as I thought. 'Elixir' is from 'al iksir', Arabic, and 'iksir' is from 'xerion', Greek. That's the Alexandrine Greeks, of course, and I'm sure *they* got it from the Egyptians." He looked up brightly. "So 'xerion' is the same as 'elixir'. I'd



Kelly Freas

forgotten they'd changed over, after Avicenna."

"May I see the book?"

"Sure." He handed it over.

"Alchemyia collecta," read Marguerite, looking at the frontispiece. "By Andreas Livau." Her eyes widened. "It was printed in 1895 . . . and it's all in Latin."

"Why, yes. One of the old standards. Still very useful, though."

"It must be worth a lot of money." She handed it back slowly. "Now we're down to 'elixir', at any rate. What's 'elixir', Pierre?"

"Why, I thought every chemist knew *that,* Marguerite. 'Elixir' is the exactly correct union of the four elements: the body—as represented by copper and lead; the spirit—as represented by mercury; the male element; and the female element. Some of the philosophers added gold, but I think that rather begs the question, doesn't it?" He looked at her expectantly.

"Pierre, you're making me feel very stupid. What does it *do?"*

"Why, it causes the reaction, of course."

"You mean it's the catalyst?"

"Well, not exactly. It would be more accurate to say it causes the silicon and terbium to react to provide the necessary reaction heat. The atomic number of silicon is fourteen, terbium is sixty-five. Add them together, and what do you get?"

"Seventy-nine?"

"Quite right. Terbium, at sixty-five, is only fair. It's not even a prime. Seventy-nine is perfect. It's a prime, a favorite of Pythagoras, and even though it's a rather low isotope, it's a sure thing for quantitative yields of silamine. Does that clear it up?"

The girl sighed.

"I like talking to you, Marguerite," said the man. "I'm glad Con Patrick has finally got a patent attorney who can understand real chemistry."

Marguerite looked at him quizzically. "Pierre, I'm glad you like me, because I like you, too." She measured her words carefully. "Would you come over to my apartment for supper some evening?"

The man looked at her in amazement.

The girl continued hurriedly. "I'm a wonderful cook. We could talk and play records. But you don't have to, of course . . ."

"Oh, no—it's a wonderful idea. I've never been to . . . I mean, I never had an invitation before . . . what I mean, is, I'd love to. When?"

"How about tomorrow evening?"

"But that's the first shift run on silamine."

"Did they ask you to be there?"

"No, but I think I ought to be."

"Pierre, there's a rumor going around. Ben Kober is trying to persuade Mr. Bleeker to let him make that first run, all by himself."

The man frowned. "You mean . . . they don't want me to be there at all?"

"They don't mean it that way, Pierre. They don't mean to slight you. Ben simply wants to check out the process. He wants Analytical to stay open all night, for sample analysis."

Celsus caught his breath. "Samples of what?"

"Why silamine product, I suppose. Is anything wrong?"

"No, not if that's all they're doing." He exhaled slowly.

"There's no danger in any of it, is there?" insisted the girl.

"Not if they follow the flow sheet."

"I'm sure that's exactly what they intend to do. See you tomorrow night?"

"Sure thing."

The next day Patrick got another call from Bleeker, this time to report to Bleeker's office, to review a problem with Ben Kober of Gruen.

As was his way with anything unpleasant, Bleeker got to the point at once. "Con, the Gruen people" —he nodded toward Kober—"have made a tentative selection for their Unit Profile. This time I agree with them."

Patrick pulled out his meerschaum, filled it expertly from his pocket pouch, and fired up. He puffed and waited. He did not intend to make it easier for the older man.

Bleeker took this all in. He smiled faintly. "It's Celsus."

"But tentative?" said Patrick.

Kober answered. "We're pretty sure. But we want to do one more thing. We want to take one of his projects and make it work all by ourselves, simply by following his written instructions. He will not be present."

"Have you picked a project?" asked Patrick quietly.

Kober looked at Bleeker.

"There's really only one," said the research director. "Silamine."

"In the new Fluidizer Bay?" asked Patrick.

"Yes."

"How am I involved?"

"Your man in the patent department and Ben Kober will both be trying to develop the identical information. Each will be trying to extract from Celsus the explanation of the silamine reaction. But there's a basic difference. Your man—"

"Marguerite French," murmured Patrick.

"Ah, yes, Miss French. Good man. Well, she'll be talking to Celsus on the theory he can and will explain the process. Kober will be talking to Celsus on the theory Celsus can't or won't explain anything. Each will be a check on the other. Both cannot be right."

Patrick groaned inwardly. He could not say it, and yet it had to be said, here, now, before this thing got out of hand. "Just suppose it's something not in the books—something Celsus can do but can't explain to anyone else how to do."

"Like what?" said Kober.

"Like telekinesis!" blurted Patrick. "Psi . . ." He blushed easily, and he realized with hellish discomfort that he was blushing now.

Kober stared at him in unabashed amazement.

Bleeker swiveled mercifully around and looked through the office window.

Kober gave a short embarrassed laugh. "I don't think you need me anymore. If you'll excuse me . . ." He left quickly.

Bleeker turned back to the patent director. He began swiveling in slow unease. "Con, I appreciate your telling me your views, especially in front of Kober." The monotonous oscillations continued. "However, please understand me. I cannot accept psi as an explanation. That's as bad as alchemy; we've been through all that. To put the matter even stronger: even if what you say is true, I couldn't accept it as any part of our normal research effort. Maybe psi is all right for esoteric seminars at the universities, where they don't really bother anybody. But it is *not* all right in a modern chemical laboratory. How could we put twenty million dollars in a silamine plant, when start-up depended on the availability of Pierre Celsus? And suppose we went through with this plant design and license with the Peoples Republic? Could we give plant guarantees? What if we truly did have to have some hocus-pocus from Celsus to get the plant on stream? Are we sure we could deliver Celsus on twenty-four hours' notice? And if we couldn't, would we be protected in our Force Majeure clause? Is Celsus an Act of God that relieves Hope of liability?" Bleeker leaned forward and looked at Patrick earnestly. "Con, this is madness. Don't even *think* about it anymore. It *can't* be psi."

"It *has* to be," insisted Patrick. "It was impossible, until he made it work."

The research director stared hard at Patrick. He said finally, "All right, let's assume that he *can* make just about anything work. Let's assume that he can even make an impossible reaction go, because he wills that it shall go. (Not that I believe it, not for a moment!) Let's say he can upset every known law of chemistry. Yet, if he alone can make it work, what good is it to the company? He can never explain it to the Engineering Department. You could never build a commercial plant based on his data. That's why Kober wants to conduct the new silamine process in the Fluidizer Bay personally."

Patrick sighed and got up. "Maybe you're right."

"Where are you going?"

"To see our psychiatrist."

"We all need it. Wish I had the time."

Patrick smiled.

Siegfried Walters was "free-associating." Inventors. Very few. Why does a man invent? *How* does he invent? There's an element of play in it. The best of them don't really seem to care whether it works or not. Indifferent. Barely one real inventor in a hundred. Steinmetz. White's "Organization Man" explained all this. I could do a paper with figures. Statistics. One man starts it all. Study him. Pick one man. The oddest. Pierre Celsus. Bleeker has this study going. This Gruen outfit. Profile. How long would it take them to find Celsus. And what will they do with a fistful of mercury?

His reverie was broken by the intercom. Conrad Patrick was waiting in the anteroom.

Walters chose his words carefully. "Con, you realize that I may not be able to tell you what you want to know. I cannot discuss confidential matters."

"Relax, Siegfried. I'm not going to let you get called up before the Ethics Committee. I just need a few nonconfidential facts about Pierre. I've assigned one of my women attorneys to him, and now I'm wondering if I did the right thing."

"How can I help you?"

"Is he dangerous?"

"No. At least not in the sense that he would pick up a wrench and start swinging. He has no wish to hurt—conscious or subconscious. Quite the contrary. He has been most helpful—to me, at least. In fact, our doctor-patient relationship has become somewhat . . ." The psychiatrist hesitated.

"Somewhat *what?"* demanded Patrick.

But Walters was silent.

Frustrated, Patrick tried another tack. "Well, is he sane?"

"Sane? For him, that question is either irrelevant or wrong. Were William Blake and Beethoven and Buddha sane? Is a Chopin nocturne sane? Consider the falcon, the tiger, the temple at Karnak, and a moonbeam on a field of snow. Are these things sane?" His head jerked as though to squelch Patrick's snort of impatience. "The point is, Con, all these things, these people, these creatures, are the best of their kind. Perfect. Unique. Standards of comparison that work for other things are meaningless for them. And you ask whether Pierre Celsus is sane."

"That still is the question," said Patrick grimly.

"Well, then, he's not sane. But not insane, either. Maybe the best word—and not really a good one—is *un*sane."

Patrick shook his head in helpless frustration.

"Take this study by Gruen," continued Walters. "They are trying to pick this one man, to summarize all that is wrong with this lab. But suppose that he also summarizes all that is right at Hope? Suppose that he adds up all the magic and mystery of chemistry—the control of mind over matter . . . sixty centuries of reacting things and coming out with other things?" He paused, searching for the phrases that would explain Pierre Celsus to the patent director. "Do you remember H. G. Wells' short story, 'In the Country of the Blind'?"

" 'In the country of the blind, the one-eyed man is king'?"

"That's just the point. He wasn't. Being sighted, he was regarded as a freak. When he talked about 'seeing', they thought he was crazy. They felt sorry for him. To cure him so that he could be a fit member of the community, they blinded him. If we're not careful, we might do the same to Pierre Celsus."

There was a pause. Patrick cleared his throat and studied the psychiatrist a moment. "Siegfried, I know this sounds crazy, but have you ever detected anything . . . unusual . . . I mean, really extraordinary . . ." He realized he must sound very strange. "Like—"

"Psi?" asked Walters quietly.

Patrick started.

Walters seemed almost relieved. "You do know, don't you? I wonder how." He took a deep breath. "I'm going to stretch medical ethics just a trifle, Con. Since one of your patent people will be working closely with Pierre, I think you are entitled to know something further about him—something you don't even know to ask about." He got up and walked over to the tape recorder. "Pierre and I make tapes. We do this every session, once a week. The theory is, the patient can replay the tape at leisure to reinforce his therapy. Except replay isn't the right word. Not the right word at all. Because some of the material on these tapes, the recent ones, was never spoken during the analysis."

Patrick was silent, expectant. Walters became almost pleading. "Do you understand what I have just told you?"

"I *guess* so," said the attorney hesitantly. "But there must be some logical explanation. Did somebody dub in something on the tape afterward?"

"That's what I thought, too, the first time it happened. The second time, I knew it was the right tape, even though I knew that what was on it was impossible."

"What *was* on it?"

"The *real* stream of consciousness. *The real thing,* mind you."

"What's so unusual about that? Isn't that the standard procedure?"

Walters leaned forward anxiously, as though it were essential to his own sanity that Patrick understand him. "Let me explain. We talk about the 'stream of conscious-

ness'. It's a great tool in analysis. When a patient starts to think out loud, his thoughts soon wander to topics closely connected with the experiences buried in his subconscious, the things causing his neurosis. The patient puts up road signs, as it were, to guide the analyst. Now, you will have to appreciate that in this oral free association, the patient's tongue is hopelessly outdistanced by his mind, which is racing ahead a mile a minute, hearing sounds, seeing and feeling things, and his tongue has to pick and choose out of this kaleidoscope of sensation a few meager, widely spaced scraps to pass along to the analyst. So a great deal is lost when the stream of consciousness passes through the speech bottleneck. I complained about this to Pierre in one of our early sessions. He . . . ah . . . solved the problem."

"Siegfried," said Patrick, "are you trying to tell me that Celsus is telekinetically imposing his thoughts on tape?"

The two men stared dumbly at each other. Patrick waited for the psychiatrist to say yes, to nod. But there was no gesture. In silence Walters picked up a spool of tape and put it on the recorder. Instantly the room was full of sound. There were cries, tense voices. Patrick looked at Walters.

"You'd have to be a doctor to recognize what's going on there," said the other. "A baby is being born."

"Incredible," breathed Patrick.

"You think *that's* incredible?" said Walters, almost pensively. "Then listen to *this.*" He put on a second tape, ran it soundlessly for a few seconds, then turned up the volume.

Patrick leaned forward.

Something rhythmic was coming from the speaker. ". . . Thub-lub . . . thub-lub. . . thub-lub . . ."

Walters snapped off the recorder. "Recognize *that?*"

Patrick shook his head in wonder.

"It's a heartbeat," said Walters quietly.

"Heartbeat? Whose heartbeat?"

"My mother's."

"Your . . . *mother's?*" Patrick's jaw dropped. "You mean, *your* mother's?"

"Of course. Whom did you think I've been talking about? It's *my* stream of consciousness. It's *my* prenatal recall. Remarkable, isn't it? Even Freud couldn't recall farther back than age three. Pierre has been helping me. He puts this beam —sort of a psi laser—on my cerebral cortex, and then reflects and focuses it on the tape."

Patrick gulped. "I see. Then when you said doctor-patient confidence, you meant that the *doctor* was—"

"Con," said Walters, looking at his watch, "you'll have to excuse me. I have an appointment."

As Patrick left, he met Pierre Celsus coming in.

"Well, Sieg, how are we today?" cried Celsus cheerily.

"You're late," said Walters petulantly.

"I was tied up on silamine." He smiled contritely. "Sorry."

"Well, let's get started," said Walters.

Celsus nodded gravely and sat down in the big leather chair in back of the couch. Walters walked over to the couch, where he lay down and crossed his fingers behind his head.

"I hope you've reconsidered what you threatened to do at our last session," said Celsus.

"No, Pierre. My mind's made up. I'm going back to Vienna for a long refresher course. I'll be gone several months. You've given me a terrible inferiority complex. In fact, I think I may be on the verge of total breakdown. They didn't teach psi at the University. They didn't prepare me for people like you. They let me down." His voice trembled. "I'm no good to myself, my patients, or to anybody."

"They didn't know," soothed Celsus. "It couldn't be helped. Psi wasn't accepted when you went to med school. I guess it still isn't. But you can't blame yourself. There's nobody to blame."

Walters' face twisted around. "You're not putting this on tape. You *know* I have to reinforce my therapy by replaying these tapes."

"Of course, Sieg. Right away."

There was a click from Walters' desk, followed by the almost inaudible whirring of the tape recorder turntable. Celsus had not moved from his chair.

"That's better," said Walters, mollified. He closed his eyes. "I've looked you up, you know . . . your kind. It's quite a story.

"Ten centuries ago the best metal workers were respected dealers in the black arts. That's where the *black* smith got his name. An oath taken on his anvil was sacred, and binding in the courts. In China, only the priests were permitted to work copper and bronze, because everyone understood that extra-human help was necessary. But this is all gone. Nowadays, when anything impossible happens in a chemical laboratory, science always assumes there's a perfectly good reason, and generally they're able to find some sort of way to reproduce the impossibility. They overlook the fact that before it was first done, it was often truly impossible. They overlook the nature of the man who caused it to happen that first impossible time. Often the man himself doesn't understand how he did it. He would resist knowing. Even those who have psi often refuse to believe it. Take Carothers and nylon, Bell and the telephone, De Forest and the triode, Roentgen and X rays, Goodyear and rubber. They did these things, and later, much later, their successors figured out why the thing worked. They want you to explain why silamine

works. But you can't. At least, not in terms that would make sense to Andrew Bleeker and Arnold Gruen.

"This Gruen thing. They're going to find you, you know."

"Yes, I know." The response came from the speaker on the tape recorder.

"You don't seem to be worried. Do you know what's going to happen?"

"Some of it," said the recorder, "but I don't know where or when."

"What will it be like?"

There was a silence. And then, as if to answer him, there came sounds from the speaker that the psychiatrist could barely make out. He sat up slowly, heavily, as though wakening from a dream. He was alone in the room. The impression grew on him that he had been alone for some time. He stared at the tape recorder, and now he understood the sounds. It was music. It was beautiful. He slowly recognized it. Bach's "Sheep May Safely Graze." And then other sounds began to emerge through the music in eerie counterpoint. He recognized the intrusive, incessant ringing of a telephone. Then an automobile horn. Then a woman's scream. And then there was a click, and the recorder stopped. Siegfried Walters pressed his hands to his face and groaned. "Oh, Freud, how could you have missed it!"

It was nearly midnight.

They sat on the sofa in Marguerite's tiny parlor, leaning back, and listening to Bach. It came to its lovely dreaming end, and continued to float in the silence.

Finally Pierre Celsus said quietly, "What do you want of me, Marguerite?"

"I want to be your friend."

"Always before, when somebody wanted to be my friend, he really wanted something else."

"I know, Pierre. I once hoped you would explain—*really* explain—your silamine process to me." Her voice became morose. "But I gave up. I don't care anymore."

"But we've been through all that, Marguerite," he said patiently. "The reaction needs heat in an amount available only in a nuclear process. So we provide that. The terbium reacts with the silicon. The atomic number of silicon is fourteen. Terbium is sixty-five. To make them react, we simply feed in a little xerion. It doesn't react all at once; it's continuous—over several hours. This gives the necessary BTU's over the required reaction period. In fact we get a little *too* much heat. That's why we have to cool the fluidizer column. We cool it with liquid ammonia, which we heat exchange from the hot column. This vaporizes the ammonia, so we just use the resulting vapor ammonia as the combination fluidizing and reaction vapor. The vapor ammonia reacts with the suspended silica particles, and out comes sila-

mine. But you know all that. Why do you want to hear it again?"

The girl was puzzled. "You mean, the terbium oxide *really* reacts with the silica?"

"Of course. The xerion, or elixir, causes it. Some centuries ago, it was a very well known catalyst for this kind of reaction."

"I don't think it's in *Gmelin*."

"No, I suppose not. But of course *Gmelin* is concerned only with chemical reactions. There's nothing nuclear in the *Handbuch*."

"Nuclear . . . ?"

"Of course. How else could you get the necessary heat." He looked at his watch. "Kober ought to be finishing the first silamine run right now. You're sure he isn't changing anything?"

"Not really. I think he plans to collect the catalyst, after the run, to analyze it."

The man started. "What do you mean, collect it? He's supposed to discharge it into the alkahest."

"Why, Pierre, I'm sure I don't know. Can't he simply ladle out a sample from the alkahest?"

The man's voice was suddenly harsh. "The alkahest will dissolve anything he dips into it. And *then* what will he try?"

As she watched, the blood drained slowly from his face. Yet, when he spoke, his voice was controlled, almost resigned. "I have to go now, Marguerite."

Troubled, she did not try to stop him.

But after she heard his car drive away from the front of the apartment building, she began to worry in earnest. She had a premonition that something terrible was going to happen. But what? In fact, what *was* happening? What was going on, down at the lab, right now? Why did the process work at all? What was terbium plus silicon? Suppose you added their atomic numbers? What was sixty-five plus fourteen? Seventy-nine. And what element was number seventy-nine? It could be . . . but it couldn't be . . . She jumped up, ran over to her bookcase. *Ephraim* would have it. She flipped through the pages. There it was, "Gold, atomic number 79." Pierre Celsus was making gold. *That* was his nuclear reaction, his source of tremendous heat. The wisdom of the ages applied to making silamine in the Twentieth Century. And if gold were really there, it was there as auric oxide. And auric oxide, ammonia, and water would react to form—gold fulminate.

She whirled, seized the phone, and dialed rapidly.

Marguerite's voice was low, urgent. "Ben? Ben Kober?"

"Yes? Who is it?"

"Ben, this is Marguerite French. I want you to listen carefully."

"I can't talk now, Marguerite. The silamine yield was twice what we expected. The collector overflowed, and I had to shut down.

I'm still mopping up." Kober sounded irritable, impatient. "Marguerite, I'll have to call you back."

"No, Ben! This is extremely important. Just tell me this: Are you running the spent catalyst into the alkahest—all of it?"

"No, I'm not. That alkahest stuff is—crazy. I tried to ladle some spent catalyst out of it with an iron dipper, and the whole dipper dissolved. Anything that goes into that alkahest is *gone*. The only way to collect a sample of catalyst is to dry it with hot air, *in situ*, in the fluidizer columns. Which is what I'm doing now. And as soon as it's dry, I'm going to take samples for analysis."

"That's what I thought. Ben, you must get everyone out of the Fluidizer Bay, instantly."

"There's no one else here."

"Then get out, yourself. Don't even wait to cut the switches."

"And why should I get out?"

"The catalyst is going to blow."

She heard Kober's curt chuckle. "You don't say. This is just plain silica, Marguerite. Sand."

"It is *not*. If I tried to explain, it wouldn't make any sense to you."

"Try me."

"Some . . . gold . . . has got into the fluidizers. This has reacted with the ammonia. The whole unit has been working with gold fulminate coating the silica. The fulminate was harmless, because it was wet with by-product water, and Pierre intended that it all be dumped into the alkahest, where it would—disappear. But now you're drying it in the fluidizers. As soon as it's dry, it will explode."

"Gold . . . fulminate—?" said Kober slowly.

Marguerite continued with a sense of desperate futility. "Yes. You get it when you react auric oxide with ammonia and water. When it's hot, it detonates by friction. Your drying conditions are perfect."

"Marguerite, have you been drinking?"

"No, Ben. Just a couple before dinner. That was hours ago."

"You had dinner alone?"

"With Pierre."

"Now, Marguerite, let's consider this thing calmly. I don't know what nonsense Celsus has been feeding you. But believe me, there's not a trace of gold in the whole silamine system. We analyzed everything that went in, and I've been here from the beginning. Celsus is just trying to queer the whole run, because he wasn't asked to supervise it."

"No, Ben, it isn't that way at all. I know there was no gold in the catalyst in the beginning. *But there is now*."

"Impossible. The seals on the fluidizer and the feeder are still intact. There's absolutely no way for anything, gold, silver, or your fine pea soup to get into the reactor."

Marguerite felt her slight body begin to shake. She took a big breath, then exhaled slowly. When

she spoke again, her voice was quiet, with the calm of fatalism. "Pierre did it. By a technique that neither you nor I could possibly understand. There is reason to think that he is an . . . alchemist. You know . . . philosopher's stone . . . xerion . . . alkahest . . . universal solvent . . . the whole bit. He can create gold on the silica—*out* of the silica. That's what provides the heat."

Kober said curtly, "I must say, Marguerite, this is the last thing I'd expect to hear from one of your standing in this company. What are you trying to do to our survey?" He continued with mounting bitterness. "The patent department stands to gain as much from our study as any group in the lab. I know Gruen has enemies. We expect that. But not at your level. You can be sure Bleeker will be told."

There was a click.

"Ben!" screamed the girl. Instantly, she dialed back. She listened to the ring for a moment, and then there was another click. "Ben? Ben?" There was no answer, and she finally realized that Kober must have taken the phone off the cradle. And that meant her own phone was dead. She could not call Patrick.

Within seconds Marguerite had pulled on her coat and was running downstairs to her car. Patrick. Kober would listen to Patrick. And fortunately Patrick's house was on the way to the lab.

In five minutes she was simultaneously jabbing at Patrick's doorbell and pounding on the door. The lights came on after what seemed forever, and Patrick stumbled downstairs, pulling ineffectually at the sleeves of his robe, red hair and moustache awry. "I'm coming, I'm coming," he called hoarsely. "Marguerite, what in the world!"

She had a momentary impulse to dump the whole thing in Patrick's lap and then collapse. But suppose *he* didn't believe her either? What then? She couldn't take the chance. There was only one way to do it.

She said quickly: "Emergency at the lab. Where's your phone?"

Patrick was already moving into the study. "This way."

"Call the night watchman. Tell him to call an ambulance. And tell him to stay away from the Fluidizer Bay. Then you follow me down."

"I'll be right behind you, Marguerite. Don't take any unnecessary—"

But the front door had already slammed behind the girl.

Marguerite's ride down Route 29 to the lab had a vague, dreamlike quality. At eighty miles an hour, the car seemed floating lazily. Ridiculous irrelevancies flitted through her mind. It can't be happening. Not now. Not today. Not in the Twentieth Century. Perhaps it would be all right in some dark Thirteenth Century cellar, but not at the Research Laboratory of Hope Chemi-

cal Corporation, organized and existing under the laws of the State of Delaware, United States of America, and having a principal place of business at Camelot, Virginia.

Somewhere behind her she heard a siren howling, and her eye caught a blinking red light in her rear-view mirror. Ambulance? No, patrol car. She laughed soundlessly and turned up the drive into the lab grounds. As she did so, she saw ahead of her another car already far up in the drive, already drawing to a halt at the first of the buildings. In a moment of dark prescience, Marguerite knew it had to be the little red compact of Pierre Celsus. And it was plainly Celsus who ran into the building.

Marguerite honked her horn savagely. Then she screamed. "Pierre! Pierre!" It was useless. She pulled in behind the other car, brakes screeching, and ran in through the lobby, then dashed down the corridor toward the Fluidizer Bay. As she burst through the swinging doors of the Bay, she thought she was in time. Celsus and Kober were struggling on the floor by the silamine control panel. Each of the three fluidizer columns was gleaming peacefully under the bright fluorescent lights.

She saw Celsus break away, reaching for the switches.

Then the first column exploded.

The blast, projecting outward, for a microsecond bathed Celsus in an iridescent spray, outlining his shadow on the gray-painted concrete block wall behind him.

In that moment a great wind lifted the girl, almost gently. She closed her eyes by reflex, and wondered whether her back would be broken when she was hurled through the doors behind her. But she did not touch the doors, because they were burst from their hinges even before she was thrown through the doorway. Then there was a second blast, and something massive whistled over her head while she was still in the air. The third blast was complete before she stopped skidding down the hall. All three fluidizers had blown in sequence. She picked herself up and ran back to the doorway, where Kober passed her, staggering, coughing, face bleeding.

Inside, Celsus lay face down in the wreckage of the silamine unit. In the bay, a merciful pall of dust swirled slowly, and nothing was recognizable.

She gathered her crumbling wits and stumbled down the stairs to the body, lying small and rumpled on the concrete floor. She knelt down, thrust her hands gently under the armpits, and began to drag the body slowly toward the stairs. She was met halfway by Patrick, who seemed to have materialized from nowhere. Together they got Celsus into the hall. He was unconscious, but breathing regularly, and no bones seemed broken. By now they

had been joined by Kober, the night watchman, a state trooper, and two ambulance attendants.

Celsus, amid groans, tried to sit up. Patrick peremptorily pushed him back down. Then, as Patrick straightened up, he looked back into the Bay. He pointed, wordless. Marguerite stared with him.

The dust was settling, and as it settled, it was changing color. It went through the spectrum. It was pink. Then it was blue. Then purple, brown, black. The emergency lights were turning green, and Marguerite knew that this had to be so, because gold was translucent in thin sections and transmitted green light. The aluminum blinds just beyond the fluidizers were momentarily purple, with the instant formation of gold-aluminum alloy, and even as she watched, the color was changing to a more golden luster. Even the iron stair guard was changing, the blue of the ferro-gold creeping rapidly up toward them. And then the shift of colors slowly ceased, and an aureate patina lay everywhere. Marguerite knew then that every piece of exposed metal in the bay, from the wrecked fluidizers to the sink fittings, was Midas-stricken.

And then Patrick pointed again, this time across the great room, toward the opposite wall. On that wall was the shadow of a man, blast-written, one arm raised to them in eternal greeting, a gray silhouette stenciled within a scintillating sheet of golden particles embedded in concrete, a chiaroscuro of darkness and shining promise, a thing to measure them forever.

"What it is?" whispered Celsus.

With awe, Patrick replied, "Your profile."

The Staff Room, used regularly by Bleeker for the monthly meetings of his department heads, was kept on a continuing standby basis by Miss Sally for instant emergency use. To ensure this condition of perpetual preparedness, she had made it clear to her boss and his lieutenants that the pencils, tablets, and ash trays in front of each chair were there solely for puposes of state and were never to be touched. Patrick, who felt naked and insecure without his meerschaum, met the ash-tray problem by hiding several in an old briefcase in the drawer of the big conference table. The conferees, of course, took notes, if any, on paper they brought with them. Bleeker sometimes assigned to one man, generally Henry Pfennig, the comptroller, the task of "writing up" the meeting for circulation to all participants, after checking the draft with Bleeker, who occasionally added a few comments, which, although never said in conference, should, on his due reflection, have been said. And sometimes he struck passages—his own and those of others—which he felt were inconsistent with conclusions reached after the conference.

Except for Bleeker, the seating at

Bleeker's conferences was a matter of subconscious choice. Bleeker always sat at the head of the long table, like the captain at the helm. From there on, the seating varied, depending on the type of meeting expected. If it were rumored that Bleeker was going to read a letter of praise from the Board of Directors for accomplishments of the past year, all the chairs close to the head of the table were likely to be occupied. And contrariwise, if the meeting were rumored to deal with matters of budget cutting, then the staff shrank to the far end of the table in an anxious cluster.

This morning of course, as everyone knew, the conference sat as a court of inquiry, and from this fact the proper seating emerged. Patrick, as counsel for the defense, took the end of the table opposite from Bleeker, the judge-prosecutor. The defendants, Celsus and Prentice, took seats together, alone on one side of the table, and opposite them, Gruen, Kober, Bond, Pfennig, and Marvin—of Personnel—formed the jury.

Pierre Celsus stole uneasy glances at the unsmiling faces opposite him. He sighed and dropped his eyes. He knew he had sinned chemically. Because of him, three people might have been killed. His process had demolished equipment worth many thousands of dollars. The project had been set back by several weeks. Now, in fact, silamine might never reach the pilot plant stage.

Initiative, he had been told, was valued at Hope, but, he suspected, not when it resulted in disaster. That was when they stopped talking about brilliant breakthroughs, and started talking about sheer crass sophomoric stupidity. There was no use in trying to explain anything. Those few who accepted his talent required no explanations; to those who did not accept psi, no explanation was possible.

He knew he was through at Hope. He wouldn't mind being fired, except for Marguerite. He was going to miss Marguerite. He slumped miserably down into his chair. Prentice looked at him for a moment and then did the same.

Bleeker looked slowly around the table. "I think you all know why we are here. Last night's explosion merely brought matters to a head. Apparently this situation has existed for some time, and with certain exceptions"—he nodded gravely to Patrick—"we have been too blind to see what has been going on. I have asked all of you here to help me decide on a course of action. And Pierre, I'll start with you. Do you really have this power, psi, or whatever it's called?"

"Yes, Mr. Bleeker, I guess I do."

"And Prentice, he has it, too?"

"He has it, too, but I'm still teaching him how to control it."

"Perhaps both of you could use a little more instruction," said Bleeker dryly.

"Kober shouldn't have tried to

dry the catalyst," said Celsus shortly.

"I don't hold him blameless," said Bleeker. "But the question is, what do we do about it. I take it, Pierre, this is by no means the first time you have used psi in our research?"

"That's right, sir. Only, this is the first time we got caught."

Bond asked curiously, "What were the other times?"

"Different times. Certain processes required high exotherms, and we provided the heat the same way that we did for silamine, by nuclear reactions in which we made gold *in situ*. And then we got rid of the gold in various ways."

"How do you mean, various ways," asked Bleeker.

"Well, last year we ran the effluent into a tank of ferrous sulfate-sodium hypophosphite. The iron came out as metallic iron, of course, and then immediately alloyed with the gold, to give crystals of green iron-gold alloy. It sat around in the solids-disposal vat, near the parking lot, for several weeks before it was hauled away. Mr. Pfennig used to toss his cigarette butts into it, coming to work every morning. Another time we hid the gold as nice purple crystals of aluminum-gold alloy. Nobody noticed, because everybody thinks that gold is gold-colored."

"Why did you switch over to alkahest, in the silamine process?" asked Bleeker. "Why didn't you figure out another way to 'hide' the spent catalyst?"

"We were afraid there would be too much catalyst to hide. We needed something that would absorb hundreds, even thousands of pounds of spent catalyst. It had to be the alkahest."

Pfennig turned his cold blue eyes on Celsus. "Gold is worth thirty-five dollars an ounce. How many ounces, all told, did you throw away?"

Celsus studied the ceiling. "Well, from the beginning, I guess there was a total of about three or four hundred.

Pfennig's eyes widened. "Four hundred ounces? That's fourteen hundred dollars!"

"No, Mr. Pfennig. I meant four hundred pounds. Twelve ounces to the pound, troy weight."

"But that's"—his voice rose in a horrified shriek—"one hundred sixty-eight thousand dollars!"

"Spare us the arithmetic, Henry," said Patrick. He turned to Celsus. "About the silamine unit. You started it with psi. You heated it with nuclear psi. Could you shut it down with psi?"

Celsus and Prentice exchanged glances. Celsus rubbed his chin. "In the sense you mean, I think the answer is 'yes'."

"Without blowing up the plant, I mean," said Patrick hastily.

"Of course."

Patrick relaxed back into his

chair, fired up his meerschaum, and smiled across at Bleeker as though to say, "Your witness."

"I don't see your point, Con," said Bleeker impatiently. "Who cares whether he can *stop* it? I think we'd better go on to the technology of the operational process. Pierre, about this alkahest: Is this a true universal solvent?"

Celsus shrugged his shoulders. "I think so."

"Then why," demanded Kober triumphantly, "doesn't it dissolve the vessel that contains it?"

Celsus looked at Prentice. The latter grinned, then replied, "That's easy. The solvent isn't in direct contact with the container. Also, I don't believe the solvent action is really chemical."

"You don't *believe*!" sneered Kober. "You admit you don't know?"

"That's right. We think it's more —mental-electrical. To activate it, we have to set up these encephalographic oscillations. In fact, we think that anything that goes into the alkahest truly disappears—dematerializes. Now, if we had a companion psi field, we might make it rematería . . ."

"I believe that's enough for now," said Bleeker quietly. "Pierre, would you and Prufrock be good enough to wait in the anteroom? I'd like to discuss this further with the rest of the group."

After the two had gone, Bleeker looked around the table. "And now, I want some constructive suggestions."

"The answer's obvious, Andy," said Pfennig. "These men are dangerous. They've destroyed equipment, nearly killed a couple of people, fouled up orderly administrative processes, and driven our psychiatrist crazy. We'll have to let them go."

Bleeker looked thoughtful. He glanced over at Bond. "Jim?"

The Silicon Group Leader spoke with slow dignity. "I've been with this company ever since I got out of graduate school. When I arrived here, the lab was one wooden shack in the middle of a corn field. Our pilot plant was an old bathtub. I watched the first brick building go up. I've spent my professional life watching Hope Chemicals grow into the giant it is today, and I like to think I've done my share to help it grow. We did this by science, by ordered imagination. And we can keep doing it. We don't need magic or chicanery. Are you going to let these men louse up a generation of Hope chemistry? In fact, will you let them destroy several centuries of genuine science? Are we to return to the Dark Ages? And suppose we branch out into alchemical processes—do you think it will end there? What lies beyond alchemy?" Bond's mouth wrenched bitterly. "Can't you see what will happen? This means the breakdown of modern chemistry. It's like Einstein and the collapse of classical physics, except

this will be worse—much, much worse."

Bleeker winced. "You brought out a number of interesting points." He turned to Gruen. "Arnold, how does our consultant say?"

"Even if it's all true, what Celsus claims, this talent, which I very much doubt, I suggest that you wait a while. Let some of the smaller, irresponsible chemical companies make fools of themselves. Of course, in the remote event it works, then Hope can always pick it up."

"I see. Dave?" Bleeker nodded to Marvin of Personnel.

"Insane," muttered Marvin. "If any rumor of this thing leaks out, we'll never get another serious job applicant—just kooks."

"And now, Con," said Bleeker. "It's your turn. What's the legal viewpoint?"

"I've looked into a number of points," said Patrick, "but I'm sure I haven't caught everything. Our corporate charter is silent on alchemy. It says generally, though, that we can engage in any lawful activity in the chemical field. The early Virginia laws against witchcraft and magic were repealed in the Eighteenth Century, during the Williamsburg days, and I believe we could argue that any implied restrictions against alchemy were abolished at the same time. At the national level, though, there may be a problem on alchemical gold-making as such. Nuclear processes belong by law to the Atomic Energy Commission. If word got out, the United States Government might seize Celsus and Prentice by eminent domain. Furthermore, aside from a little jewelry use, the only real market for gold is the United States Mint. We seem to be clear, though, on all other alchemical processes, such as silamine."

"Can we take out patents on these processes?" asked Bond heavily.

"No. Not at present. There are no specific statutes permitting psi patents. Also, the United States Supreme Court held in Halliburton v. Walker that a patent claiming a mental step is invalid. This is a gap in our patent statutes that can be overcome only by legislation specifically aimed at psi patents, just as the Plant Patent Statute was enacted in 1930 to protect certain new varieties of plants. But I'm not sure we want psi patent legislation. Not yet, anyhow."

Bleeker looked at him curiously. "If we can't get patent protection, what's to stop Celsus from leaving us and setting up a competitor in the silamine business?"

"Any court in the country would give us an injunction against that," said Patrick. "His employment contract with Hope says that we own all processes he developed here, and requires that he won't disclose our processes to any subsequent employer. On the other hand, if we make life attractive for him here, why would he want to leave?"

"You mean," said Bleeker, "have him *deliberately* develop more psi processes?"

"Certainly, and hold them all as trade secrets. Exploiting psi techniques as trade secrets will have many advantages over our normal patent procedures. In the first place, you don't have to worry about infringing adverse psi patents. There aren't any. Secondly, most foreign countries can force you to grant a license under your foreign patents. We'd never have to worry about that. With psi, we can always pick our own licensees. Thirdly, all patents finally expire. But a psi technique need never expire."

Bleeker leaned forward and peered keenly at Patrick. "Let's get specific. Suppose we license silamine to the Peoples Republic at a running royalty. How do we enforce payment?"

"They pay or Celsus shuts them down," said Patrick simply.

Bleeker studied the blank pad in front of him. His face held no expression, but his mind was racing, searching. The answer was here, if he could only put his finger on it.

"Besides our own plant," continued Patrick quietly, "we would have licensees in all civilized countries. But of course," he shrugged, "it's only money."

Bleeker stared at him with widening eyes. "Money . . ." he whispered. And suddenly he saw the solution . . . the answer . . . the way out. And with this came a shocking, awesome insight into those glacial faces in Richmond, with their rimless spectacles: the Hope Board of Directors. They had put him here, knowing that when this moment arrived, he, and he alone, would know what to do, and would be worthy of their trust, and of the fabulous salary they paid him. It made a man very humble. And yet, it was so easy, and so obvious, at least to him. He felt almost sorry for his department heads, with their routine minds, thinking only of patents, of personnel, of run-of-the-mill research problems, and of the ordered progress of science.

"Arnold," said Bleeker to Gruen, "before we get too far with this, I want to thank you on behalf of Hope. Without your survey, we might never have discovered this potential hidden in our midst."

Gruen was puzzled, but took it in stride. He had not reached his present eminence by rejecting undeserved credits. "We simply did our duty," he said with noncommittal modesty. That, he thought, would take care of most anything.

Ben Kober stared in bemused silence, first at the research director, then at Gruen.

"Does this mean," demanded Pfennig with painful perception, "that Celsus and Prentice stay?"

Bleeker nodded. "Of course they stay. But that's just the start. Call them both back in, will you, Henry,

and let's get this thing organized."

The two men came back in hesitantly, looking scared.

"Gentlemen, be seated," said Bleeker genially. "Pierre, I think you'll be delighted to know that we're going to set up a group for you, a psi group, devoted exclusively to alchemy. You can work on anything you like, so long as it's a money-maker, of course."

Celsus slowly relaxed. "Why, that's wonderful. However, I wonder if you could make it retroactive to last month, when the moon was in Aries?"

"Astrology!" cried Pfennig. "What incredible impertinence!"

Bleeker held up his hand. "The auspices were at their maximum then?" he asked Celsus gravely.

"Yes, sir."

"Call me Andy, Pierre."

"Yes, Andy."

"So be it. Now, Pierre, everything should have a name. What shall we call your new group?"

Celsus looked doubtful. "Most anything. 'Special Projects' . . .?"

"Too tame," said Bleeker. "How about the 'Alchemical Group'?"

"Andy!" cried Dave Marvin. "The Board of Directors will think you're crazy!"

"Crazy, Dave? If it makes money, it can't be crazy. That's a contradiction in terms. Anyhow, if the Board notices it at all, they'll think it's just another promotion gimmick of our Madison Avenue ad agency. You know, like 'miracle plastics', 'miracle cigarette filters', 'miracle detergents', except that they'll be pleased that we're not using a tired, overworked word like 'miracle'."

"They'll find out sooner or later," said Bond sourly.

"I know. But by then the silamine contract with the Peoples Republic will be making so much money they won't care what we call it."

"With that name, we'll be tipping our hand to the competition," demurred Marvin.

"The industry may eventually find out," conceded Bleeker. "But at least this will delay the discovery. This way, they'll think we're joking. Everybody knows there's no such thing as alchemy. But if we called it 'Special Projects', they'd have spies in here overnight. Our best camouflage is to be wide open. Business as usual. So we have a name." Bleeker leaned back. He was enjoying himself immensely. "And when we sign that Peoples Republic contract, we'll automatically have to spend ten per cent of the receipts on supporting research. So now let's staff the new group and give this thing some functional structure." He looked across to Celsus. "Pierre, you'll need an Assistant Group Leader. Anyone in mind?"

"Well, Prufrock and I have worked together—"

"Oh no!" groaned Pfennig.

Patrick shot a warning glance at the comptroller. "Don't say it, Henry," he said quietly.

"I *will* say it! A. P. Prentice—*the sorcerer's apprentice!*"

Bleeker looked at him thoughtfully. "Well, there's an idea. 'Sorcerer's Apprentice.' Hm-m-m. Perhaps we should use *that* as the title, instead of 'Assistant Group Leader'. It goes nicely with the alchemical motif. Is that all right with you, Prufrock?"

"It's fine with me," said Prentice. "I never had *any* title before. Can I use it when signing mail?"

"Certainly. Now, then, let's go on. Hope has big insurance policies on the lives of its key executives, payable to Hope, of course. Henry, we'll need something like that for our people in the Alchemical Group, something similar to a violinist insuring his hands. Only here, we're covering loss of psi."

"I'll try Lloyds of London," said Pfennig. He added cynically, "The premium should be fairly cheap, if we tell them it's for continuance of *existing* talent."

"Fine," said Bleeker. "Now, the new group will need some technicians. Dave Marvin can take another look around here, for talent. And also, Dave, will you line up a good body-snatching technique for locating psi talent in the colleges . . . and among our competitors. When we set up our job application booths at the A.C.S. conventions, include some way to catch the psi's."

Marvin looked dubious. "We stopped the A.C.S. job booth months ago. As you may recall, Con, we borrowed your Miss French to take the applications. Very attractive young lady. And we got more applications from our own lab than we did from the competition."

"Try her again," said Bleeker. "At least, this way maybe she can detect some talent in our own applicants. Now then, for the universities. We ought to sponsor some graduate research. Two or three fellowships to start. Pierre, any ideas?"

"Oh, there's plenty of projects. Psi-rearrangement of plant chromosomes for better crops. And Prufrock could use some blue sky research on the operation of the alkahest."

"Sounds good," said Bleeker. "How about placing them with Duke University? They've done a lot of work on psi phenomena."

Patrick frowned. "I don't know. Duke is too ivory tower for my taste. They've been in this field for thirty years, and never made a nickel on it."

"All right," said Bleeker, "we'll try a school with a more realistic approach."

"How about the University of Transylvania?" said Bond acidly.

"Just the thing," said Bleeker. "And that'll give us an objective foreign viewpoint, too."

"Also," said Celsus, "we ought to place a project on psi-control of Maxwell's Demon, for our thermodynamic studies."

"For that one," said Bond wearily, "Texas Christian University."

Bleeker beamed at him. "The very thing!" He studied his notes. "Consultants. We ought to have a couple of top-flight men."

"We need a good astrologer," said Celsus.

"Fine. Get some names. I'll go over them with you. Any others?"

"I've been corresponding with a man in Trinidad . . . a *houngan.*"

"That's voodoo!" hissed Pfennig. "And it's outlawed there."

"The government of Trinidad is squarely behind its new chemical industry," said Bleeker smoothly. "I'm sure they would help us in making the necessary arrangements for a bona-fide chemical consultant, such as Pierre's friend."

"We'll also need a computer expert," said Celsus, "at least one, for programming our machine translators."

"What for?" demanded Kober.

"It's for the incantations for our foreign licensees," explained Celsus. "For example, English won't work for the Peoples Republic plan in Czezhlo, and I don't know whether we could trust an interpreter."

"Agreed," said Bleeker. "One computerman. Now, we'll need a trademark for silamine. Any ideas?"

" 'Psilamine'," said Patrick, sounding the 'p'.

"Will the Patent Office register that?" demanded Bleeker. "Isn't it descriptive?"

"Is the Patent Office going to believe it's made with psi?" countered Patrick.

"I suppose not. Very well, then, 'Psilamine' it is."

Patrick broke in. "The new group should include a Trade Secret Officer, to work on psi inventions in liaison with my own department. He could take quite a load off us."

Bleeker looked at Patrick blankly. It was incomprehensible that Patrick should recommend that the function of the Hope Patent Department be diminished in favor of a competing group. As Patrick continued, however, Bleeker relaxed.

"Marguerite French is the obvious candidate for the job," said Patrick. "And, of course, I'll need an additional man in *my* group to work with her, besides another attorney to replace her."

"Seems reasonable," said Bleeker. At least, he thought, it fits the pattern. Whenever we figure out how to eliminate one man, we find we need two more to replace him. He sighed. "All this is going to cost a lot of money. So let's start making that money. Con, if you will blueback a couple of execution copies, I think we can sign that contract with the Peoples Republic."

So the world's first commercial silamine plant was built. The day it went on stream Comrade Sasanov dedicated the plant to the Peoples Republic in an elaborate ceremony,

with ribbon cutting, valve turning, and Pierre Celsus standing beside the machine translator awaiting the signal to start the punched-tape incantation.

Three months later Pfennig telephoned Beeker. "The first royalty check is now one week overdue."

This struck a chill to Bleeker's heart, but he kept his voice assured and cheerful. "Don't worry about it, Henry. I'll cable Sasanov."

The cables—and there were finally three—brought no response. Bleeker then telephoned the chancellery at Czezhlo. He got as far as the second assistant secretary. Comrade Sasanov was unavailable.

"Then give his excellency a message," said Bleeker in clipped fury. "We are going to close down your plant."

Across six thousand miles, he heard a polite purr: "How very droll, Mr. Bleeker! When, exactly, do you plan to shut down our plant?"

Bleeker thought wildly. Had he stepped into something? Still, Celsus had assured him he could, if necessary, shut the plant down. "Next Friday," he grated. "At midnight, Czezhlo time. And it will stay down until we get that check. Tell Sasanov."

A chuckle squeaked back through the static. "I shall, Mr. Bleeker, I shall indeed."

Even as he was hanging the phone up, Bleeker realized that he had violated the basic rule of leadership: he had made an emotional decision. Even worse, he would now have to call on his assistants to bail him out, and he hadn't the faintest idea how, or whether, they could do it.

Ordinarily Bleeker knew how far his people could be led, cajoled, threatened, coaxed, and pushed. He knew their inner resources, hidden strengths, latent ingenuities, better than they themselves.

But psi was different. He knew he didn't have the "feel," the insight, and the understanding that would surely bring forth the necessary team effort to solve the Sasanov problem. It would be like trying to conduct the lab symphony orchestra in an evening of Beethoven, when he couldn't even read music.

He glared bitterly across the room at the model of the silamine plant sitting on his credenza. The model had been painstakingly contrived in the lab maintenance shop. It had first been exhibited to the Board of Directors, and later, by special recommendation of the Hope President, it had sat in glory on a dais at the annual stockholders meeting in Richmond.

A dozen times in the past few months Bleeker had caught himself daydreaming in the direction of the model. The scene of his visions varied, but generally it was the bar of the Chemists Club in New York. He was seated there over cocktails with a couple of old friends, research directors with Hope's competitors,

basking in their eager, envious inquiries as to how he had pulled off that fabulous silamine license with Peoples Republic. He could see himself smiling in poorly-simulated self-deprecation. "Seems like magic to us, too." That's all he would tell them. And now the vision was fizzling out. If Sasanov refused to pay royalties, Bleeker would never dare show his face in the Chemists Club again.

Just now the model was gleaming at him in minuscule mockery.

He took a deep breath and buzzed his secretary. "Miss Sally, get me Mr. Celsus."

Bleeker looked gravely from the silamine plant model occupying the center of the conference table to the surrounding faces. "I want to thank all of you for coming, especially you, Dr. Dessaline. We apologize for the short notice."

The dusky *houngan* from Trinidad nodded inscrutably.

Bleeker continued. "As you all know, this is a real emergency." He looked at his watch impatiently. "Does anyone know where Con Patrick is?"

"He's on his way from the airport," said Celsus evasively. "He'll be here in a few minutes."

Bleeker sighed. Give a man a title, and the first thing you know he starts wearing a clean lab coat; next, he wears a suit, and the jacket matches his pants. But Celsus had not stopped there. He was now wearing a vest. He had obviously hired another very important—and very expensive—consultant. Patrick was probably bringing him in from the airport.

"We'll have to go ahead without Patrick," said Bleeker. "It's already five o'clock—eleven p.m. Czezhlo time. If we're going to accomplish anything, we have barely an hour. Pierre, what can we do?"

"I've reviewed the background with Dr. Dessaline," said Celsus. "We both agree on the basic approach. We must put a temporary hex on the Czezhlo plant."

"What does that involve?" asked Bleeker, curiosity breaking through his gloom.

"The principle of malediction is quite simple," said Dr. Dessaline. "The condemnation recital requires no set words. If it is sincere, if it comes from the heart, that is enough. Promptly following the incantation, the denunciator sticks the pin in the effigy—the doll, if you will. The entity represented by the doll instantly falls into a swoon and recovers only when the pin is removed."

"Doll?" said Bleeker apprehensively. "Of Sasanov?"

Dr. Dessaline smiled thinly. "Nothing so sophomoric, Mr. Bleeker. The doll we mean is this model of the plant, which Mr. Celsus brought in from your office just for this purpose. For a pin we can use almost anything—a knife, a ruler . . . this letter opener will do."

"I see," said Bleeker. He turned to Celsus. "*You* are going to perform this hex, I presume?"

"No, Mr. Bleeker!" said Dessaline quickly. "Not Mr. Celsus. You must not ask him to curse his own child! Even if he should try, out of loyalty to you, it probably would not be completely effective, because he could not possibly be sincere at the necessary subconscious level."

"Well, then," said Bleeker grimly, "who *is* going to do it? *You,* Dr. Dessaline?"

The *houngan* sighed. "I could do it, but I would need time for the necessary preparations, and I would have to collect suitable assistants, with specially tuned drums. This could be done only back in Port-of-Spain, and would mean a delay of several days. The dramatic effect of calling the exact time would be lost. Sasanov would not be sure that the shutdown was your direct act."

"Am I to understand, then," said Bleeker slowly, "that *nobody* can do *anything,* here and now?"

"We intend to try, Andy." Celsus studied his superior hesitantly. "I hope the budget will stand one more consultant?"

"I suppose so." Bleeker turned to Pfennig. "Henry, how much is this hex going to cost?"

The comptroller adjusted his pince-nez and studied his accounting sheets. "Depends on whether we charge it out as a normal operating expense, or whether we have to amortize it as a capital expense resulting from the transfer of assets held more than six months." He cleared his throat. "I must confess, I've had trouble in getting a clear answer from the Internal Revenue people—"

"Never mind," said Bleeker hastily. "If we really have to have another consultant for the hex, we can't bother about the expense."

"We need someone with unusual qualifications, Andy," said Arnold Gruen. "We have analyzed his profile. As a minimum, he must be a physical chemist with an international reputation. He must be a man of convictions, and not given to delicate nuances in his pronouncements."

(How curious, thought Bleeker. Not so many months ago, I had to ram the Alchemical Group down their throats. Now they are all telling me how it ought to be run.)

"To sum up," concluded Gruen, "he must be a scientific man of letters, sincere, yet eloquent in extemporaneous scientific discourse."

"This is all very fine," said Bleeker, "but where will you find such a man within the hour remaining to us?"

The door burst open.

Patrick and a stranger entered.

"Gentlemen," announced Patrick triumphantly, "Professor Max Klapproth!"

As a man, the group stood up. Patrick made the introductions.

Bleeker studied the newcomer with interest. Professor Klapproth

was a big man with a shaven skull, penetrating blue eyes, and an inquisitive tetrahedral nose. Bleeker had never before met him, but knew him by reputation.

Professor Klapproth's texts on physical chemistry had been standards in American universities for a quarter of a century. His research and publications in heat transfer, catalysis, and vapor phase reactions were classics, and his work on reaction rates had won him a Nobel prize. All of this he had done with a purity, logic, and economy of concept that was at once the inspiration and despair of his following throughout the world. He had turned down innumerable offers from industry, but freely accepted consulting assignments, on the theory that when he worked for everyone, he need not curb his tongue for anyone. Despite his outspoken independence, and despite the fact that he charged by the hour the fees asked by most other consultants by the day, he was in such demand that he was able to select assignments that really interested him. He delighted in going over a flow sheet for a few minutes and then pointing out to the dismayed client errors in design that would require hundreds of thousands of dollars to correct. He stood for no nonsense. There was an apocryphal story that he had dismissed a graduate student who had proposed as his Ph.D. thesis, "Free Will Aspects of Brownian Motion."

Yes, thought Bleeker, the boys have chosen well. He felt a warm glow begin to diffuse through his chest. For the first time in three days, he relaxed.

Patrick motioned Klapproth to a chair.

"I don't think I'll be here long enough to sit down, Mr. Patrick," said Klapproth curtly. He looked at his watch. "I hope to be on the next plane to Kennedy Airport."

Celsus glanced at the wall clock and smiled. "We'll have you on that plane, Professor Klapproth."

"Is that the plant model?" demanded Klapproth, pointing at the table.

"Yes." Dessaline handed the letter opener to the professor.

"And you want my opinion as to whether it will work?"

"Yes," said Bleeker.

"It can't possibly work," said Klapproth. "I went over the flow sheet thoroughly with Mr. Patrick as he drove me out from the airport. Someone is trying to make a fool out of you, Mr. Bleeker. You got hold of me just in time." He tapped the model fluidizer with the tip of the letter opener. "You'll need a fantastic heat input here—a BTU requirement that you could obtain only in a semi-nuclear reaction. But instead of heating, you *cool* the reaction. Also, you plan to dead-end spent catalyst continuously into *this* vessel"—he tapped the alkahest container—"which will certainly overflow within a few hours. And

another thing. Your reagents . . . xerion . . . alkahest . . . there are no such things. And finally, by your own admission, no silamine process can operate without being autocatalyzed by at least one molecule of preexisting silamine. Which is a contradiction in terms . . . an insuperable paradox."

"Might not all these problems be overcome by the proper application of psi?" asked Patrick innocently.

". . . *Psi?*" Klapproth stared at the patent director in open amazement. Then his face, forehead, and scalp slowly turned red. "Gentlemen!" he sputtered. "What do you take me for!"

"Mr. Patrick," said Bleeker soothingly—while carefully avoiding Patrick's indignant eyes—"is our patent attorney."

"Oh, of course," said Klapproth coldly. "I forgot." He looked about him suspiciously. No one seemed to be disconcerted or chagrined. One or two seemed actually pleased.

Celsus broke in hurriedly. "We have to watch our timing very carefully now. Would you say, Professor Klapproth, that any silamine plant represented by this model probably would not work?"

"It could not possibly work," snorted Klapproth. "And when I say a thing is impossible, IT'S IMPOSSIBLE!"

"Completely hopeless, would you say," prodded Patrick.

"Worthless, futile, useless . . ." echoed Klapproth.

"Ridiculous?" murmured Dessaline.

"And stupid, idiotic, feckless, moronic, otiose," boomed Klapproth.

Patrick stared at the man, transfixed by awe and admiration. Mark Twain, he thought, had not been more eloquent in his mule-skinner days.

But Klapproth had not finished. "A pixilated pile of junk . . . a raffish refugee from a scrap heap . . . a haphazard heap of harebrained hardware . . ."

"It's midnight in Czezhlo!" whispered Bleeker.

"Through the heart!" cried Dr. Dessaline.

Professor Klapproth lunged the letter opener into the vitals of the model. And then immediately jumped back in horror. "Mr. Bleeker," he gasped, "I don't know what came over me! I got carried away . . ." He leaned over to pull the knife out.

Dessaline seized his wrist. "Not just yet, professor."

"But—"

"No. We stick the pin in the doll. Now we wait. I think we do not wait very long."

"Wait? For what? What is this all about?"

"Dr. Dessaline means we are now waiting for a transatlantic telephone call," said Bleeker. "But we don't know how long it will take. Con, maybe you'd better take Professor Klapproth on to the airport."

Klapproth looked uncertainly at the faces around the table. He finally picked up his hat. It was clear that he considered himself among madmen. "Telephone call?" he muttered to Patrick.

"Yes, a Mr. Sasanov, in Czezhlo," explained Patrick. "Just now, you put a curse on his silamine plant, and Mr. Sasanov is going to call Mr. Bleeker and tell him he'll pay up his back royalties, and then he'll ask Mr. Bleeker to get the plant started again."

The visitor stepped back uneasily. "Don't bother about me, Mr. Patrick. I'll get a taxi at the desk."

The phone rang. Bleeker picked it up. "Yes, operator, Bleeker here. By all means, put him on. Comrade Sasanov, what a delightful surprise!"

In the excitement no one noticed Professor Klapproth's flight. ■

IN TIMES TO COME

It's been a long time since we first presented a "Cover by Bonestell"—next month's issue will have our first Bonestell cover since the (O.K. long-timers—when *was* the last?!)

It's a beauty—of course—and was worked out in detail by a collaboration between Bonestell and Poul Anderson. Poul invented the planet and The Ancient Gods who rule it. It's a fascinating background—a planet 200,000 light-years from the Galaxy, circling a dim red star, with not a single star visible in its night sky! Not a single star—only the great sprawling glow of the Galaxy, for there is no single star within hundreds of light-years, and those stars are too dim and weak to be seen at such distances.

Not a desirable place to be marooned by a space accident—but a perfect place to demonstrate that a monomaniac can be an inspiration that can save men's lives!

THE EDITOR

P. Schuyler Miller

READERS' CHOICE

Almost fourteen years ago, in the "Reference Library" for June, 1952, I asked the readers of Astounding to nominate their choices for two lists of the best science-fiction books of all time: one "basic" library of just good books, and another list that would show the historical development of science fiction. The results of the vote were published in the January, 1953 issue of Astounding.

Ever since, I have had requests from teachers, librarians, students, new readers and old to bring the list of "best" SF up-to-date. I am now giving in.

The portrait of science fiction has changed tremendously since 1952. Then, the magazine boom had not reached its peak and the paperback boom hadn't started. (The publisher of Astounding ruled against reviewing paperbacks in "The Reference Library," then and for several years afterward.) The lists were heavy with "classics," but Bradbury, Heinlein, van Vogt, de Camp, John Campbell, Henry Kuttner/"Lewis Padgett," Asimov, Edward E. Smith —all but Bradbury identified with this magazine—were the top eight authors, followed by H. G. Wells and Edgar Rice Burroughs. Van Vogt was the only "modern" author to get into the Top Ten in the "classics" list—mainly for "Slan"—but Heinlein almost made it.

Times have changed. Paperbacks dominate the SF book field. Some authors write almost exclusively for paperback publication, and there are many good originals. The average Analog reader of today hasn't much interest in the "classics" of the pre-*Amazing Stories* era. So, this time, let's settle for one list of books and add one of authors.

Here are the rules:

1. I am after a list of twenty-five

books that will represent your choice of the best *science fiction* of all time. I don't want fantasy, though you can take your chance with borderline books; if enough people feel they are SF, they'll get into the finals.

2. Titles should be *books*—not serials. This gives you the opportunity to get in some of the omnibus volumes by Wells, Stapledon and others, and short-story collections or anthologies. (More than half of the titles in the 1952-'53 list were of this sort, but I doubt that they will rate as high now.)

3. I hope you will send a full list of twenty-five books, but feel free to stop short or go further. Don't try to rank them; it's too complicated to score fairly. Books needn't be in print; paperback lists change too fast to keep track of that.

4. I'd also like your list of the ten authors you consider the best of all time. (Our authors' listing last time was a by-product of the vote on the books. Now I'm asking for a direct vote on the top ten.)

5. Send your lists to me, care of "The Reference Library," either directly to 4805 Centre Avenue, Pittsburgh, Pa. 15213 or to Analog at 420 Lexington Avenue, New York, N.Y. 10017. I give you two months, then I start the tally and lists that come late won't be counted. My full-time job and some outside responsibilities make it impossible to correspond with you about the vote.

Now—what say you all?

CONQUERORS FROM THE DARKNESS

By Robert Silverberg • Holt, Rinehart & Winston, New York • 1965 • 191 pp. • $3.50

I think teachers and librarians are going to have some qualms about the bloodthirstiness of this yarn of the far future, but for all that, it's the best of Bob Silverberg's juveniles to date . . . always excluding his excellent series of reviews of archaeology and anthropology for teen-agers, which are in a class of their own.

A thousand years in the future an amphibious race from the stars, the "Star Beasts," have remade Earth into a water-world where their eggs and young can be raised safely, cared for by human slaves. Mankind has splintered into two species and three cultures: a new, artificially adapted species deliberately created to combat the Duchay'y, breathing water and living under the seas that have swallowed Man's civilization; a meek urban culture bound to its floating cities, each with its specialty to trade; and the Sea Lords who keep order and exact tribute.

Dovirr Stargan, fed up with city life, begs and wins a place in the crew of the Thallassarch of the Western Sea. He rises rapidly and ruthlessly and is thallassarch himself rather too soon. Then he leads the united Sea Lords and the Sea-born in bloody battle against the returning Star Beasts.

The three contrasting societies are nicely drawn, though we don't see enough of the Seaborn. There'll be opportunity for that in a sequel. By maintaining logic and consistency, the author has had to depict a pretty bloody culture—and has.

SPACE WINNERS

By Gordon R. Dickson • Holt, Rinehart & Winston, New York • 1965 • 217 pp. • $3.50

Gordon Dickson not only writes very good adult science fiction, but has shown in this and a few other books that he can write excellent juvenile SF that is not simply an adult story with a teen-age hero. "Space Winners" is earmarked for ages 12-16 and belongs there. Some younger readers will enjoy it; some older will find it interesting for details.

Three American high school students are selected by examination to be educated by a galactic federation that has just discovered Earth. They and a furry extraterrestrial are cast away on a planet inhabited by three disparate races, and in spite of their efforts to reach a signal station without being detected, find themselves drawn into the affairs of the aliens. Problem: whom do they help . . . how can they help . . . should they help anybody.

The author has taken the same kind of pains with this book that he does with his adult fare . . . say his "Dorsai" series. It shows.

QUEST CROSSTIME

By Andre Norton • Viking Press, New York • 1965 • 253 pp. • $3.75

Andre Norton has had a busy year: the excellent "X Factor" for Harcourt, Brace and World; a younger children's fantasy, "Steel Magic," for (another) World; and now her first juvenile SF for Viking. This one is a sequel to her Ace original of 1956, "Crossroads of Time," but covers a few too many parallel worlds too rapidly to be one of her best yarns.

In the earlier paperback, Blake Walker of Earth is drawn into the intricate crossworld society of Vroom, an alternate world somewhat more advanced than ours. In this story, he is drawn into the quest for one of a pair of teen-age girls who has vanished from a sterile outpost world that Vroom is slowly terraforming—or I suppose I should say, vroomforming. The search takes the party to still another crosstime world, in which an Aztec empire and New Britain face each other across the Mississippi at a cultural level something like that of our 1840s.

As I've said over and over, one of the delights of Miss Norton's allegedly juvenile SF—and her adult paperbacks, for that matter—is that she deliberately leaves loose ends for the reader's imagination to tease and play with. The sterile world could be good for a book in itself; so could the world of civi-

lized reptiles; and we merely glimpse the complexities of World E625, with the crosscurrents and whirlpools of the evolved Aztec society, and the effects of crosstime tampering.

Richer juvenile SF just isn't being written regularly since Robert Heinlein quit, but Andre Norton has topped this sample herself—with "The X Factor," among others.

BEYOND THE GREAT OBLIVION

By George Allan England • Avalon Books, New York • 1965 • 190 pp. • $3.25

I understand that Avalon is, as usual, shortening the text of this "classic" trilogy from the Munsey magazines of 1912 and 1913. I've never seen the original serial or book versions, but the editing has been substantial enough so that the publisher has taken out a new copyright.

In "Darkness and Dawn," the first part of the trilogy, which had the same name in its massive one-volume book form, an engineer and his secretary fall asleep in New York of 1911 and come to centuries later to find mankind gone and New York in ruins. In this episode they begin to find out what has happened to Earth—some kind of cataclysm that has apparently split the planet in two, and left the remains badly shattered and inhabited by gruesome humanoids, either evolved (too rapidly) from some lower species, or devolved from human survivors. The whole picture will doubtless be drawn in the third and final part, "The Afterglow."

George Allan England was a professional writer, and a much more accomplished one than his contemporary, Edgar Rice Burroughs. These stories are dated, but not as much as some of Burroughs' books, and England was beginning to let himself go a bit in this episode. A number of his stories were reprinted by Hugo Gernsback, but this trilogy was evidently too long to be used intact, and he wouldn't cut it. I wish Avalon hadn't.

THE CORRIDORS OF TIME

By Poul Anderson • Doubleday & Co., Garden City, N.Y. • 1965 • 209 pp. • $3.95

As you'd expect, this time/adventure yarn is head-and-shoulders above the average story of its kind, but it somehow isn't up to Poul Anderson's own standards. A condensation was in *Amazing Stories* last spring.

Malcolm Lockridge is snaked out of a death cell in our time to lend a hand in a war between time-traveling factions, first in Stone Age Denmark, then in medieval Germany, and finally in the far future. His patroness, Storm Dalloway, is at times all woman, at times all goddess, and all the time wholly ruthless and selfish. On the other

hand, her adversaries in time, the Rangers, are no lily-white saints.

One of the author's principal rewards in writing a time-travel story is the opportunity to show the past through modern eyes. Poul Anderson has had some fun of this kind in this story, but by no means as much as in his rather similar, but openly fantasy yarn, "Three Hearts and Three Lions." Which is by no means to suggest that I didn't enjoy every page . . .

THREE BY HEINLEIN: THE PUPPET MASTERS, WALDO, and MAGIC, INC.

By Robert A. Heinlein • Doubleday & Co., Garden City, N.Y. • 1965 • 426 pp. • $5.95

This is a Heinlein omnibus of stories that every veteran reader of this magazine will remember fondly, but that may be new to a new generation. It's too important an event to slough off with mention among the reprints and re-reprints, though it is both.

"The Puppet Masters" was a *Galaxy* serial in 1951, published by Doubleday the same year. Flying saucer critters are not little green men but amoeboid slugs that plug into human nerve networks and ride us to our doom. I personally like it least of Heinlein's books of that period, but others consider it his best.

"Waldo" was here in Astounding in 1942, as the work of "Anson MacDonald," and "Magic, Inc." was in *Unknown Worlds* in 1940 as "The Devil Makes the Law." Doubleday had them both in one volume in 1950. Waldo is the fat genius who lives in orbit and whose mechanical manipulators persuaded physicists to give his name to the actual mechanisms in "hot" labs. "Magic, Inc." is the wholly joyous exploits of an honest businessman who takes on a set of magic-swinging mobsters.

They don't hardly write this kind of story no more. Well, do they?

Reprints

THE LOST WORLD

By Sir Arthur Conan Doyle • Berkley Books, New York • No. F-1162 • 176 pp. • 50¢

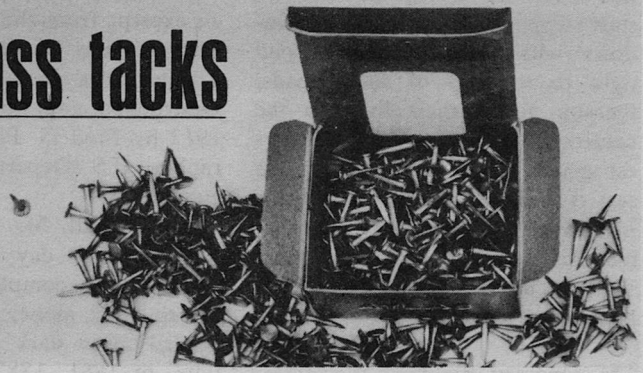
The copyright on many of the original classics of science fiction has expired or is expiring, putting them "in the public domain," where any publisher can reprint them without paying royalties or permission fees. Hence you'll be seeing a lot of new paperback editions of Wells, Doyle, et al. Some have extra material: introductions, commentaries, et cetera. This hasn't.

A FOR ANYTHING

By Damon Knight • Berkley Books, New York • No. F-1136 • 160 pp. • 50¢

The previous paperback edition appeared in 1959 and was called "The People Maker." It's an excellent variation on the matter-duplicator theme.

brass tacks



Dear Mr. Campbell:

When we were kids, back in the Thirties, there was a stunt we used to enjoy. I have never seen nor heard of it since, though this does not prove anything. For all I know there may be thousands of kids all around the world performing simple levitation experiments on the quiet.

The process went like this.

You got someone to sit down on an ordinary kitchen chair. The two lifters stood either side of him and explained in their preliminary spiel that they would try to lift him using only two fingers of each hand, under his armpits and knees. Usually they didn't succeed at all. At best they never got him up very far.

"Now," they said, "we will try the same thing again, but before we do, we do *this* . . . !"

This consisted of putting their hands alternately, one over the other, on top of the victim's head, and then pressing down hard until the seated kid, whose head was being rammed down into his shoulders, cried weakly for release.

Quickly, then, speed being of the essence, they went through the lifting process again. The seated kid went up like a rocket. If he was a flyweight, he nearly went out through the ceiling.

Of course, invariably there was the bright boy who said "Puh. Sudden release of muscles!" Or something to that effect.

Well . . . all right. But you try pressing hard down on a piece of really heavy furniture prior to lifting it, and see where it gets you. Point two. For a very few brief seconds the victim not only feels like a cork released under water, but has a powerful mental conviction that he cannot help but go up.

Flattening the spinal disks appears to concentrate the mind wonderfully.

Before readers of Analog take this experiment a stage further, and start stepping out of fifth-floor windows with their hands clamped tight to the top of their heads, thereby giving their lives to the cause of Science, it would be interesting to see what happens when the seated body is balanced on a weighing machine, whether any improvement is noted if the participants share a bottle of whisky beforehand, and so on.

ARTHUR KEMSLEY
106 Finchley Road
London, N. W. 3, England

Well, really, the explanation is simple. Like telepathy, it's all in the mind!

Dear Mr. Campbell:

I am writing to you in connection with a letter from Mr. Witmer Zell which was published in Brass Tacks of November 1965. In it he discounted the theory that the "Black Pall" of 1950 was caused by a forest fire in Canada, and said he thought it had been caused by some object coming between the earth and the sun. He asked why no investigation was made. You were unable to answer the question.

This matter caught my attention because I recently read an article dealing with the subject of dark days, as they are correctly called, in the August 1965 issue of *The Journal of the Royal Astronomical Society of Canada.* The article in question comes under the heading "Out of Old Books," and is mostly an excerpt from the paper "Forest Fires: Their Causes, Extent and Effects with a summary of recorded Destruction and Loss," written in 1912 by Fred G. Plummer, Geographer, U.S. Department of Agriculture.

First of all, Mr. Zell says that the last dark day took place in 1871. This is completely incorrect. Up to 1912 alone, there were recorded seven dark days after this time, in 1881, 1887, 1894, 1902, 1903, 1904, and 1910. In addition, the date 1871 itself does not accord with the dates in the article, dark days being listed in 1868 and 1881, but not in 1871.

Dark days do not necessarily occur close to a fire. According to Mr. Plummer, "The tendency is for smoke to spread out and to be dissipated, but if the volume is great, it may be identified for hundreds of miles, even when the cause of it is unknown."

As far as the 1950 dark day is concerned, it should be noted that while it is not dealt with in Mr. Plummer's part of the article, which was written thirty-eight years before it occurred, the author of the article as a whole cites it as a recent example of the phenomenon, *"hardly to be compared with some of the dark days recorded in the past."*

The fact that there were no major forest fires in Canada does not

erase the possibility of a fire being the cause. In the eight examples cited above, all of the fires that caused them were located within the borders of the United States. I believe it is not an uncommon occurrence for fires to happen in the western part of the U.S. in summer and fall. The dark day took place in September. Mr. Zell comes from Pennsylvania. Plummer states, "The tracks of many air currents and storm centers converge toward this area from all over the United States and sometimes meet an opposing storm from the east or northeast. It, therefore, seems that dark days are caused by the banking up of smoke-laden air. Thus smoke from a single large fire, or several small fires in different regions could have banked up hundreds of miles from the fires, and caused this comparatively mild darkness. Due to its ability to be carried a long way by air currents, it could also have reached Scotland as Mr. Zell claims. Peat burning and smoke from volcanoes also can cause dark days and must be taken into account.

Plummer can also be quoted to help deal with the suggestion that something might have passed between the earth and the sun. He states "theories advanced in olden time that dark days are caused by solar eclipses or by the transit of inferior planets across the solar disk are ridiculous since a total solar eclipse seldom lasts over five minutes, and a transit of Venus, the largest and nearest of the inferior planets is barely visible to the naked eye, and would not cause a diminution in light or heat that could be measured. If any consideration of such theories were necessary it would be sufficient to point out that the dark days of modern history have not been coincident with either eclipses or transits.

Mr. Zell seems to be of the opinion that it might be some mysterious body that passed between the earth and the sun. An eclipse of the sun by the moon does not cover the earth for as large an area or for as long a time as the 1950 darkness did. Therefore the body in question would have to be either larger than the moon, or much closer to the earth. It is difficult to believe such a phenomenon could escape the attention of the world's astronomers, and an organized suppression of evidence seems incredible, especially considering the large number of amateur astronomers existing.

Accordingly, it may be seen that a rational cause for the dark day can easily be arrived at, without resorting to mysterious bodies or explosions. Perhaps this will answer Mr. Zell.

JENNIFER BANKER
208 Governor's Road,
Dundas, Ont., Canada

Possibly if we knew a bit more about the real causes of weather, we'd be able to explain things better!

continued from page 7

of the money, J.Q. can kid himself that *he* isn't paying for it.

And since people act not on the Truth, but on what they believe—no matter for what reason!—the truth to be, they are not seriously concerned with wage increases in private business.

At the present stage of the TWU-TA negotiations, the politicos are making a great to-do about getting the needed hundreds of millions per year from sources other than the subway rider. "The State government should supply it!" "The Federal Mass Transit funds should pay for it!" Basically, "Some other guy ought to pay my debts!"

The State isn't going to, because Buffalo, Syracuse, Ithaca, and other city residents elsewhere in the state don't really care if New York City residents do have to walk to work, or pay several dollars tolls and parking fees to get there. And the upstaters somehow don't see why they should pay the New Yorker's debts for him.

However this particular hassle is settled, the problem remains—and grows. It's the problem inevitable when the democratic people insist on getting what they *want* and refuse to acknowledge that what they *need* may be different. Nobody *wants* lower wages; if there isn't enough money to go around, somebody else should have to give it up, not me! Nobody *wants* to have to pay the full price of the services he likes. And they will, therefore, vote for the demagogue who soothes them with promises that they can get what they want and not have to pay for it, if they just elect him.

That demagogue type can get away with it, so long as he can force private companies to pay the bills. That puts the cost so many stages removed from the public that the public doesn't realize they're still going to pay.

Do that a few times, and the companies go bankrupt, and either cease to exist or, in the case of essential service companies—like subway operators!—have to be taken over by the government. As soon as the government does take over, however—the government now becomes the villainous hated group that gouges the poor, infuriated public out of higher rates. I.e., the government is now revealing that the public *does* have to pay, thus shattering all the demagogic promises of non-payment.

The Public Utility Commission system is a sort of compromise. A private company owns the utility, whatever it may be, but the government fixes the rates. A rise in rates is, then, less apt to bring the seething wrath of the voters down on the politician's head, since the utility *company* is sending the bills, yet the government is fixing the rates.

This can lead to some fancy strike maneuvers, too. Again, the

workers must strike *against the public*, not against the utility (though, of course, the strike is directly aimed at the company) because a *political* goal must be achieved.

For example: Suppose the local electric power company's workers demand a twenty-five per cent wage increase. Now the power company's rates were fixed by the Public Utility Commission on the basis of allowing the company to collect enough from its customers to pay for its equipment, fuel, depreciation, taxes of course, the wages of employees, and a "reasonable return on investment." (Chop *that* off, and banks, insurance companies, and mutual funds would start folding; utilities are the blue-chip investments that such institutions put most of their funds in. If that happened, the wrath of the voters would be most violent!)

Now the utility company accountants and executives laid their books before the Commission, and showed what their costs were, what their invested capital was, what all expenses were, and convinced the Commission that a certain rate, X cents per kilowatt-hour, was necessary and proper.

So now the Union wants a twenty-five per cent increase.

If the utility company management grants it, it must mean that, somehow, they had deceived the Public Utility Commission, and really had padded their expenses so slyly that they were able to pay their workers twenty-five per cent more without losing money. In other words, that they'd made fools of the Commissioners.

This would (1) be highly improbable, and (2) highly unwise, if it were true. It means that the utility company *can not raise wages.*

Before a utility—electric power, telephone, gas, water, whatever it may be—can raise wages, it must get the Public Utility Commission to allow them to do so, with the understanding that the company's rate structure will be changed upward to compensate. If they don't need that raise in rates, it means the Commissioners didn't know what was going on when they originally established those rates.

But the Public Utility Commission is a politically appointed group—it represents political thinking. And the Great Public does *not* like to have to pay for things. It's politically most undesirable.

So, because the required upward rate revisions are considerable, the Commission says "No!"

So the Union strikes against the company.

So the public gets its services turned off, or more and more poorly provided.

So finally the public gets so angry and irritated that any reasonably keen political ear can hear them saying "Ah, fer Pete's sake—give 'em their money and let me get some service around here!"

Whereupon the Public Utility Commission says, "O.K., you can have a rate increase," and the utility company can now say "O.K., boys—back to work. We are allowed to pay you more now."

When people think that they can escape paying for what they need, they're deluding themselves, of course.

When they believe that wages can be increased without increasing costs, and without introducing labor-saving automation—

Funny how a people that delights in quoting Lincoln's famous "government of the people, by the people, and for the people" never think of it as also applying to government expenditures!

Government expenditures are just as "of the people, by the people, and for the people"—but the people prefer to go on thinking that the government's money is, somehow, not out of their pockets.

The more government gets into business—the more we'll have strikes directed at inconveniencing, harassing, or angering *the people.* A union can gain nothing whatever from applying pressure against a management which cannot set its own rates, has no money to spend, and no authority to spend it if it could get it.

Under those conditions—when rates and operating policies are set by governmental agencies—the Union has to strike against the public.

The New York City transit strike will be ended when a keen political ear can clearly hear the New York City public saying, "Oh, for Pete's sake—give 'em their money, dammit. I'd rather pay thirty cents for a subway or bus ride than put up with this nuisance!"

But even Mike Quill refrains from coming out and *saying: "You're* gonna have to pay our higher wages! You, the public, that needs our services—and whether you like it or not!"

The nation will see more and more such strikes against the public—for the simple reason that, when the public takes control of businesses, then the public must pay the bills. If the public takes the authority—the public must be forced to accept the responsibility, willy-nilly, like it or not. And the labor strike was invented as a weapon to force those in authority, like it or not, to accept responsibility.

It's also fascinating to observe that Labor, which made such frightful gestures of shocked amazement when a capitalist of a generation or so ago said: "The public be damned!" is now in precisely the same position.

Now *they're* saying "The public be damned—until they pay for what they need!"

When the public is the group that must be made to recognize the realities of a problem—the public must be made to accept the bitter dose. ■ The Editor.

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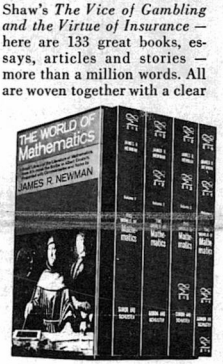

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☐ **ADDED SAVINGS:** Check here if you are enclosing $9.95 per soft-bound set ($25 per De Luxe hard-bound set) as payment in full. Then WE will pay all postage. Same 10-day privilege of return for full refund applies.