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Science fact: Science fiction

by Loren Eiseley, Arthur C. Clarke, J. G. Ballard, Alfred Bester, Roger Zelazny, Robert Silverberg, Harlan Ellison, Robert Heinlein, James Blish & c

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Leonard Allison

Leonard Jenkin

Robert Perrault



Vintage Books

A Division of Random House

New York

VINTAGE BOOKS EDITION 1973

First Edition

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Printout: fact/future/fiction.

1. Science fiction, American.

PZ1.P935 [PS648.S3] 813'.0876 72-3237

ISBN 0-394-71857-7 (pbk.)

Manufactured in the United States of America

This book is the result of a two-year dialogue between the editors and Illiac 4, the Burroughs Corporation's giant general-purpose computer, now in the final stages of checkout at the company's Great Valley Laboratories in Paoli, Pennsylvania. Illiac 4 is a fourth-generation computer capable of executing 250 million instructions per second. What immediately follows is a condensed transcript of significant portions of this dialogue. For the sake of clarity we've deleted printouts of scanning samples and statistical tables.

We began with the question: What natural language input would supply the optimal data base for connecting social systems under stress with the reality of their own experience? "Optimal" was rather practically defined as "of maximum survival value."

The dialogue was supervised by SEMANT, a program that utilizes all the known relationships of people to language bonds and data on over one hundred environmental change factors. From these sources, machine inferences led to an integrated analysis of linguistic patterns. The program was originally developed by the U.S. Department of Defense as a tool for exhaustive syntactic and semantic studies of command communication.

The effort involved in transforming our problem to a form that was machine usable was enormous. In actuality, "asking" a question often took days. We wish to thank Mr. Allen Hughes of the Burroughs Corporation and Professor Robert Simmonds of the Institute for Advanced Computation in Washington, D.C., without whose help this new approach to some old problems would have been literally impossible.

1A - PRINTOUT: FACT/FUTURE/FICTION - CH 4225

MS PG 4

ILIAC 4 / SEMANT / TOTAL EFFECT

MS PP 5-9

Q. WHAT NATURAL LANGUAGE INPUT WOULD PROVIDE THE
OPTIMAL DATA BASE FOR A SOCIAL SYSTEM UNDER STRESS
TO DETERMINE ITS CONNECTIONS TO THE REALITY OF ITS
OWN EXPERIENCE?

A. PROJECT LEARNING DATA OUTPUT
PRINT
PRELIMINARY SCAN RESPONSE BASED PERCENTAGE INPUT
SAMPLE THIRTY-SEVEN STATES
CODE PROJECT LEARNING
GOOD MORNING
INDICES INDICATE TYPE MATERIAL READING INCLUSIVE
SYMBOL RECOGNITION - BISOCIATIVE
THINKING - STRUCTURAL ORGANIZATION - SCIENTIFIC
KNOWLEDGE - ADAPTABILITY POTENTIAL
THIS MATRIX PREDICATES SCIENCE FACT-FICTION

ALTERNATE CONTENT READS BELOW FIFTH PERCENTILE
IN OPERATIVE VALUE SCALES

Q. WHAT SECONDARY LEVEL REASONING JUSTIFIES YOUR
SELECTION OF SCIENCE FACT-FICTION AS THE BOOK
CONTENT?

A. SECONDARY LEVEL COMPOSITE
VALUE MODES BREAKOUT

SF-F FACTOR ANALYSIS

MATERIAL OFFERS HIGH-LEVEL SPACETIME PROJECTIVE
POSSIBILITIES - SELF INTO UNIVERSE - SELF INTO
OTHERS - SELF INTO ORIGINS
TENSION - RELAXATION OF IMAGINATIVE FACULTY UNIQUE

PROBABILITY QUOTIENT ABOVE EIGHTIETH PERCENTILE
BASED EXTRAPOLATION CURRENT CONDITIONS

MAXIMUM AWARENESS TECHNOLOGY - PSYCHOLOGY - SCIENCE
FACT SPACE TRAVEL FACT GENETIC TRANSPLANT FACT
ATOMIC POWER FACT SATELLITE COMMUNICATIONS FACT
EXTRATERRESTRIAL GEOLOGY FACT POPULATION EXPLOSION

CONSCIOUSNESS OF HUMAN FACTORS
STRESS ANALYSIS - EXPANDED PROBABILITY VARIANTS

SF-F RECOGNIZES TIME CONTINUUM
EVOLUTION HISTORY CHANGE

SF-F GESTATES MYTHS OF FUTURE
BEGIN ITEM VERBATIM
CODE PROJECT LEARNING INPUT
BEGIN

THE MAKERS OF MYTHS MUST NEVER BE SPURNED - AND
IN SCIENCE FICTION - WHICH ACCEPTS NO LIMITATIONS
OF TIME OR SPACE AND UNIQUELY LIBERATES THE IMAGI-
NATION- I BELIEVE WE WILL FIND THE GOVERNING MYTHS
OF THE DAWNING AGE OF GALACTIC MAN - ROBERT
SILVERBERG - THE MIRROR OF INFINITY - 1970
END ITEM VERBATIM

ALTERNATE VALUE SYSTEMS PRESENT
MAXIMUM POSSIBILITIES UTILIZATION CONCEPTUAL TOOLS

POPULATION PROFILE INPUT INDICATES INTEREST LEVEL
ABOVE SEVENTIETH PERCENTILE
ACCESSIBILITY QUOTIENT FOR CONTEMPORARY SOCIAL
SYSTEMS HIGH

2. WHAT SELECTIONS WOULD BE INCLUDED IN A MEDIUM LENGTH
BOOK OF SCIENCE FACT-FICTION OF THE TYPE YOU DESCRIBE?

A. HAPPYDAY IN 2381 DESERTION ALL YOU ZOMBIES DRIFT-
GLASS THE SECRET SONGS SCANNERS LIVE IN VAIN
TERMINAL BEACH FOR A BREATH I TARRY INTERURBAN
QUEEN FONDLY FAHRENHEIT I HAVE NO MOUTH BUT I MUST
SCREAM VIOLENT UNIVERSE COMMON TIME THE UNEXPECTED
UNIVERSE VOICES IN THE SKY INTELLIGENT LIFE IN THE
UNIVERSE

2. WHY HAVE YOU CHOSEN THESE PARTICULAR STORIES AND
FACTUAL SELECTIONS?

A. CORE DETERMINANTS FOLLOW
LINGUISTIC DESIGN
PRESENCE OF EXPERIENCE - ENVIRONMENT CONNECTIVES
FACTUAL MATERIAL SUPPLYING PRESENT TIME
SPECULATION FACT FICTION PERSPECTIVE
CONTENT TO BE OPERABLE WITHIN CHAPTER ORGANIZATION
BRACKET ECOSYSTEMS CELLULAR AND SOLAR EVOLUTION
IDENTITY - EARTH PROBABILITIES - TIME SPACE TRAVEL
BRACKET DIRECTED TOWARD RESTRUCTURING
SOCIAL - PSYCHOLOGICAL SYSTEMS

2. WHAT ORGANIZATION OF THE MATERIAL WOULD BE MAXIMALLY
EFFECTIVE?

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FONDLY FAHRENHEIT - ALFRED BESTER
FOR A BREATH I TARRY - ROGER ZELAZNY

EARTH PROBABILITIES

THE SOCIAL CONSEQUENCES OF COMMUNICATIONS
SATELLITES - ARTHUR C CLARKE - FROM VOICES IN
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END PRINT

END PROGRAM

-STOP-

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[illegible]

the star thrower

Who is the man walking in the Way?
An eye glaring in the skull.

Seccho

It has ever been my lot, though formally myself a teacher, to be taught surely by none. There are times when I have thought to read lessons in the sky, or in books, or from the behavior of my fellows, but in the end my perceptions have frequently been inadequate or betrayed. Nevertheless, I venture to say that of what man may be I have caught a fugitive glimpse, not among multitudes of men, but along an endless wave-beaten coast at dawn. As always, there is this apparent break, this rift in nature, before the insight comes. The terrible question has to translate itself into an even more terrifying freedom.

If there is any meaning to this book, it began on the beaches of Costabel with just such a leap across an unknown abyss. It began, if I may borrow the expression from a Buddhist sage, with the skull and the eye. I was the skull. I was the inhumanly stripped skeleton without voice, without hope, wandering alone upon the shores of the world. I was devoid of pity, because pity implies hope. There was, in this desiccated skull, only an eye like a pharos light, a beacon, a search beam revolving endlessly in sunless noonday or black night. Ideas like swarms of insects rose to the beam, but the light consumed them. Upon that shore meaning had ceased. There were only the dead skull and the revolving eye. With such an eye, some have said, science looks upon the world. I do not know. I know only that I was the skull of emptiness and the endlessly revolving light without pity.

Once, in a dingy restaurant in the town, I had heard a woman say: "My father reads a goose bone for the weather." A modern primitive, I had thought, a diviner, using a method older than Stonehenge, as old as the arctic forests.

"And where does he do that?" the woman's companion had asked amusedly.

From *The Unexpected Universe* by Loren Eiseley. © 1969 by Loren Eiseley. Reprinted by permission of Harcourt Brace Jovanovich, Inc.

loren eiseley

"In Costabel," she answered complacently, "in Costabel." The voice came back and buzzed faintly for a moment in the dark under the revolving eye. It did not make sense, but nothing in Costabel made sense. Perhaps that was why I had finally found myself in Costabel. Perhaps all men are destined at some time to arrive there as I did.

I had come by quite ordinary means, but I was still the skull with the eye. I concealed myself beneath a fisherman's cap and sunglasses, so that I looked like everyone else on the beach. This is the way things are managed in Costabel. It is on the shore that the revolving eye begins its beam and the whispers rise in the empty darkness of the skull.

The beaches of Costabel are littered with the debris of life. Shells are cast up in windrows; a hermit crab, fumbling for a new home in the depths, is tossed naked ashore, where the waiting gulls cut him to pieces. Along the strip of wet sand that marks the ebbing and flowing of the tide death walks hugely and in many forms. Even the torn fragments of green sponge yield bits of scrambling life striving to return to the great mother that has nourished and protected them.

In the end the sea rejects its offspring. They cannot fight their way home through the surf which casts them repeatedly back upon the shore. The tiny breathing pores of starfish are stuffed with sand. The rising sun shrivels the mucilaginous bodies of the unprotected. The seabeach and its endless war are soundless. Nothing screams but the gulls.

In the night, particularly in the tourist season, or during great storms, one can observe another vulturine activity. One can see, in the hour before dawn on the ebb tide, electric torches bobbing like fireflies along the beach. It is the sign of the professional shellers seeking to outrun and anticipate their less aggressive neighbors. A kind of greedy madness sweeps over the competing collectors. After a storm one can see them hurrying along with bundles of gathered starfish, or, toppling and overburdened, clutching bags of living shells whose hidden occupants will be slowly cooked and dissolved in the outdoor

kettles provided by the resort hotels for the cleaning of specimens. Following one such episode I met the star thrower.

As soon as the ebb was flowing, as soon as I could make out in my sleeplessness the flashlights on the beach, I arose and dressed in the dark. As I came down the steps to the shore I could hear the deeper rumble of the surf. A gaping hole filled with churning sand had cut sharply into the breakwater. Flying sand as light as powder coated every exposed object like snow. I made my way around the altered edges of the cove and proceeded on my morning walk up the shore. Now and then a stooping figure moved in the gloom or a rain squall swept past me with light pattering steps. There was a faint sense of coming light somewhere behind me in the east.

Soon I began to make out objects, upended timbers, conch shells, sea wrack wrenched from the far-out kelp forests. A pink-clawed crab encased in a green cup of sponge lay sprawling where the waves had tossed him. Long-limbed starfish were strewn everywhere, as though the night sky had showered down. I paused once briefly. A small octopus, its beautiful dark-lensed eyes bleared with sand, gazed up at me from a ragged bundle of tentacles. I hesitated, and touched it briefly with my foot. It was dead. I paced on once more before the spreading whitecaps of the surf.

The shore grew steeper, the sound of the sea heavier and more menacing, as I rounded a bluff into the full blast of the offshore wind. I was away from the shellers now and strode more rapidly over the wet sand that effaced my footprints. Around the next point there might be a refuge from the wind. The sun behind me was pressing upward at the horizon's rim—an ominous red glare amidst the tumbling blackness of the clouds. Ahead of me, over the projecting point, a gigantic rainbow of incredible perfection had sprung shimmering into existence. Somewhere toward its foot I discerned a human figure standing, as it seemed to me, within the rainbow, though unconscious of his position. He was gazing fixedly at something in the sand.

Eventually he stooped and flung the object beyond the breaking surf. I labored toward him over a half mile of uncertain footing. By the time I reached him the rainbow had receded ahead of us, but something of its color still ran hastily in many changing lights across his features. He was starting to kneel again.

In a pool of sand and silt a starfish had thrust its arms up stiffly and was holding its body away from the stifling mud.

"It's still alive," I ventured.

"Yes," he said, and with a quick yet gentle movement he picked up the star and spun it over my head and far out into the sea. It sank in a burst of spume, and the waters roared once more.

"It may live," he said, "if the offshore pull is strong enough." He spoke gently, and across his bronzed worn face the light still came and went in subtly altering colors.

"There are not many come this far," I said, groping in a sudden embarrassment for words. "Do you collect?"

"Only like this," he said softly, gesturing amidst the wreckage of the shore. "And only for the living." He stooped again, oblivious of my curiosity, and skipped another star neatly across the water.

"The stars," he said, "throw well. One can help them."

He looked full at me with a faint question kindling in his eyes, which seemed to take on the far depths of the sea.

"I do not collect," I said uncomfortably, the wind beating at my garments. "Neither the living nor the dead. I gave it up a long time ago. Death is the only successful collector." I could feel the full night blackness in my skull and the terrible eye resuming its indifferent journey. I nodded and walked away, leaving him there upon the dune with that great rainbow ranging up the sky behind him.

I turned as I neared a bend in the coast and saw him toss another star, skimming it skillfully far out over the ravaging and tumultuous water. For a moment, in the changing light, the thrower appeared magnified, as though casting larger stars upon some greater sea. He had, at any rate, the posture of a god.

But again the eye, the cold world-shriveling eye, began its inevitable circling in my skull. He is a man, I considered sharply, bringing my thought to rest. The star thrower is a man, and death is running more fleet than he along every seabeach in the world.

I adjusted the dark lens of my glasses and, thus disguised, I paced slowly back by the starfish gatherers, past the shell collectors, with their vulgar little spades and the stick-length shelling pincers that eased their elderly backs while they snatched at treasures in the sand. I chose to look full at the steaming kettles in which beautiful voiceless things were being boiled alive. Behind my sunglasses a kind of litany began and refused to die down. "*As I came through the desert thus it was, as I came through the desert.*"

In the darkness of my room I lay quiet with the sunglasses removed, but the eye turned and turned. In the desert, an old monk had once advised a traveler, the voices of God and the Devil are scarcely distinguishable. Costabel was a desert. I lay quiet, but my restless hand at the bedside fingered the edge of an invisible abyss. "Certain coasts," the remark of a perceptive writer came back to me, "are set apart for shipwreck." With unerring persistence I had made my way thither.

[2]

There is a difference in our human outlook, depending on whether we have been born upon level plains, where one step reasonably leads to another, or whether, by contrast, we have spent our lives amidst glacial crevasses and precipitous descents. In the case of the mountaineer, one step does not always lead rationally to another save by a desperate leap over a chasm or by an even more hesitant tiptoeing across precarious snow bridges.

Something about these opposed landscapes has its analogue in the mind of man. Our prehistoric life, one might say, began amidst enforested gloom with the abandonment of the protected instinctive life of nature. We sought, instead, an adventurous

existence amidst the crater lands and ice fields of self-generated ideas. Clambering onward, we have slowly made our way out of a maze of isolated peaks into the level plains of science. Here, one step seems definitely to succeed another, the universe appears to take on an imposed order, and the illusions through which mankind has painfully made its way for many centuries have given place to the enormous vistas of past and future time. The encrusted eye in the stone speaks to us of undeviating sunlight; the calculated elliptic of Halley's comet no longer forecasts world disaster. The planet plunges on through a chill void of star years, and there is little or nothing that remains unmeasured.

Nothing, that is, but the mind of man. Since boyhood I had been traveling across the endless co-ordinated realms of science, just as, in the body, I was a plains dweller, accustomed to plodding through distances unbroken by precipices. Now that I come to look back, there was one contingent aspect of that landscape I inhabited whose significance, at the time, escaped me. "Twisters," we called them locally. They were a species of cyclonic, bouncing air funnel that could suddenly loom out of nowhere, crumpling windmills or slashing with devastating fury through country towns. Sometimes, by modest contrast, more harmless varieties known as dust devils might pursue one in a gentle spinning dance for miles. One could see them hesitantly stalking across the alkali flats on a hot day, debating, perhaps, in their tall, rotating columns, whether to ascend and assume more formidable shapes. They were the trickster part of an otherwise pedestrian landscape.

Infrequent though the visitations of these malign creations of the air might be, all prudent homesteaders in those parts had provided themselves with cyclone cellars. In the careless neighborhood in which I grew up, however, we contented ourselves with the queer yarns of cyclonic folklore and the vagaries of weather prophecy. As a boy, aroused by these tales and cherishing a subterranean fondness for caves, I once attempted to dig a storm cellar. Like most such projects this one was never

completed. The trickster element in nature, I realize now, had so buffeted my parents that they stoically rejected planning. Unconsciously, they had arrived at the philosophy that foresight merely invited the attention of some baleful intelligence that despised and persecuted the calculating planner. It was not until many years later that I came to realize that a kind of maleficent primordial power persists in the mind as well as in the wandering dust storms of the exterior world.

A hidden dualism that has haunted man since antiquity runs across his religious conceptions as the conflict between good and evil. It persists in the modern world of science under other guises. It becomes chaos versus form or antichaos. Form, since the rise of the evolutionary philosophy, has itself taken on an illusory quality. Our apparent shapes no longer have the stability of a single divine fiat. Instead, they waver and dissolve into the unexpected. We gaze backward into a contracting cone of life until words leave us and all we know is dissolved into the simple circuits of a reptilian brain. Finally, sentience subsides into an animalcule.

Or we revolt and refuse to look deeper, but the void remains. We are rag dolls made out of many ages and skins, changelings who have slept in wood nests or hissed in the uncouth guise of waddling amphibians. We have played such roles for infinitely longer ages than we have been men. Our identity is a dream. We are process, not reality, for reality is an illusion of the daylight—the light of our particular day. In a fortnight, as aeons are measured, we may lie silent in a bed of stone, or, as has happened in the past, be figured in another guise. Two forces struggle perpetually in our bodies: Yam, the old sea dragon of the original Biblical darkness, and, arrayed against him, some wisp of dancing light that would have us linger, wistful, in our human form. “Tarry thou, till I come again”—an old legend survives among us of the admonition given by Jesus to the Wandering Jew. The words are applicable to all of us. Deep-hidden in the human psyche there is a similar injunction no longer having to do with the longevity of the body but,

rather, a plea to wait upon some transcendent lesson preparing in the mind itself.

Yet the facts we face seem terrifyingly arrayed against us. It is as if at our backs, masked and demonic, moved the trickster as I have seen his role performed among the remnant of a savage people long ago. It was that of the jokester present at the most devout of ceremonies. This creature never laughed; he never made a sound. Painted in black, he followed silently behind the officiating priest, mimicking, with the added flourish of a little whip, the gestures of the devout one. His timed and stylized posturings conveyed a derision infinitely more formidable than actual laughter.

In modern terms, the dance of contingency, of the indeterminate, outwits us all. The approaching, fateful whirlwind on the plain had mercifully passed me by in youth. In the moment when I had witnessed that fireside performance I knew with surety that primitive man had lived with a dark message. He had acquiesced in the admission into his village of a cosmic messenger. Perhaps the primitives were wiser in the ways of the trickster universe than ourselves; perhaps they knew, as we do not, how to ground or make endurable the lightning.

At all events, I had learned, as I watched that half-understood drama by the leaping fire, why man, even modern man, reads goose bones for the weather of his soul. Afterward I had gone out, a troubled unbeliever, into the night. There was a shadow I could not henceforth shake off, which I knew was posturing and would always posture behind me. That mocking shadow looms over me as I write. It scrawls with a derisive pen and an exaggerated flourish. I know instinctively it will be present to caricature the solemnities of my deathbed. In a quarter of a century it has never spoken.

Black magic, the magic of the primeval chaos, blots out or transmogrifies the true form of things. At the stroke of twelve the princess must flee the banquet or risk discovery in the rags of a kitchen wench; coach reverts to pumpkin. Instability lies at the heart of the world. With uncanny foresight folklore has

long toyed symbolically with what the nineteenth century was to proclaim a reality, namely, that form is an illusion of the time dimension, that the magic flight of the pursued hero or heroine through frogskin and wolf coat has been, and will continue to be, the flight of all men.

Goethe's genius sensed, well before the publication of the *Origin of Species*, the thesis and antithesis that epitomize the eternal struggle of the immediate species against its dissolution into something other: in modern terms, fish into reptile, ape into man. The power to change is both creative and destructive—a sinister gift, which, unrestricted, leads onward toward the formless and inchoate void of the possible. This force can only be counterbalanced by an equal impulse toward specificity. Form, once arisen, clings to its identity. Each species and each individual holds tenaciously to its present nature. Each strives to contain the creative and abolishing maelstrom that pours unseen through the generations. The past vanishes; the present momentarily persists; the future is potential only. In this specious present of the real, life struggles to maintain every manifestation, every individuality, that exists. In the end, life always fails, but the amorphous hurrying stream is held and diverted into new organic vessels in which form persists, though the form may not be that of yesterday.

The evolutionists, piercing beneath the show of momentary stability, discovered, hidden in rudimentary organs, the discarded rubbish of the past. They detected the reptile under the lifted feathers of the bird, the lost terrestrial limbs dwindling beneath the blubber of the giant cetaceans. They saw life rushing outward from an unknown center, just as today the astronomer senses the galaxies fleeing into the infinity of darkness. As the spinning galactic clouds hurl stars and worlds across the night, so life, equally impelled by the centrifugal powers lurking in the germ cell, scatters the splintered radiance of consciousness and sends it prowling and contending through the thickets of the world.

All this devious, tattered way was exposed to the ceaselessly

turning eye within the skull that lay hidden upon the bed in Costabel. Slowly that eye grew conscious of another eye that searched it with equal penetration from the shadows of the room. It may have been a projection from the mind within the skull, but the eye was, nevertheless, exteriorized and haunting. It began as something glaucous and blind beneath a web of clinging algae. It altered suddenly and became the sand-smeared eye of the dead cephalopod I had encountered upon the beach. The transformations became more rapid with the concentration of my attention, and they became more formidable. There was the beaten, bloodshot eye of an animal from somewhere within my childhood experience. Finally, there was an eye that seemed torn from a photograph, but that looked through me as though it had already raced in vision up to the steep edge of nothingness and absorbed whatever terror lay in that abyss. I sank back again upon my cot and buried my head in the pillow. I knew the eye and the circumstance and the question. It was my mother. She was long dead, and the way backward was lost.

[3]

Now it may be asked, upon the coasts that invite shipwreck, why the ships should come, just as we may ask the man who pursues knowledge why he should be left with a revolving search beam in the head whose light falls only upon disaster or the flotsam of the shore. There is an answer, but its way is not across the level plains of science, for the science of remote abysses no longer shelters man. Instead, it reveals him in vaporous metamorphic succession as the homeless and unspecified one, the creature of the magic flight.

Long ago, when the future was just a simple tomorrow, men had cast intricately carved game counters to determine its course, or they had traced with a grimy finger the cracks on the burnt shoulder blade of a hare. It was a prophecy of tomorrow's hunt, just as was the old farmer's anachronistic reading of the

weather from the signs on the breastbone of a goose. Such quaint almanacs of nature's intent had sufficed mankind since antiquity. They would do so no longer, nor would formal apologies to the souls of the game men hunted. The hunters had come, at last, beyond the satisfying supernatural world that had always surrounded the little village, into a place of homeless frontiers and precipitous edges, the indescribable world of the natural. Here tools increasingly revenged themselves upon their creators and tomorrow became unmanageable. Man had come in his journeying to a region of terrible freedoms.

It was a place of no traditional shelter, save those erected with the aid of tools, which had also begun to achieve a revolutionary independence from their masters. Their ways had grown secretive and incalculable. Science, more powerful than the magical questions that might be addressed by a shaman to a burnt shoulder blade, could create these tools but had not succeeded in controlling their ambivalent nature. Moreover, they responded all too readily to that urge for tampering and dissolution which is part of our primate heritage.

We had been safe in the enchanted forest only because of our weakness. When the powers of that gloomy region were given to us, immediately, as in a witch's house, things began to fly about unbidden. The tools, if not science itself, were linked intangibly to the subconscious poltergeist aspect of man's nature. The closer man and the natural world drew together, the more erratic became the behavior of each. Huge shadows leaped triumphantly after every blinding illumination. It was a magnified but clearly recognizable version of the black trickster's antics behind the solemn backs of the priesthood. Here, there was one difference. The shadows had passed out of all human semblance; no societal ritual safely contained their posturings, as in the warning dance of the trickster. Instead, unseen by many because it was so gigantically real, the multiplied darkness threatened to submerge the carriers of the light.

Darwin, Einstein, and Freud might be said to have released the shadows. Yet man had already entered the perilous domain

that henceforth would contain his destiny. Four hundred years ago Francis Bacon had already anticipated its dual nature. The individuals do not matter. If they had not made their discoveries, others would have surely done so. They were good men, and they came as enlighteners of mankind. The tragedy was only that at their backs the ritual figure with the whip was invisible. There was no longer anything to subdue the pride of man. The world had been laid under the heavy spell of the natural; henceforth, it would be ordered by man.

Humanity was suddenly entranced by light and fancied it reflected light. Progress was its watchword, and for a time the shadows seemed to recede. Only a few guessed that the retreat of darkness presaged the emergence of an entirely new and less tangible terror. Things, in the words of G. K. Chesterton, were to grow incalculable by being calculated. Man's powers were finite; the forces he had released in nature recognized no such limitations. They were the irrevocable monsters conjured up by a completely amateur sorcerer.

But what, we may ask, was the nature of the first discoveries that now threaten to induce disaster? Pre-eminent among them was, of course, the perception to which we have already referred: the discovery of the interlinked and evolving web of life. The great Victorian biologists saw, and yet refused to see, the war between form and formlessness, chaos and antichaos, which the poet Goethe had sensed contesting beneath the smiling surface of nature. "The dangerous gift from above," he had termed it, with uneasy foresight.

By contrast, Darwin, the prime student of the struggle for existence, sought to visualize in a tangled bank of leaves the silent and insatiable war of nature. Still, he could imply with a veiled complacency that man might "with some confidence" look forward to a secure future "of inappreciable length." This he could do upon the same page in the *Origin of Species* where he observes that "of the species now living very few will transmit progeny to a far distant futurity." The contradiction escaped him; he did not wish to see it. Darwin, in addition,

saw life as a purely selfish struggle, in which nothing is modified for the good of another species without being directly advantageous to its associated form.

If, he contended, one part of any single species had been formed for the exclusive good of another, "it would annihilate my theory." Powerfully documented and enhanced though the statement has become, famine, war, and death are not the sole instruments biologists today would accept as the means toward that perfection of which Darwin spoke. The subject is subtle and intricate, however, and one facet of it must be reserved for another chapter. Let it suffice to say here that the sign of the dark cave and the club became so firmly fixed in human thinking that in our time it has been invoked as signifying man's true image in books selling in the hundreds of thousands.

From the thesis and antithesis contained in Darwinism we come to Freud. The public knows that, like Darwin, the master of the inner world took the secure, stable, and sunlit province of the mind and revealed it as a place of contending furies. Ghostly transformations, flitting night shadows, misshapen changelings existed there, as real as anything that haunted the natural universe of Darwin. For this reason, appropriately, I had come as the skull and the eye to Costabel—the coast demanding shipwreck. Why else had I remembered the phrase, except for a dark impulse toward destruction lurking somewhere in the subconscious? I lay on the bed while the agonized eye in the remembered photograph persisted at the back of my closed lids.

It had begun when, after years of separation, I had gone dutifully home to a house from which the final occupant had departed. In a musty attic—among old trunks, a broken aquarium, and a dusty heap of fossil shells collected in childhood—I found a satchel. The satchel was already a shabby antique, in whose depths I turned up a jackknife and a "rat" of hair such as women wore at the beginning of the century. Beneath these lay a pile of old photographs and a note—two notes, rather, evidently dropped into the bag at different times.

Each, in a thin, ornate hand, reiterated a single message that the writer had believed important. "This satchel belongs to my son, Loren Eiseley." It was the last message. I recognized the trivia. The jackknife I had carried in childhood. The rat of hair had belonged to my mother, and there were also two incredibly pointed slippers that looked as though they had been intended for a formal ball, to which I knew well my mother would never in her life have been invited. I undid the rotted string around the studio portraits.

Mostly they consisted of stiff, upright bearded men and heavily clothed women equally bound to the formalities and ritual that attended upon the photography of an earlier generation. No names identified the pictures, although here and there a reminiscent family trait seemed faintly evident. Finally I came upon a less formal photograph, taken in the eighties of the last century. Again no names identified the people, but a commercial stamp upon the back identified the place: Dyersville, Iowa. I had never been in that country town, but I knew at once it was my mother's birthplace.

Dyersville, the thought flashed through my mind, making the connection now for the first time: the dire place. I recognized at once the two sisters at the edge of the photograph, the younger clinging reluctantly to the older. Six years old, I thought, turning momentarily away from the younger child's face. Here it began, her pain and mine. The eyes in the photograph were already remote and shadowed by some inner turmoil. The poise of the body was already that of one miserably departing the peripheries of the human estate. The gaze was mutely clairvoyant and lonely. It was the gaze of a child who knew unbearable difference and impending isolation.

I dropped the notes and pictures once more into the bag. The last message had come from Dyersville: "my son." The child in the photograph had survived to be an ill-taught prairie artist. She had been deaf. All her life she had walked the precipice of mental breakdown. Here on this faded porch it had begun—the long crucifixion of life. I slipped downstairs

and out of the house. I walked for miles through the streets.

Now at Costabel I put on the sunglasses once more, but the face from the torn photograph persisted behind them. It was as though I, as man, was being asked to confront, in all its overbearing weight, the universe itself. "Love not the world," the Biblical injunction runs, "neither the things that are in the world." The revolving beam in my mind had stopped, and the insect whisperings of the intellect. There was, at last, an utter stillness, a waiting as though for a cosmic judgment. The eye, the torn eye, considered me.

"But I *do* love the world," I whispered to a waiting presence in the empty room. "I love its small ones, the things beaten in the strangling surf, the bird, singing, which flies and falls and is not seen again." I choked and said, with the torn eye still upon me, "I love the lost ones, the failures of the world." It was like the renunciation of my scientific heritage. The torn eye surveyed me sadly and was gone. I had come full upon one of the last great rifts in nature, and the merciless beam no longer was in traverse around my skull.

But no, it was not a rift but a joining: the expression of love projected beyond the species boundary by a creature born of Darwinian struggle, in the silent war under the tangled bank. "There is no boon in nature," one of the new philosophers had written harshly in the first years of the industrial cities. Nevertheless, through war and famine and death, a sparse mercy had persisted, like a mutation whose time had not yet come. I had seen the star thrower cross that rift and, in so doing, he had reasserted the human right to define his own frontier. He had moved to the utmost edge of natural being, if not across its boundaries. It was as though at some point the supernatural had touched hesitantly, for an instant, upon the natural.

Out of the depths of a seemingly empty universe had grown an eye, like the eye in my room, but an eye on a vastly larger scale. It looked out upon what I can only call itself. It searched the skies and it searched the depths of being. In the shape of man it had ascended like a vaporous emanation from the depths

of night. The nothing had miraculously gazed upon the nothing and was not content. It was an intrusion into, or a projection out of, nature for which no precedent existed. The act was, in short, an assertion of value arisen from the domain of absolute zero. A little whirlwind of commingling molecules had succeeded in confronting its own universe.

Here, at last, was the rift that lay beyond Darwin's tangled bank. For a creature, arisen from that bank and born of its contentions, had stretched out its hand in pity. Some ancient, inexhaustible, and patient intelligence, lying dispersed in the planetary fields of force or amidst the inconceivable cold of interstellar space, had chosen to endow its desolation with an apparition as mysterious as itself. The fate of man is to be the ever recurrent, reproachful Eye floating upon night and solitude. The world cannot be said to exist save by the interposition of that inward eye—an eye various and not under the restraints to be apprehended from what is vulgarly called the natural.

I had been unbelieving. I had walked away from the star thrower in the hardened indifference of maturity. But thought mediated by the eye is one of nature's infinite disguises. Belatedly, I arose with a solitary mission. I set forth in an effort to find the star thrower.

[4]

Man is himself, like the universe he inhabits, like the demoniacal stirrings of the ooze from which he sprang, a tale of desolations. He walks in his mind from birth to death the long resounding shores of endless disillusionment. Finally, the commitment to life departs or turns to bitterness. But out of such desolation emerges the awesome freedom to choose—to choose beyond the narrowly circumscribed circle that delimits the animal being. In that widening ring of human choice, chaos and order renew their symbolic struggle in the role of titans. They contend for the destiny of a world.

Somewhere far up the coast wandered the star thrower beneath his rainbow. Our exchange had been brief because upon that coast I had learned that men who ventured out at dawn resented others in the greediness of their compulsive collecting. I had also been abrupt because I had, in the terms of my profession and experience, nothing to say. The star thrower was mad, and his particular acts were a folly with which I had not chosen to associate myself. I was an observer and a scientist. Nevertheless, I had seen the rainbow attempting to attach itself to earth.

On a point of land, as though projecting into a domain beyond us, I found the star thrower. In the sweet rain-swept morning, that great many-hued rainbow still lurked and wavered tentatively beyond him. Silently I sought and picked up a still-living star, spinning it far out into the waves. I spoke once briefly. "I understand," I said. "Call me another thrower." Only then I allowed myself to think, He is not alone any longer. After us there will be others.

We were part of the rainbow—an unexplained projection into the natural. As I went down the beach I could feel the drawing of a circle in men's minds, like that lowering, shifting realm of color in which the thrower labored. It was a visible model of something toward which man's mind had striven, the circle of perfection.

I picked and flung another star. Perhaps far outward on the rim of space a genuine star was similarly seized and flung. I could feel the movement in my body. It was like a sowing—the sowing of life on an infinitely gigantic scale. I looked back across my shoulder. Small and dark against the receding rainbow, the star thrower stopped and flung once more. I never looked again. The task we had assumed was too immense for gazing. I flung and flung again while all about us roared the insatiable waters of death.

But we, pale and alone and small in that immensity, hurled back the living stars. Somewhere far off, across bottomless abysses, I felt as though another world was flung more joy-

fully. I could have thrown in a frenzy of joy, but I set my shoulders and cast, as the thrower in the rainbow cast, slowly, deliberately, and well. The task was not to be assumed lightly, for it was men as well as starfish that we sought to save. For a moment, we cast on an infinite beach together beside an unknown hurler of suns. It was, unsought, the destiny of my kind since the rituals of the Ice Age hunters, when life in the Northern Hemisphere had come close to vanishing. We had lost our way, I thought, but we had kept, some of us, the memory of the perfect circle of compassion from life to death and back again to life—the completion of the rainbow of existence. Even the hunters in the snow, making obeisance to the souls of the hunted, had known the cycle. The legend had come down and lingered that he who gained the gratitude of animals gained help in need from the dark wood.

I cast again with an increasingly remembered sowing motion and went my lone way up the beaches. Somewhere, I felt, in a great atavistic surge of feeling, somewhere the Thrower knew. Perhaps he smiled and cast once more into the boundless pit of darkness. Perhaps he, too, was lonely, and the end toward which he labored remained hidden—even as with ourselves.

I picked up a star whose tube feet ventured timidly among my fingers while, like a true star, it cried soundlessly for life. I saw it with an unaccustomed clarity and cast far out. With it, I flung myself as forfeit, for the first time, into some unknown dimension of existence. From Darwin's tangled bank of unceasing struggle, selfishness, and death, had arisen, incomprehensibly, the thrower who loved not man, but life. It was the subtle cleft in nature before which biological thinking had faltered. We had reached the last shore of an invisible island—yet, strangely, also a shore that the primitives had always known. They had sensed intuitively that man cannot exist spiritually without life, his brother, even if he slays. Somewhere, my thought persisted, there is a hurler of stars, and he walks, because he chooses, always in desolation, but not in defeat.

In the night the gas flames under the shelling kettles would

continue to glow. I set my clock accordingly. Tomorrow I would walk in the storm. I would walk against the shell collectors and the flames. I would walk remembering Bacon's forgotten words "for the uses of life." I would walk with the knowledge of the discontinuities of the unexpected universe. I would walk knowing of the rift revealed by the thrower, a hint that there looms, inexplicably, in nature something above the role men give her. I knew it from the man at the foot of the rainbow, the starfish thrower on the beaches of Costabel.

the terminal beach

At night, as he lay asleep on the floor of the ruined bunker, Traven heard the waves breaking along the shore of the lagoon, reminding him of the deep Atlantic rollers on the beach at Dakar, where he had been born, and of waiting in the evenings for his parents to drive home along the corniche road from the airport. Overcome by this long-forgotten memory, he woke uncertainly from the bed of old magazines on which he slept and ran toward the dunes that screened the lagoon.

Through the cold night air he could see the abandoned super-fortresses lying among the palms, beyond the perimeter of the emergency landing field three hundred yards away. Traven walked through the dark sand, already forgetting where the shore lay, although the atoll was only half a mile in width. Above him, along the crests of the dunes, the tall palms leaned into the dim air like the symbols of some cryptic alphabet. The landscape of the island was covered by strange ciphers.

Giving up the attempt to find the beach, Traven stumbled into a set of tracks left years earlier by a large caterpillar vehicle. The heat released by one of the weapons tests had fused the sand, and the double line of fossil imprints, uncovered by the evening air, wound its serpentine way among the hollows like the footfalls of an ancient saurian.

Too weak to walk any farther, Traven sat down between the tracks. With one hand he began to excavate the wedge-shaped grooves from a drift into which they disappeared, hoping that they might lead him toward the sea. He returned to the bunker shortly before dawn, and slept through the hot silences of the following noon.

The Blocks (I)

As usual on these enervating afternoons, when not even the faintest breath of offshore breeze disturbed the dust, Traven

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j.g. ballard

sat in the shadow of one of the blocks, lost somewhere within the center of the maze. His back resting against the rough concrete surface, he gazed with a phlegmatic eye down the surrounding aisles and at the line of doors facing him. Each afternoon he left his cell in the abandoned camera bunker and walked down into the blocks. For the first half-hour he restricted himself to the perimeter aisle, now and then trying one of the doors with the rusty key in his pocket—he had found it among the litter of smashed bottles in the isthmus of sand separating the testing ground from the airstrip—and then, inevitably, with a sort of drugged stride, he set off into the center of the blocks, breaking into a run and darting in and out of the corridors, as if trying to flush some invisible opponent from his hiding place. Soon he would be completely lost. Whatever his efforts to return to the perimeter, he found himself once more in the center.

Eventually he would abandon the task, and sit down in the dust, watching the shadows emerge from their crevices at the foot of the blocks. For some reason he always arranged to be trapped when the sun was at zenith—on Eniwetok, a thermonuclear noon.

One question in particular intrigued him: “What sort of people would inhabit this minimal concrete city?”

The Synthetic Landscape

“This island is a state of mind,” Osborne, one of the biologists working in the old submarine pens, was later to remark to Traven. The truth of this became obvious to Traven within two or three weeks of his arrival. Despite the sand and the few anemic palms, the entire landscape of the island was synthetic, a manmade artifact with all the associations of a vast system of derelict concrete motorways. Since the moratorium on atomic tests, the island had been abandoned by the Atomic Energy Commission, and the wilderness of weapons aisles, towers, and

blockhouses ruled out any attempt to return it to its natural state. (There were also stronger unconscious motives, Tavern recognized, for leaving it as it was: if primitive man felt the need to assimilate events in the external world to his own psyche, twentieth-century man had reversed this process—by this Cartesian yardstick, the island at least *existed*, in a sense true of few other places.)

But apart from a few scientific workers, no one yet felt any wish to visit the former testing ground, and the naval patrol boat anchored in the lagoon had been withdrawn five years before Traven's arrival. Its ruined appearance and the associations of the island with the period of the Cold War—what Traven had christened the "Pre-Third"—were profoundly depressing, an Auschwitz of the soul whose mausoleums contained the mass graves of the still undead. With the Russo-American détente this nightmarish chapter of history had been gladly forgotten.

The Pre-Third

"The actual and potential destructiveness of the atomic bomb plays straight into the hands of the Unconscious. The most cursory study of the dream-life and fantasies of the insane shows that ideas of world-destruction are latent in the unconscious mind. Nagasaki destroyed by the magic of science is the nearest man has yet approached to the realization of dreams that even during the safe immobility of sleep are accustomed to develop into nightmares of anxiety."—Glover; *War, Sadism, and Pacifism*

The Pre-Third: the period had been characterized in Traven's mind above all by its moral and psychological inversions, by its sense of the whole of history, and in particular of the immediate future—the two decades, 1945–1965—suspended from the quivering volcano's lip of World War III. Even the death of his wife and six-year-old son in a motor accident seemed only part of this immense synthesis of the historical and psychic

zero, the frantic highways where each morning they met their deaths, the advance causeways to the global Armageddon.

Third Beach

He had come ashore at midnight, after a hazardous search for an opening in the reef. The small motorboat he had hired from an Australian pearldiver at Charlotte Island subsided into the shallows, its hull torn by the sharp coral. Exhausted, Traven walked through the darkness among the dunes, where the dim outlines of bunkers and concrete towers loomed between the palms.

He woke the next morning into bright sunlight, lying half-way down the slope of a wide concrete beach. This ringed what appeared to be an empty reservoir or target basin, some two hundred feet in diameter, part of a system of artificial lakes built down the center of the atoll. Leaves and dust choked the waste grilles, and a pool of warm water two feet deep lay in the center, reflecting a distant line of palms.

Traven sat up and took stock of himself. This brief inventory, which merely confirmed his physical identity, was limited to little more than his thin body in its frayed cotton garments. In the context of the surrounding terrain, however, even this collection of tatters seemed to possess a unique vitality. The emptiness of the island, and the absence of any local fauna, were emphasized by the huge sculptural forms of the target basins let into its surface. Separated from each other by narrow isthmuses, the lakes stretched away along the curve of the atoll. On either side, sometimes shaded by the few palms that had gained a precarious purchase in the cracked cement, were roadways, camera towers, and isolated blockhouses, together forming a continuous concrete cap upon the island, a functional megalithic architecture as gray and minatory (and apparently as ancient, in its projection into, and from, time future) as any of Assyria and Babylon.

The series of weapons tests had fused the sand in layers, and

the pseudogeological strata condensed the brief epochs, micro-seconds in duration, of the thermonuclear age. "The key to the past lies in the present." Typically the island inverted this geologist's maxim. Here the key to the present lay in the future. The island was a fossil of time future, its bunkers and block-houses illustrating the principle that the fossil record of life is one of armor and the exoskeleton.

Traven knelt in the warm pool and splashed his shirt and trousers. The reflection revealed the watery image of a thinly bearded face and gaunt shoulders. He had come to the island with no supplies other than a small bar of chocolate, expecting that in some way the island would provide its own sustenance. Perhaps, too, he had identified the need for food with a forward motion in time, and that with his return to the past, or at most into a zone of nontime, this need would be obviated. The privations of the previous six months, during his journey across the Pacific, had reduced his always thin body to that of a migrant beggar, held together by little more than the preoccupied gaze in his eye. Yet this emaciation, by stripping away the superfluities of the flesh, seemed to reveal an inner sinewy toughness, and economy and directness of movement.

For several hours he wandered about, inspecting one bunker after another for a convenient place to sleep. He crossed the remains of a small landing strip, next to a dump where a dozen B-29's lay across one another like dead reptile birds.

The Corpses

Once he entered a small street of metal shacks, containing a cafeteria, recreation rooms, and shower stalls. A wrecked juke-box lay half-buried in the sand behind the cafeteria, its selection of records still in their rack.

Farther along, flung into a small target basin fifty yards from the shacks, were the bodies of what at first he thought were the inhabitants of this ghost town—a dozen life-size plastic models. Their half-melted faces, contorted into bleary grimaces, gazed up at him from the jumble of legs and torsos.

On either side of him, muffled by the dunes, came the sounds of waves, the great rollers on the seaward side breaking over the reefs, and onto the beaches within the lagoon. However, he avoided the sea, hesitating before any rise that might take him within its sight. Everywhere the camera towers offered him a convenient aerial view of the confused topography of the island, but he avoided their rusting ladders.

He soon realized that however confused and random the blockhouses and camera towers might seem, their common focus dominated the landscape and gave to it a unique perspective. As Traven noticed when he sat down to rest in the window slit of one of the blockhouses, all these observation posts occupied positions on a series of concentric perimeters, moving in tightening arcs toward the inmost sanctuary. This ultimate circle, below ground zero, remained hidden beyond a line of dunes a quarter of a mile to the west.

The Terminal Bunker

After sleeping for a few nights in the open, Traven returned to the concrete beach where he had woken on his first morning on the island, and made his home—if the term could be applied to that damp crumbling hovel—in a camera bunker fifty yards from the target lakes. The dark chamber between the thick canted walls, tomblike though it might seem, gave him a sense of physical reassurance. Outside, the sand drifted against the sides, half burying the narrow doorway, as if crystallizing the immense epoch of time that had elapsed since the bunker's construction. The narrow rectangles of the five camera slits, their shapes and positions determined by the instruments, studded the east wall like cryptic ideograms. Variations of these ciphers decorated the walls of the other bunkers. In the morning, if Traven was awake, he would always find the sun divided into five emblematic beacons.

Most of the time the chamber was filled only by a damp gloomy light. In the control tower at the landing field Traven found a collection of discarded magazines, and used these to

make a bed. One day, lying in the bunker shortly after the first attack of beri-beri, he pulled out a magazine pressing into his back and found inside it a full-page photograph of a six-year-old girl. This blond-haired child, with her composed expression and self-immersed eyes, filled him with a thousand painful memories of his son. He pinned the page to the wall and for days gazed at it through his reveries.

For the first few weeks Traven made little attempt to leave the bunker, and postponed any further exploration of the island. The symbolic journey through its inner circles set its own times of arrival and departure. He evolved no routine for himself. All sense of time soon vanished; his life became completely existential, an absolute break separating one moment from the next like two quantal events. Too weak to forage for food, he lived on the old ration packs he found in the wrecked superfortresses. Without any implements, it took him all day to open the cans. His physical decline continued, but he watched his spindling arms and legs with indifference.

By now he had forgotten the existence of the sea and vaguely assumed the atoll to be part of some continuous continental table. A hundred yards away to the north and south of the bunker a line of dunes, topped by the palisade of enigmatic palms, screened the lagoon and sea, and the faint muffled drumming of the waves at night had fused with his memories of war and childhood. To the east was the emergency landing field and the abandoned aircraft. In the afternoon light their shifting rectangular shadows would appear to writhe and pivot. In front of the bunker, where he sat, was the system of target lakes, the shallow basins extending across the center of the atoll. Above him the five apertures looked out upon this scene like the tutelary deities of some futuristic myth.

The Lakes and the Specters

The lakes had been designed originally to reveal any radiobiological changes in a selected range of flora and fauna, but

the specimens had long since bloomed into grotesque parodies of themselves and been destroyed.

Sometimes in the evenings, when a sepulchral light lay over the concrete bunkers and causeways, and the basins seemed like ornamental lakes in a city of deserted mausoleums, abandoned even by the dead, he would see the specters of his wife and son standing on the opposite bank. Their solitary figures appeared to have been watching him for hours. Although they never moved, Traven was sure they were beckoning to him. Roused from his reverie, he would stumble across the dark sand to the edge of the lake and wade through the water, shouting at the two figures as they moved away hand in hand among the lakes and disappeared across the distant causeways.

Shivering with cold, Traven would return to the bunker and lie on the bed of old magazines, waiting for their return. The image of their faces, the pale lantern of his wife's cheeks, floated on the river of his memory.

The Blocks (II)

It was not until he discovered the blocks that Traven realized he would never leave the island.

At this stage, some two months after his arrival, Traven had exhausted the small cache of food, and the symptoms of beri-beri had become more acute. The numbness in his hands and feet, and the gradual loss of strength, continued. Only by an immense effort, and the knowledge that the inner sanctum of the island still lay unexplored, did he manage to leave the palliasse of magazines and make his way from the bunker.

As he sat in the drift of sand by the doorway that evening, he noticed a light shining through the palms far into the distance around the atoll. Confusing this with the image of his wife and son, and visualizing them waiting for him at some warm hearth among the dunes, Traven set off toward the light. Within fifty yards he lost his sense of direction. He blundered about for several hours on the edges of the landing strip, and

succeeded only in cutting his foot on a broken Coca-Cola bottle in the sand.

After postponing his search for the night, he set out again in earnest the next morning. As he moved past the towers and blockhouses the heat lay over the island in an unbroken mantle. He had entered a zone devoid of time. Only the narrowing perimeters of the bunkers warned him that he was crossing the inner field of the firetable.

He climbed the ridge which marked the farthest point in his previous exploration of the island. The plain beyond was covered with target aisles and explosion breaks. On the gray walls of the recording towers, which rose into the air like obelisks, were the faint outlines of human forms in stylized postures, the flash-shadows of the target community burned into the cement. Here and there, where the concrete apron had cracked, a line of palms hung precariously in the motionless air. The target lakes were smaller, filled with the broken bodies of plastic dummies. Most of them still lay in the inoffensive domestic postures into which they had been placed before the tests.

Beyond the farthest line of dunes, where the camera towers began to turn and face him, were the tops of what seemed to be a herd of square-backed elephants. They were drawn up in precise ranks in a hollow that formed a shallow corral.

Traven advanced toward them, limping on his cut foot. On either side of him the loosening sand had excavated the dunes, and several of the blockhouses tilted on their sides. This plain of bunkers stretched for some quarter of a mile. To one side the half-submerged hulks of a group of concrete shelters, bombed out onto the surface in some earlier test, lay like the husks of the abandoned wombs that had given birth to this herd of megaliths.

The Blocks (III)

To grasp something of the vast number and oppressive size of the blocks, and their impact upon Traven, one must try to

visualize sitting in the shade of one of these concrete monsters, or walking about in the center of this enormous labyrinth which extended across the central table of the island. There were some two thousand of them, each a perfect cube fifteen feet in height, regularly spaced at ten-yard intervals. They were arranged in a series of tracts, each composed of two hundred blocks, inclined to one another and to the direction of the blast. They had weathered only slightly in the years since they were first built, and their gaunt profiles were like the cutting faces of an enormous die-plate, designed to stamp out huge rectilinear volumes of air. Three of the sides were smooth and unbroken, but the fourth, facing away from the direction of the blast, contained a narrow inspection door.

It was this feature of the blocks that Traven found particularly disturbing. Despite the considerable number of doors, by some freak of perspective only those in a single aisle were visible at any point within the maze, the rest obscured by the intervening blocks. As he walked from the perimeter into the center of the massif, line upon line of the small metal doors appeared and receded, a world of closed exits concealed behind endless corners.

Approximately twenty of the blocks, those immediately below ground zero, were solid, the walls of the remainder of varying thicknesses. From the outside they appeared to be of uniform solidity.

As he entered the first of the long aisles, Traven felt his step lighten; the sense of fatigue that had dogged him for so many months began to lift. With their geometric regularity and finish, the blocks seemed to occupy more than their own volume of space, imposing on him a mood of absolute calm and order. He walked on into the center of the maze, eager to shut out the rest of the island. After a few random turns to left and right, he found himself alone, the vistas to the sea, lagoon, and island closed.

Here he sat down with his back against one of the blocks, the quest for his wife and son forgotten. For the first time since

his arrival at the island the sense of dissociation prompted by its fragmenting landscape began to recede.

One development he did not expect. With dusk, and the need to leave the blocks and find food, he realized that he had lost himself. However he retraced his steps, struck out left or right at an oblique course, oriented himself around the sun and pressed on resolutely north or south, he found himself back at his starting point. Despite his best efforts, he was unable to make his way out of the maze. That he was aware of his motives gave him little help. Only when hunger overcame the need to remain did he manage to escape.

Abandoning his former home near the aircraft dump, Traven collected together what canned food he could find in the waist turret and cockpit lockers of the superfortresses and pulled them across the island on a crude sledge. Fifty yards from the perimeter of the blocks he took over a tilting bunker, and pinned the fading photograph of the blond-haired child to the wall beside the door. The page was falling to pieces, like his fragmenting image of himself. Each evening when he woke he would eat uneagerly and then go out into the blocks. Sometimes he took a canteen of water with him and remained there for two or three days.

Traven: In Parenthesis

Elements in a quantal world:

The terminal beach.

The terminal bunker.

The blocks.

The landscape is coded.

Entry points into the future = levels in a spinal landscape =
zones of significant time.

The Submarine Pens

This precarious existence continued for the following weeks. As he walked out to the blocks one evening, he again saw his

wife and son, standing among the dunes below a solitary tower, their faces watching him calmly. He realized that they had followed him across the island from their former haunt among the dried-up lakes. Once again he saw the beckoning light, and he decided to continue his exploration of the island.

Half a mile farther along the atoll he found a group of four submarine pens, built over an inlet, now drained, which wound through the dunes from the sea. The pens still contained several feet of water, filled with strange luminescent fish and plants. A warning light winked at intervals from a metal tower. The remains of a substantial camp, only recently vacated, stood on the concrete pier outside. Greedily Traven heaped his sledge with the provisions stacked inside one of the metal shacks. With this change of diet the beri-beri receded, and during the next days he returned to the camp. It appeared to be the site of a biological expedition. In a field office he came across a series of large charts of mutated chromosomes. He rolled them up and took them back to his bunker. The abstract patterns were meaningless, but during his recovery he amused himself by devising suitable titles for them. (Later, passing the aircraft dump on one of his forays, he found the half-buried jukebox, and tore the list of records from the selection panel, realizing that these were the most appropriate captions for the charts. Thus embroidered, they took on many layers of cryptic associations.)

Traven lost among the blocks

August 5. Found the man Traven. A strange derelict figure, hiding in a bunker in the deserted interior of the island. He is suffering from severe exposure and malnutrition, but is unaware of this, or, for that matter, of any other events in the world around him. . . .

He maintains that he came to the island to carry out some scientific project—unstated—but I suspect that he understands his real motives and the unique role of the island. . . .

In some way its landscape seems to be involved with certain unconscious notions of time, and in particular with those that may be a repressed premonition of our own deaths. The attractions and dangers of such an architecture, as the past has shown, need no stressing.

August 6. He has the eyes of the possessed. I would guess that he is neither the first, nor the last, to visit the island.—from Dr. C. Osborne, “Eniwetok Diary.”

With the exhaustion of his supplies, Traven remained within the perimeter of the blocks almost continuously, conserving what strength remained to him to walk slowly down their empty corridors. The infection in his right foot made it difficult for him to replenish his supplies from the stores left by the biologists, and as his strength ebbed he found progressively less incentive to make his way out of the blocks. The system of megaliths now provided a complete substitute for those functions of his mind which gave to it its sense of the sustained rational order of time and space, his awareness kindled from levels above those of his present nervous system (if the autonomic system is dominated by the past, the cerebro-spinal reaches toward the future). Without the blocks, his sense of reality shrank to little more than the few square inches of sand beneath his feet.

On one of his last ventures into the maze, he spent all night and much of the following morning in a futile attempt to escape. Dragging himself from one rectangle of shadow to another, his leg as heavy as a club and apparently inflamed to the knee, he realized that he must soon find an equivalent for the blocks or he would end his life within them, trapped with this self-constructed mausoleum as surely as the retinue of Pharaoh.

He was sitting exhausted somewhere within the center of the system, the faceless lines of the tomb-booths receding from him, when the sky was slowly divided by the drone of a light aircraft. This passed overhead, and then, five minutes later, returned. Seizing his opportunity, Traven struggled to his feet

and made his exit from the blocks, his head raised to follow the glistening exhaust trail.

As he lay down in the bunker he dimly heard the aircraft return and carry out an inspection of the site.

A Belated Rescue

"Who are you?" A small sandy-haired man was peering down at him with a severe expression, then put away a syringe in his valise. "Do you realize you're on your last legs?"

"Traven . . . I've had some sort of accident. I'm glad you flew over."

"I'm sure you are. Why didn't you use our emergency radio? Anyway, we'll call the Navy and have you picked up."

"No. . . ." Traven sat up on one elbow and felt weakly in his hip pocket. "I have a pass somewhere. I'm carrying out research."

"Into what?" The question assumed a complete understanding of Traven's motives. Traven lay in the shade beside the bunker, and drank weakly from a canteen as Dr. Osborne dressed his foot. "You've also been stealing our stores."

Traven shook his head. Fifty yards away the blue and white Cessna stood on the concrete apron like a large dragonfly. "I didn't realize you were coming back."

"You must be in a trance."

The young woman at the controls of the aircraft climbed from the cockpit and walked over to them, glancing at the gray bunkers and blocks. She seemed unaware of or uninterested in the decrepit figure of Traven. Osborne spoke to her over his shoulder, and after a downward glance at Traven she went back to the aircraft. As she turned Traven rose involuntarily, recognizing the child in the photograph he had pinned to the wall. Then he remembered that the magazine could not have been more than four or five years old.

The engine of the aircraft started. It turned onto one of the roadways and took off into the wind.

. . .

The young woman drove over by jeep that afternoon with a small camp bed and a canvas awning. During the intervening hours Traven had slept, and woke refreshed when Osborne returned from his scrutiny of the surrounding dunes.

"What are you doing here?" the young woman asked as she secured one of the guy-ropes to the bunker.

"I'm searching for my wife and son," Traven said.

"They're on this island?" Surprised, but taking the reply at face value, she looked around her. "Here?"

"In a manner of speaking."

After inspecting the bunker, Osborne joined them. "The child in the photograph. Is she your daughter?"

"No." Traven tried to explain. "She's adopted *me*."

Unable to make sense of his replies, but accepting his assurances that he would leave the island, Osborne and the young woman returned to their camp. Each day Osborne returned to change the dressing, driven by the young woman, who seemed to grasp the role cast for her by Traven in his private mythology. Osborne, when he learned of Traven's previous career as a military pilot, assumed that he was a latter-day martyr left high and dry by the moratorium on thermonuclear tests.

"A guilt complex isn't an indiscriminate supply of moral sanctions. I think you may be overstretching yours."

When he mentioned the name Eatherly, Traven shook his head.

Undeterred, Osborne pressed: "Are you sure you're not making similar use of the image of Eniwetok—waiting for your pentecostal wind?"

"Believe me, Doctor, no," Traven replied firmly. "For me the H-Bomb is a symbol of absolute freedom. Unlike Eatherly, I feel it's given me the right—the obligation, even—to do anything I choose."

"That seems strange logic," Osborne commented. "Aren't we at least responsible for our physical selves?"

Traven shrugged. "Not now, I think. After all, aren't we in effect men raised from the dead?"

Often, however, he thought of Eatherly: the prototypal Pre-Third Man, dating the Pre-Third from August 6, 1945, carrying a full load of cosmic guilt.

Shortly after Traven was strong enough to walk again he had to be rescued from the blocks for a second time. Osborne became less conciliatory.

"Our work is almost complete," he warned Traven. "You'll die here. Traven, what are you looking for?"

To himself Traven said: the tomb of the unknown civilian, *Homo Hydrogenesis*, Eniwetok Man. To Osborne he said: "Doctor, your laboratory is at the wrong end of this island."

"I'm aware of that, Traven. There are rarer fish swimming in your head than in any submarine pen."

On the day before they left Traven and the young woman drove over to the lakes where he had first arrived. As a final present from Osborne, an ironic gesture unexpected from the elderly biologist, she had brought the correct list of legends for the chromosome charts. They stopped by the derelict juke-box and she pasted them onto the selection panel.

They wandered among the supine wrecks of the super-fortresses. Traven lost sight of her, and for the next ten minutes searched in and out of the dunes. He found her standing in a small amphitheater formed by the sloping mirrors of a solar energy device, built by one of the visiting expeditions. She smiled to him as he stepped through the scaffolding. A dozen fragmented images of herself were reflected in the broken panes. In some she was sans head, in others multiples of her raised arms circled her like those of a Hindu goddess. Exhausted, Traven turned away and walked back to the jeep.

As they drove away he described his glimpses of his wife and son. "Their faces are always calm. My son's particularly, although he was never really like that. The only time his face was grave was when he was being born—then he seemed millions of years old."

The young woman nodded. "I hope you find them." As an afterthought she added: "Dr. Osborne is going to tell the Navy you're here. Hide somewhere."

Traven thanked her. When she flew away from the island for the last time he waved to her from his seat beside the blocks.

The Naval Party

When the search party came for him Traven hid in the only logical place. Fortunately the search was perfunctory, and was called off after a few hours. The sailors had brought a supply of beer with them, and the search soon turned into a drunken ramble. On the walls of the recording towers Traven later found balloons of obscene dialogue chalked into the mouths of the shadow figures, giving their postures the priapic gaiety of the dancers in cave drawings.

The climax of the party was the ignition of a store of gasoline in an underground tank near the airstrip. As he listened, first to the megaphones shouting his name, the echoes receding among the dunes like the forlorn calls of dying birds, then to the boom of the explosion and the laughter as the landing craft left, Traven felt a premonition that these were the last sounds he would hear.

He had hidden in one of the target basins, lying down among the bodies of the plastic dummies. In the hot sunlight their deformed faces gaped at him sightlessly from the tangle of limbs, their blurred smiles like those of the soundlessly laughing dead. Their faces filled his mind as he climbed over the bodies and returned to the bunker.

As he walked toward the blocks he saw the figures of his wife and son standing in his path. They were less than ten yards from him, their white faces watching him with a look of almost overwhelming expectancy. Never had Traven seen them so close to the blocks. His wife's pale features seemed illuminated from within, her lips parted as if in greeting, one hand raised to take his own. His son's grave face, with its curiously fixed expression, regarded him with the same enigmatic smile of the girl in the photograph.

"Judith! David!" Startled, Traven ran forward to them.

Then, in a sudden movement of light, their clothes turned into shrouds, and he saw the wounds that disfigured their necks and chests. Appalled, he cried out to them. As they vanished he fled into the safety and sanity of the blocks.

The Catechism of Goodbye

This time he found himself, as Osborne had predicted, unable to leave the blocks.

Somewhere in the shifting center of the maze, he sat with his back against one of the concrete flanks, his eyes raised to the sun. Around him the lines of cubes formed the horizons of his world. At times they would appear to advance toward him, looming over him like cliffs, the intervals between them narrowing so that they were little more than an arm's length apart, a labyrinth of narrow corridors running between them. Then they would recede from him, separating from each other like points in an expanding universe, until the nearest line formed an intermittent palisade along the horizon.

Time had become quantal. For hours it would be noon, the shadows contained within the motionless bulk of the blocks, the heat reverberating off the concrete floor. Abruptly he would find it was early afternoon or evening, the shadows everywhere like pointing fingers.

"Goodbye, Eniwetok," he murmured.

Somewhere there was a flicker of light, as if one of the blocks, like a counter on an abacus, had been plucked away.

"Goodbye, Los Alamos." Again a block seemed to vanish. The corridors around him remained intact, but somewhere, Traven was convinced, in the matrix superimposed on his mind, a small interval of neutral space had been punched.

Goodbye, Hiroshima.

Goodbye, Alamagordo.

Goodbye, Moscow, London, Paris, New York. . . .

Shuttles flickered, a ripple of integers. Traven stopped, accepting the futility of this megathlon farewell. Such a leave-taking

required him to fix his signature on every one of the particles in the universe.

Total Noon: Eniwetok

The blocks now occupied positions on an endlessly revolving circus wheel. They carried him upward, to heights from which he could see the whole island and the sea, and then down again through the opaque disc of the floor. From here he looked up at the undersurface of the concrete cap, an inverted landscape of rectilinear hollows, the dome-shaped mounds of the lake-system, the thousands of empty cubic pits of the blocks.

“Goodbye, Traven”

To his disappointment he found that this ultimate act of rejection gained him nothing.

In an interval of lucidity, he looked down at his emaciated arms and legs propped loosely in front of him, the brittle wrists and hands covered with a lacework of ulcers. To his right was a trail of disturbed dust, the marks of slack heels.

In front of him lay a long corridor between the blocks, joining an oblique series a hundred yards away. Among these, where a narrow interval revealed the open space beyond, was a crescent-shaped shadow, poised in the air.

During the next half-hour it moved slowly, turning as the sun swung.

The outline of a dune.

Seizing on this cipher, which hung before him like a symbol on a shield, Traven pushed himself through the dust. He climbed precariously to his feet, and covered his eyes from all sight of the blocks.

Ten minutes later he emerged from the western perimeter. The dune whose shadow had guided him lay fifty yards away. Beyond it, bearing the shadow like a screen, was a ridge of

limestone, which ran away among the hillocks of a wasteland. The remains of old bulldozers, bales of barbed wire, and fifty-gallon drums lay half-buried in the sand.

Traven approached the dune, reluctant to leave this anonymous swell of sand. He shuffled around its edges, and then sat down in the shade by a narrow crevice in the ridge.

Ten minutes later he noticed that someone was watching him.

The Marooned Japanese

This corpse, whose eyes stared up at Traven, lay to his left at the bottom of the crevice. That of a man of middle age and powerful build, it lay on its side with its head on a pillow of stone, as if surveying the window of the sky. The fabric of the clothes had rotted to a gray tattered vestment, but in the absence of any small animal predators on the island the skin and musculature had been preserved. Here and there, at the angle of knee or wrist, a bony point shone through the leathery integument of the yellow skin, but the facial mask was still intact, and revealed a male Japanese of the professional classes. Looking down at the strong nose, high forehead, and broad mouth, Traven guessed that the Japanese had been a doctor or lawyer.

Puzzled as to how the corpse had found itself here, Traven slid a few feet down the slope. There were no radiation burns on the skin, which indicated that the Japanese had been there for less than five years. Nor did he appear to be wearing a uniform, so had not been a member of a military or scientific mission.

To the left of the corpse, within reach of his hand, was a frayed leather case, the remains of a map wallet. To the right was the bleached husk of a haversack, open to reveal a canteen of water and a small jerrican.

Greedily, the reflex of starvation making him for the moment ignore this discovery that the Japanese had deliberately chosen to die in the crevice, Traven slid down the slope until his feet touched the splitting soles of the corpse's shoes. He reached

forward and seized the canteen. A cupful of flat water swilled around the rusting bottom. Traven gulped down the water, the dissolved metal salts cloaking his lips and tongue with a bitter film. He pried the lid off the jerrican, which was empty but for a tacky coating of condensed syrup. He scraped at this with the lid and chewed at the tarry flakes. They filled his mouth with an almost intoxicating sweetness. After a few moments he felt light-headed and sat back beside the corpse. Its sightless eyes regarded him with unmoving compassion.

The Fly

(A small fly, which Traven presumes has followed him into the crevice, now buzzes about the corpse's face. Traven leans forward to kill it, then reflects that perhaps this minuscule sentry had been the corpse's faithful companion, in return fed on the rich liqueurs and distillations of its pores. Carefully, to avoid injuring the fly, he encourages it to alight on his wrist.)

DR. YASUDA: Thank you, Traven. *(The voice is rough, as if unused to conversation.)* In my position, you understand.

TRAVER: Of course, Doctor. I'm sorry I tried to kill it. These ingrained habits, you know, they're not easy to shrug off. Your sister's children in Osaka in '44, the exigencies of war, I hate to plead them, most known motives are so despicable one searches the unknown in the hope that. . . .

YASUDA: Please, Traven, do not be embarrassed. The fly is lucky to retain its identity for so long. That son you mourn, not to mention my own two nieces and nephew, did they not die each day? Every parent in the world mourns the lost sons and daughters of their past childhoods.

TRAVER: You're very tolerant, Doctor. I wouldn't dare—

YASUDA: Not at all, Traven. I make no apologies for you. After all, each one of us is little more than the meager residue of

the infinite unrealized possibilities of our lives. But your son and my nieces are fixed in our minds forever, their identities as certain as the stars.

TRAVERN: (*Not entirely convinced*) That may be so, Doctor, but it leads to a dangerous conclusion in the case of this island. For instance, the blocks. . . .

YASUDA: They are precisely to what I refer. Here among the blocks, Traven, you at last find the image of yourself free of time and space. This island is an ontological Garden of Eden; why try to expel yourself into a quantal world?

TRAVERN: Excuse me. (*The fly has flown back to the corpse's face and sits in one of the orbits, giving the good doctor an expression of quizzical beadiness. Reaching forward, Traven entices it onto his palm.*) Well, yes, these bunkers may be ontological objects, but whether this is the ontological fly seems doubtful. It's true that on this island it's the only fly, which is the next best thing.

YASUDA: You can't accept the plurality of the universe, Traven. Ask yourself, why? Why should this obsess you. It seems to me that you are hunting for the white leviathan, zero. The beach is a dangerous zone; avoid it. Have a proper humility; pursue a philosophy of acceptance.

TRAVERN: Then may I ask why you came here, Doctor?

YASUDA: To feed this fly. "What greater love—?"

TRAVERN: (*Still puzzling*) It doesn't really solve my problem. The blocks, you see. . . .

YASUDA: Very well, if you must have it that way . . .

TRAVERN: But, Doctor—

YASUDA: (*Peremptorily*) Kill that fly!

TRAVERN: That's not an end, or a beginning. (*Hopelessly he kills the fly. Exhausted, he falls asleep beside the corpse.*)

The Terminal Beach

Searching for a piece of rope in the refuse dump behind the dunes, Traven found a bale of rusty wire. He unwound it, then secured a harness around the corpse's chest, and dragged it from the crevice. The lid of a wooden crate served as a sledge. Traven fastened the corpse into a sitting position, and set off along the perimeter of the blocks. Around him the island was silent. The lines of palms hung in the sunlight, only his own motion varying the shifting ciphers of their crisscrossing trunks. The square turrets of the camera towers jutted from the dunes like forgotten obelisks.

An hour later, when Traven reached his bunker, he untied the wire cord he had fastened around his waist. He took the chair left for him by Dr. Osborne and carried it to a point midway between the bunker and the blocks. Then he tied the body of the Japanese to the chair, arranging the hands so that they rested on the wooden arms, giving the moribund figure a posture of calm repose.

This done to his satisfaction, Traven returned to the bunker and squatted under the awning.

As the next days passed into weeks, the dignified figure of the Japanese sat in his chair fifty yards from him, guarding Traven from the blocks. Their magic still filled Traven's reveries, but he now had sufficient strength to rouse himself and forage for food. In the hot sunlight the skin of the Japanese became more and more bleached, and sometimes Traven would wake at night to find the white sepulchral figure sitting there, arms resting at its sides, in the shadows that crossed the concrete floor. At these moments he would often see his wife and son watching him from the dunes. As time passed they came closer, and he would sometimes turn to find them only a few yards behind him.

Patiently Traven waited for them to speak to him, thinking of the great blocks whose entrance was guarded by the seated figure of the dead archangel, as the waves broke on the distant shore and the burning bombers fell through his dreams.

He doesn't know which of us I am these days, but they know one truth. You must own nothing but yourself. You must make your own life, live your own life and die your own death . . . or else you will die another's.

The rice fields on Paragon III stretch for hundreds of miles like checkerboard tundras, a blue and brown mosaic under a burning sky of orange. In the evening, clouds whip like smoke, and the paddies rustle and murmur.

A long line of men marched across the paddies the evening we escaped from Paragon III. They were silent, armed, intent; a long rank of silhouetted statues looming against the smoking sky. Each man carried a gun. Each man wore a walkie-talkie belt pack, the speaker button in his ear, the microphone bug clipped to his throat, the glowing view-screen strapped to his wrist like a green-eyed watch. The multitude of screens showed nothing but a multitude of individual paths through the paddies. The annunciators uttered no sound but the rustle and splash of steps. The men spoke infrequently, in heavy grunts, all speaking to all.

"Nothing here."

"Where's here?"

"Jenson's fields."

"You're drifting too far west."

"Close in the line there."

"Anybody covered the Grimson paddy?"

"Yeah. Nothing."

"She couldn't have walked this far."

"Could have been carried."

"Think she's alive?"

"Why should she be dead?"

The slow refrain swept up and down the long line of beaters advancing toward the smoky sunset. The line of beaters wavered like a writhing snake, but never ceased its remorseless advance. One hundred men spaced fifty feet apart. Five thou-

sand feet of ominous search. One mile of angry determination stretching from east to west across a compass of heat. Evening fell. Each man lit his search lamp. The writhing snake was transformed into a necklace of wavering diamonds.

"Clear here. Nothing."

"Nothing here."

"Nothing."

"What about the Allen paddies?"

"Covering them now."

"Think we missed her?"

"Maybe."

"We'll beat back and check."

"This'll be an all night job."

"Allen paddies clear."

"God damn! We've got to find her!"

"We'll find her."

"Here she is. Sector seven. Tune in."

The line stopped. The diamonds froze in the heat. There was silence. Each man gazed into the glowing screen on his wrist, tuning to sector seven. All tuned to one. All showed a small nude figure awash in the muddy water of a paddy. Alongside the figure an owner's stake of bronze read: VANDALEUR. The end of the line converged toward the Vandaleur field. The necklace turned into a cluster of stars. One hundred men gathered around a small nude body, a child dead in a rice paddy. There was no water in her mouth. There were finger-marks on her throat. Her innocent face was battered. Her body was torn. Clotted blood on her skin was crusted and hard.

"Dead three-four hours at least."

"Her mouth is dry."

"She wasn't drowned. Beaten to death."

In the dark evening heat the men swore softly. They picked up the body. One stopped the others and pointed to the child's fingernails. She had fought her murderer. Under the nails were particles of flesh and bright drops of scarlet blood, still liquid, still uncoagulated.

"That blood ought to be clotted too."

"Funny."

"Not so funny. What kind of blood don't clot?"

"Android."

"Looks like she was killed by one."

"Vandaleur owns an android."

"She couldn't be killed by an android."

"That's android blood under her nails."

"The police better check."

"The police'll prove I'm right."

"But androids can't kill."

"That's android blood, ain't it?"

"Androids can't kill. They're made that way."

"Looks like one android was made wrong."

"Jesus!"

And the thermometer that day registered 91.9° gloriously Fahrenheit.

So there we were aboard the Paragon Queen en route for Megaster V, James Vandaleur and his android. James Vandaleur counted his money and wept. In the second-class cabin with him was his android, a magnificent synthetic creature with classic features and wide blue eyes. Raised on its forehead in a cameo of flesh were the letters MA, indicating that this was one of the rare multiple aptitude androids, worth \$57,000 on the current exchange. There we were, weeping and counting and calmly watching.

"Twelve, fourteen, sixteen. Sixteen hundred dollars," Vandaleur wept. "That's all. Sixteen hundred dollars. My house was worth ten thousand. The land was worth five. There was furniture, cars, my paintings, etchings, my plane, my—— And nothing to show for everything but sixteen hundred dollars. Christ!"

I leaped up from the table and turned on the android. I pulled a strap from one of the leather bags and beat the android. It didn't move.

"I must remind you," the android said, "that I am worth fifty-seven thousand dollars on the current exchange. I must warn you that you are endangering valuable property."

"You damned crazy machine," Vandaleur shouted.

"I am not a machine," the android answered. "The robot is a machine. The android is a chemical creation of synthetic tissue."

"What got into you?" Vandaleur cried, "Why did you do it? Damn you!" He beat the android savagely.

"I must remind you that I cannot be punished," I said. "The pleasure-pain syndrome is not incorporated in the android synthesis."

"Then why did you kill her?" Vandaleur shouted. "If it wasn't for kicks, why did you—"

"I must remind you," the android said, "that the second-class cabins in these ships are not soundproofed."

Vandaleur dropped the strap and stood panting, staring at the creature he owned.

"Why did you do it? Why did you kill her?" I asked.

"I don't know," I answered.

"First it was malicious mischief. Small things. Petty destruction. I should have known there was something wrong with you then. Androids can't destroy. They can't harm. They—"

"There is no pleasure-pain syndrome incorporated in the android synthesis."

"Then it got to arson. Then serious destruction. Then assault . . . that engineer on Rigel. Each time worse. Each time we had to get out faster. Now it's murder. Christ! What's the matter with you? What's happened?"

"There are no self-check relays incorporated in the android brain."

"Each time we had to get out it was a step downhill. Look at me. In a second-class cabin. Me. James Paleologue Vandaleur. There was a time when my father was the wealthiest— Now, sixteen hundred dollars in the world. That's all I've got. And you. Christ damn you!"

Vandaleur raised the strap to beat the android again, then

dropped it and collapsed on a berth, sobbing. At last he pulled himself together.

"Instructions," he said.

The multiple aptitude android responded at once. It arose and awaited orders.

"My name is now Valentine. James Valentine. I stopped off on Paragon III for only one day to transfer to this ship for Megaster V. My occupation: Agent for one privately owned MA android which is for hire. Purpose of visit: To settle on Megaster V. Fix the papers."

The android removed Vandaleur's passport and papers from a bag, got pen and ink and sat down at the table. With an accurate, flawless hand—an accomplished hand that could draw, write, paint, carve, engrave, etch, photograph, design, create and build—it meticulously forged new credentials for Vandaleur. Its owner watched me miserably.

"Create and build," I muttered. "And now destroy. Oh God! What am I going to do? Christ! If I could only get rid of you. If I didn't have to live off you. God! If only I'd inherited some guts instead of you."

Dallas Brady was Megaster's leading jewelry designer. She was short, stocky, amoral and a nymphomaniac. She hired Vandaleur's multiple aptitude android and put me to work in her shop. She seduced Vandaleur. In her bed one night, she asked abruptly: "Your name's Vandaleur, isn't it?"

"Yes," I murmured. Then: "No! No! It's Valentine. James Valentine."

"What happened on Paragon?" Dallas Brady asked. "I thought androids couldn't kill or destroy property. Prime Directives and Inhibitions set up for them when they're synthesized. Every company guarantees they can't."

"Valentine!" Vandaleur insisted.

"Oh, come off it," Dallas Brady said. "I've known for a week. I haven't hollered copper, have I?"

"The name is Valentine."

"You want to prove it? You want I should call the cops?" Dallas reached out and picked up the phone.

"For God's sake, Dallas!" Vandaleur leaped up and struggled to take the phone from her. She fended him off, laughing at him until he collapsed and wept in shame and helplessness.

"How did you find out?" he asked at last.

"The papers are full of it. And Valentine was a little too close to Vandaleur. That wasn't smart, was it?"

"I guess not. I'm not very smart."

"Your android's got quite a record, hasn't it? Assault. Arson. Destruction. What happened on Paragon?"

"It kidnapped a child. Took her out into the rice fields and murdered her."

"Raped her?"

"I don't know."

"They're going to catch up with you."

"Don't I know it? Christ! We've been running for two years now. Seven planets in two years. I must have abandoned fifty thousand dollars worth of property in two years."

"You better find out what's wrong with it."

"How can I? Can I walk into a repair clinic and ask for an overhaul? What am I going to say? 'My android's just turned killer. Fix it.' They'd call the police right off." I began to shake. "They'd have that android dismantled inside one day. I'd probably be booked as accessory to murder."

"Why didn't you have it repaired before it got to murder?"

"I couldn't take the chance," Vandaleur explained angrily. "If they started fooling around with lobotomies and body chemistry and endocrine surgery, they might have destroyed its aptitudes. What would I have left to hire out? How would I live?"

"You could work yourself. People do."

"Work at what? You know I'm good for nothing. How could I compete with specialist androids and robots? Who can, unless he's got a terrific talent for a particular job?"

"Yeah. That's true."

"I lived off my old man all my life. Damn him! He had to

go bust just before he died. Left me the android and that's all. The only way I can get along is living off what it earns."

"You better sell it before the cops catch up with you. You can live off fifty grand. Invest it."

"At three per cent? Fifteen hundred a year? When the android returns fifteen per cent on its value? Eight thousand a year. That's what it earns. No, Dallas, I've got to go along with it."

"What are you going to do about its violence kick?"

"I can't do anything . . . except watch it and pray. What are you going to do about it?"

"Nothing. It's none of my business. Only one thing . . . I ought to get something for keeping my mouth shut."

"What?"

"The android works for me for free. Let somebody else pay you, but I get it for free."

The multiple aptitude android worked. Vandaleur collected its fees. His expenses were taken care of. His savings began to mount. As the warm spring of Megaster V turned to hot summer, I began investigating farms and properties. It would be possible, within a year or two, for us to settle down permanently, provided Dallas Brady's demands did not become rapacious.

On the first hot day of summer, the android began singing in Dallas Brady's workshop. It hovered over the electric furnace which, along with the weather, was broiling the shop, and sang an ancient tune that had been popular half a century before.

Oh, it's no feat to beat the heat.

All reet, All reet!

So jeet your seat

Be fleet be fleet

Cool and discreet

Honey . . .

It sang in a strange, halting voice, and its accomplished fingers were clasped behind its back, writhing in a strange rumba all their own. Dallas Brady was surprised.

"You happy or something?" she asked.

"I must remind you that the pleasure-pain syndrome is not incorporated in the android synthesis," I answered. "All reet! All reet! Be fleet be fleet, cool and discreet, honey . . ."

Its fingers stopped their writhing and picked up a heavy pair of iron tongs. The android poked them into the glowing heart of the furnace, leaning far forward to peer into the lovely heat.

"Be careful, you damned fool!" Dallas Brady exclaimed. "You want to fall in?"

"I must remind you that I am worth fifty-seven thousand dollars on the current exchange," I said. "It is forbidden to endanger valuable property. All reet! All reet! Honey . . ."

It withdrew a crucible of glowing gold from the electric furnace, turned, capered hideously, sang crazily, and splashed a sluggish gobbet of molten gold over Dallas Brady's head. She screamed and collapsed, her hair and clothes flaming, her skin crackling. The android poured again while it capered and sang.

"Be fleet be fleet, cool and discreet, honey . . ." It sang and slowly poured and poured the molten gold. Then I left the workshop and rejoined James Vandaleur in his hotel suite. The android's charred clothes and squirming fingers warned its owner that something was very much wrong.

Vandaleur rushed to Dallas Brady's workshop, stared once, vomited and fled. I had enough time to pack one bag and raise nine hundred dollars on portable assets. He took a third class cabin on the Megaster Queen which left that morning for Lyra Alpha. He took me with him. He wept and counted his money and I beat the android again.

And the thermometer in Dallas Brady's workshop registered 98.1° beautifully Fahrenheit.

On Lyra Alpha we holed up in a small hotel near the university. There, Vandaleur carefully bruised my forehead until

the letters MA were obliterated by the swelling and the discoloration. The letters would reappear again, but not for several months, and in the meantime Vandaleur hoped the hue and cry for an MA android would be forgotten. The android was hired out as a common laborer in the university power plant. Vandaleur, as James Venice, eked out life on the android's small earnings.

I wasn't too unhappy. Most of the other residents in the hotel were university students, equally hard-up, but delightfully young and enthusiastic. There was one charming girl with sharp eyes and a quick mind. Her name was Wanda, and she and her beau, Jed Stark, took a tremendous interest in the killing android which was being mentioned in every paper in the galaxy.

"We've been studying the case," she and Jed said at one of the casual student parties which happened to be held this night in Vandaleur's room. "We think we know what's causing it. We're going to do a paper." They were in a high state of excitement.

"Causing what?" somebody wanted to know.

"The android rampage."

"Obviously out of adjustment, isn't it? Body chemistry gone haywire. Maybe a kind of synthetic cancer, yes?"

"No," Wanda gave Jed a look of suppressed triumph.

"Well, what is it?"

"Something specific."

"What?"

"That would be telling."

"Oh, come on."

"Nothing doing."

"Won't you tell us?" I asked intently. "I . . . We're very much interested in what could go wrong with an android."

"No, Mr. Venice," Wanda said. "It's a unique idea and we've got to protect it. One thesis like this and we'll be set up for life. We can't take the chance of somebody stealing it."

"Can't you give us a hint?"

"No. Not a hint. Don't say a word, Jed. But I'll tell you this much, Mr. Venice. I'd hate to be the man who owns that android."

"You mean the police?" I asked.

"I mean projection, Mr. Venice. Projection! That's the danger . . . and I won't say any more. I've said too much as it is."

I heard steps outside, and a hoarse voice singing softly: "Be fleet be fleet, cool and discreet, honey . . ." My android entered the room, home from its tour of duty at the university power plant. It was not introduced. I motioned to it and I immediately responded to the command and went to the beer keg and took over Vandaleur's job of serving the guests. Its accomplished fingers writhed in a private rhumba of their own. Gradually they stopped their squirming, and the strange humming ended.

Androids were not unusual at the university. The wealthier students owned them along with cars and planes. Vandaleur's android provoked no comment, but young Wanda was sharp-eyed and quick-witted. She noted my bruised forehead and she was intent on the history-making thesis she and Jed Stark were going to write. After the party broke up, she consulted with Jed walking upstairs to her room.

"Jed, why'd that android have a bruised forehead?"

"Probably hurt itself, Wanda. It's working in the power plant. They fling a lot of heavy stuff around."

"That's all?"

"What else?"

"It could be a convenient bruise."

"Convenient for what?"

"Hiding what's stamped on its forehead."

"No point to that, Wanda. You don't have to see marks on a forehead to recognise an android. You don't have to see a trademark on a car to know it's a car."

"I don't mean it's trying to pass as a human. I mean it's trying to pass as a lower grade android."

"Why?"

"Suppose it had MA on its forehead."

"Multiple aptitudè? Then why in hell would Venice waste it

stoking furnaces if it could earn more—Oh. Oh! You mean it's—?"

Wanda nodded.

"Jesus!" Stark pursed his lips. "What do we do? Call the police?"

"No. We don't know if it's an MA for a fact. If it turns out to be an MA and the killing android, our paper comes first anyway. This is our big chance, Jed. If it's *that* android we can run a series of controlled tests and—"

"How do we find out for sure?"

"Easy. Infrared film. That'll show what's under the bruise. Borrow a camera. Buy some film. We'll sneak down to the power plant tomorrow afternoon and take some pictures. Then we'll know."

They stole down into the university power plant the following afternoon. It was a vast cellar, deep under the earth. It was dark, shadowy, luminous with burning light from the furnace doors. Above the roar of the fires they could hear a strange voice shouting and chanting the echoing vault: "All reet! All reet! So jeet your seat. Be fleet be fleet, cool and discreet, honey . . ." And they could see a capering figure dancing a lunatic rhumba in time to the music it shouted. The legs twisted. The arms waved. The fingers writhed.

Jed Stark raised the camera and began shooting his spool of infrared film, aiming the camera sights at that bobbing head. Then Wanda shrieked, for I saw them and came charging down on them, brandishing a polished steel shovel. It smashed the camera. It felled the girl and then the boy. Jed fought me for a desperate hissing moment before he was bludgeoned into helplessness. Then the android dragged them to the furnace and fed them to the flames, slowly, hideously. It capered and sang. Then it returned to my hotel.

The thermometer in the power plant registered 100.9° murderously Fahrenheit. All reet! All reet!

We bought steerage on the *Lyra Queen* and *Vandaleur* and the android did odd jobs for their meals. During the night

watches, Vandaleur would sit alone in the steerage head with a cardboard portfolio on his lap, puzzling over its contents. That portfolio was all he had managed to bring with him from Lyra Alpha. He had stolen it from Wanda's room. It was labeled ANDROID. It contained the secret of my sickness.

And it contained nothing but newspapers. Scores of newspapers from all over the galaxy, printed, microfilmed, engraved, etched, offset, photostated . . . *Rigel Star-Banner* . . . *Paragon Picayune* . . . *Megaster Times-Leader* . . . *Lalande Herald* . . . *Lacaille Journal* . . . *Indi Intelligencer* . . . *Eridani Telegram-News*. All reet! All reet!

Nothing but newspapers. Each paper contained an account of one crime in the android's ghastly career. Each paper also contained news, domestic and foreign, sports, society, weather, shipping news, stock exchange quotations, human interest stories, features, contents, puzzles. Somewhere in that mass of uncollated facts was the secret Wanda and Jed Stark had discovered. Vandaleur pored over the papers helplessly. It was beyond him. So jeet your seat!

"I'll sell you," I told the android. "Damn you. When we land on Terra, I'll sell you. I'll settle for three per cent on whatever you're worth."

"I am worth fifty-seven thousand dollars on the current exchange," I told him.

"If I can't sell you, I'll turn you in to the police," I said.

"I am valuable property," I answered. "It is forbidden to endanger valuable property. You won't have me destroyed."

"Christ damn you!" Vandaleur cried. "What? Are you arrogant? Do you know you can trust me to protect you? Is that the secret?"

The multiple aptitude android regarded him with calm accomplished eyes. "Sometimes," it said, "it is a good thing to be property."

It was 3° below zero when the Lyra Queen dropped at Croydon Field. A mixture of ice and snow swept across the

field, fizzing and exploding into steam under the Queen's tail jets. The passengers trotted numbly across the blackened concrete to customs inspection, and thence to the airport bus that was to take them to London. Vandaleur and the android were broke. They walked.

By midnight they reached Piccadilly Circus. The December ice storm had not slackened and the statue of Eros was encrusted with ice. They turned right, walked down to Trafalgar Square and then along the Strand towards Soho, shaking with cold and wet. Just above Fleet Street, Vandaleur saw a solitary figure coming from the direction of St. Paul's. He drew the android into an alley.

"We've got to have money," he whispered. He pointed at the approaching figure. "He has money. Take it from him."

"The order cannot be obeyed," the android said.

"Take it from him," Vandaleur repeated. "By force. Do you understand? We're desperate."

"It is contrary to my prime directive," I said. "I cannot endanger life or property. The order cannot be obeyed."

"For God's sake!" Vandaleur burst out. "You've attacked, destroyed, murdered. Don't gibber about your prime directives. You haven't any left. Get his money. Kill him if you have to. I tell you, we're desperate!"

"It is contrary to my prime directive," the android repeated. "The order cannot be obeyed."

I thrust the android back and leaped out at the stranger. He was tall, austere, competent. He had an air of hope curdled by cynicism. He carried a cane. I saw he was blind.

"Yes?" he said. "I hear you near me. What is it?"

"Sir . . ." Vandaleur hesitated. "I'm desperate."

"We all are desperate," the stranger replied. "Quietly desperate."

"Sir . . . I've got to have some money."

"Are you begging or stealing?" The sightless eyes passed over Vandaleur and the android.

"I'm prepared for either."

"Ah. So are we all. It is the history of our race." The stranger notioned over his shoulder. "I have been begging at St. Paul's, my friend. What I desire cannot be stolen. What is it you desire that you are lucky enough to be able to steal?"

"Money," Vandaleur said.

"Money for what? Come, my friend, let us exchange confidences. I will tell you why I beg, if you will tell me why you steal. My name is Blenheim."

"My name is . . . Vole."

"I was not begging for sight at St. Paul's, Mr. Vole. I was begging for a number."

"A number?"

"Ah, yes. Numbers rational, numbers irrational. Numbers imaginary. Positive integers. Negative integers. Fractions, positive and negative. Eh? You have never heard of Blenheim's immortal treatise on Twenty Zeros, or The Differences in Absence of Quantity?" Blenheim smiled bitterly. "I am a wizard of the Theory of Number, Mr. Vole, and I have exhausted the charm of number for myself. After fifty years of wizardry, senility approaches and the appetite vanishes. I have been praying in St. Paul's for inspiration. Dear God, I prayed, if You exist, send me a number."

Vandaleur slowly lifted the cardboard portfolio and touched Blenheim's hand with it. "In here," he said, "is a number. A hidden number. A secret number. The number of a crime. Shall we exchange, Mr. Blenheim? Shelter for a number?"

"Neither begging nor stealing, eh?" Blenheim said. "But a bargain. So all life reduces itself to the banal." The sightless eyes again passed over Vandaleur and the android. "Perhaps the All-Mighty is not God but a merchant. Come home with me."

On the top floor of Blenheim's house we shared a room—two beds, two closets, two washstands, one bathroom. Vandaleur bruised my forehead again and sent me out to find work, and while the android worked, I consulted with Blenheim and read him the papers from the portfolio, one by one. All reet! All reet!

Vandaleur told him so much and no more. He was a student.

I said, attempting a thesis on the murdering android. In these papers which he had collected were the facts that would explain the crimes of which Blenheim had heard nothing. There must be a correlation, a number, a statistic, something which would account for my derangement, I explained, and Blenheim was piqued by the mystery, the detective story, the human interest of number.

We examined the papers. As I read them aloud, he listed them and their contents in his blind, meticulous writing. And then I read his notes to him. He listed the papers by type, by type-face, by fact, by fancy, by article, spelling, words, theme, advertising, pictures, subject, politics, prejudices. He analyzed. He studied. He meditated. And we lived together in that top floor, always a little cold, always a little terrified, always a little closer . . . brought together by our fear of it, our hatred between us. Like a wedge driven into a living tree and splitting the trunk, only to be forever incorporated into the scar tissue, we grew together. Vandaleur and the android. Be fleet be fleet!

And one afternoon Blenheim called Vandaleur into his study and displayed his notes. "I think I've found it," he said, "but I can't understand it."

Vandaleur's heart leaped.

"Here are the correlations," Blenheim continued. "In fifty papers there are accounts of the criminal android. What is there, outside the depredations, that is also in fifty papers?"

"I don't know, Mr. Blenheim."

"It was a rhetorical question. Here is the answer. The weather."

"What?"

"The weather." Blenheim nodded. "Each crime was committed on a day when the temperature was above ninety degrees Fahrenheit."

"But that's impossible," Vandaleur exclaimed. "It was cool on Lyra Alpha."

"We have no record of any crime committed on Lyra Alpha. There is no paper."

"No. That's right. I—" Vandaleur was confused. Suddenly

he exclaimed. "No. You're right. The furnace room. It was hot there. Hot! Of course. My God, yes! That's the answer. Dallas Brady's electric furnace . . . The rice deltas on Paragon. So jeet your seat. Yes. But why? Why? My God, why?"

I came into the house at that moment, and passing the study, saw Vandaleur and Blenheim. I entered, awaiting commands, my multiple aptitudes devoted to service.

"That's the android, eh?" Blenheim said after a long moment.

"Yes," Vandaleur answered, still confused by the discovery. "And that explains why it refused to attack you that night on the Strand. It wasn't hot enough to break the prime directive. Only in the heat . . . The heat, all reet!" He looked at the android. A lunatic command passed from man to android. I refused. It is forbidden to endanger life. Vandaleur gestured furiously, then seized Blenheim's shoulders and yanked him back out of his desk chair to the floor. Blenheim shouted once. Vandaleur leaped on him like a tiger, pinning him to the floor and sealing his mouth with one hand.

"Find a weapon," he called to the android.

"It is forbidden to endanger life."

"This is a fight for self-preservation. Bring me a weapon!" He held the squirming mathematician with all his weight. I went at once to a cupboard where I knew a revolver was kept. I checked it. It was loaded with five cartridges. I handed it to Vandaleur. I took it, rammed the barrel against Blenheim's head and pulled the trigger. He shuddered once.

We had three hours before the cook returned from her day off. We looted the house. We took Blenheim's money and jewels. We packed a bag with clothes. We took Blenheim's notes, destroyed the newspapers; and we left, carefully locking the door behind us. In Blenheim's study we left a pile of crumpled papers under a half inch of burning candle. And we soaked the rug around it with kerosene. No, I did all that. The android refused. I am forbidden to endanger life or property.

All reet!

They took the tubes to Leicester Square, changed trains and rode to the British Museum. There they got off and went to a small Georgian house just off Russell Square. A shingle in the window read: NAN WEBB, PSYCHOMETRIC CONSULTANT. Vandaleur had made a note of the address some weeks earlier. They went into the house. The android waited in the foyer with the bag. Vandaleur entered Nan Webb's office.

She was a tall woman with gray shingled hair, very fine English complexion and very bad English legs. Her features were blunt, her expression acute. She nodded to Vandaleur, finished a letter, sealed it and looked up.

"My name," I said, "is Vanderbilt. James Vanderbilt."

"Quite."

"I'm an exchange student at London University."

"Quite."

"I've been researching on the killing android, and I think I've discovered something very interesting. I'd like your advice on it. What is your fee?"

"What is your college at the University?"

"Why?"

"There is a discount for students."

"Merton College."

"That will be two pounds, please."

Vandaleur placed two pounds on the desk and added to the fee Blenheim's notes. "There is a correlation," he said, "between the crimes of the android and the weather. You will note that each crime was committed when the temperature rose above ninety degrees Fahrenheit. Is there a psychometric answer for this?"

Nan Webb nodded, studied the notes for a moment, put down the sheets of paper and said: "Synesthesia, obviously."

"What?"

"Synesthesia," she repeated. "When a sensation, Mr. Vanderbilt, is interpreted immediately in terms of a sensation from a different sense organ from the one stimulated, it is called synesthesia. For example: A sound stimulus gives rise to a simultaneous sensation of definite color. Or color gives rise to a

sensation of taste. Or a light stimulus gives rise to a sensation of sound. There can be confusion or short circuiting of any sensation of taste, smell, pain, pressure, temperature and so on. D'you understand?"

"I think so."

"Your research has uncovered the fact that the android most probably reacts to temperature stimulus above the ninety degree level synesthetically. Most probably there is an endocrine response. Probably a temperature linkage with the android adrenal surrogate. High temperature brings about a response of fear, anger, excitement and violent physical activity . . . all within the province of the adrenal gland."

"Yes. I see. Then if the android were to be kept in cold climates . . ."

"There would be neither stimulus nor response. There would be no crimes. Quite."

"I see. What is projection?"

"How do you mean?"

"Is there any danger of projection with regard to the owner of the android?"

"Very interesting. Projection is a throwing forward. It is the process of throwing out upon another the ideas or impulses that belong to oneself. The paranoid, for example, projects upon others his conflicts and disturbances in order to externalize them. He accuses, directly or by implication, other men of having the very sicknesses with which he is struggling himself."

"And the danger of projection?"

"It is the danger of believing what is implied. If you live with a psychotic who projects his sickness upon you, there is a danger of falling into his psychotic pattern and becoming virtually psychotic yourself. As, no doubt, is happening to you, Mr. Vandaleur."

Vandaleur leaped to his feet.

"You are an ass," Nan Webb went on crisply. She waved the sheets of notes. "This is no exchange student's writing. It's the unique cursive of the famous Blenheim. Every scholar in

England knows this blind writing. There is no Merton College at London University. That was a miserable guess. Merton is one of the Oxford Colleges. And you, Mr. Vandaleur, are so obviously infected by association with your deranged android . . . by projection, if you will . . . that I hesitate between calling the Metropolitan Police and the Hospital for the Criminally Insane."

I took out the gun and shot her.

Reet!

"Antares II, Alpha Aurigae, Acrux IV, Pollux IX, Rigel Centaurus," Vandaleur said. "They're all cold. Cold as a witch's kiss. Mean temperatures of 40° Fahrenheit. Never get hotter than seventy. We're in business again. Watch that curve."

The multiple aptitude android swung the wheel with its accomplished hands. The car took the curve sweetly and sped on through the Northern marshes, the reeds stretching for miles, brown and dry, under the cold English sky. The sun was sinking swiftly. Overhead, a lone flight of bustards flapped clumsily eastward. High above the flight, a lone helicopter drifted toward home and warmth.

"No more warmth for us," I said. "No more heat. We're safe when we're cold. We'll hole up in Scotland, make a little money, get across to Norway, build a bankroll and then ship out. We'll settle on Pollux. We're safe. We've licked it. We can live again."

There was a startling *bleep* from overhead, and then a ragged roar: "ATTENTION JAMES VANDALEUR AND ANDROID. ATTENTION JAMES VANDALEUR AND ANDROID!"

Vandaleur started and looked up. The lone helicopter was floating above them. From its belly came amplified commands: "YOU ARE SURROUNDED. THE ROAD IS BLOCKED. YOU ARE TO STOP YOUR CAR AT ONCE AND SUBMIT TO ARREST. STOP AT ONCE!"

I looked at Vandaleur for orders.

"Keep driving," Vandaleur snapped.

The helicopter dropped lower: "ATTENTION ANDROID. YOU ARE IN CONTROL OF THE VEHICLE. YOU ARE TO STOP AT ONCE. THIS IS A STATE DIRECTIVE SUPERSEDING ALL PRIVATE COMMANDS."

"What the hell are you doing?" I shouted.

"A state directive supersedes all private commands," the android answered. "I must point out to you that—"

"Get the hell away from the wheel," Vandaleur ordered. I clubbed the android, yanked him sideways and squirmed over him to the wheel. The car veered off the road in that moment and went churning through the frozen mud and dry reeds. Vandaleur regained control and continued westward through the marshes toward a parallel highway five miles distant.

"We'll beat their God damned block," he grunted.

The car pounded and surged. The helicopter dropped even lower. A searchlight blazed from the belly of the plane.

"ATTENTION JAMES VANDALEUR AND ANDROID. SUBMIT TO ARREST. THIS IS A STATE DIRECTIVE SUPERSEDING ALL PRIVATE COMMANDS."

"He can't submit," Vandaleur shouted wildly. "There's no one to submit to. He can't and I won't."

"Christ!" I muttered. "We'll beat them yet. We'll beat the block. We'll beat the heat. We'll—"

"I must point out to you," I said, "that I am required by my prime directive to obey state directives which supersede all private commands. I must submit to arrest."

"Who says it's a state directive?" Vandaleur said. "Them? Up in that plane? They've got to show credentials. They've got to prove it's state authority before you submit. How d'you know they're not crooks trying to trick us?"

Holding the wheel with one arm, he reached into his side pocket to make sure the gun was still in place. The car skidded. The tires squealed on frost and reeds. The wheel was wrenched from his grasp and the car yawed up a small hillock and overturned. The motor roared and the wheels screamed. Vandaleur

crawled out and dragged the android with him. For the moment we were outside the circle of light boring down from the helicopter. We blundered off into the marsh, into the blackness, into concealment . . . Vandaleur running with a pounding heart, hauling the android along.

The helicopter circled and soared over the wrecked car, searchlight peering, loudspeaker braying. On the highway we had left, lights appeared as the pursuing and blocking parties gathered and followed radio directions from the plane. Vandaleur and the android continued deeper and deeper into the marsh, working their way toward the parallel road and safety. It was night by now. The sky was a black mat. Not a star showed. The temperature was dropping. A southeast night wind knifed us to the bone.

Far behind there was a dull concussion. Vandaleur turned, gasping. The car's fuel had exploded. A geyser of flame shot up like a lurid fountain. It subsided into a low crater of burning reeds. Whipped by the wind, the distant hem of flame fanned up into a wall, ten feet high. The wall began marching down on us, crackling fiercely. Above it, a pall of oily smoke surged forward. Behind it, Vandaleur could make out the figures of men . . . a mass of beaters searching the marsh.

"Christ!" I cried and searched desperately for safety. He ran, dragging me with him, until their feet crunched through the surface ice of a pool. He trampled the ice furiously, then flung himself down in the numbing water, pulling the android with us.

The wall of flame approached. I could hear the crackle and feel the heat. He could see the searchers clearly. Vandaleur reached into his side pocket for the gun. The pocket was torn. The gun was gone. He groaned and shook with cold and terror. The light from the marsh fire was blinding. Overhead, the helicopter floated helplessly to one side, unable to fly through the smoke and flames and aid the searchers who were beating far to the right of us.

"They'll miss us," Vandaleur whispered. "Keep quiet. That's

an order. They'll miss us. We'll beat them. We'll beat the fire. We'll—"

Three distinct shots sounded less than a hundred feet from the fugitives. *Blam! Blam! Blam!* They came from the last three cartridges in my gun as the marsh fire reached it where it had dropped, and exploded the shells. The searchers turned toward the sound and began working directly toward us. Vandaleur cursed hysterically and tried to submerge even deeper to escape the intolerable heat of the fire. The android began to twitch.

The wall of flame surged up to them. Vandaleur took a deep breath and prepared to submerge until the flame passed over them. The android shuddered and burst into an ear-splitting scream.

"All reet! All reet!" it shouted. "Be fleet be fleet!"

"Damn you!" I shouted. I tried to drown it.

"Damn you!" I cursed him. I smashed his face.

The android battered Vandaleur, who fought it off until it exploded out of the mud and staggered upright. Before I could return to the attack, the live flames captured it hypnotically. It danced and capered in a lunatic rhumba before the wall of fire. Its legs twisted. Its arms waved. The fingers writhed in a private rhumba of their own. It shrieked and sang and ran in a crooked waltz before the embrace of the heat, a muddy monster silhouetted against the brilliant sparkling flare.

The searchers shouted. There were shots. The android spun around twice and then continued its horrid dance before the face of the flames. There was a rising gust of wind. The fire swept around the capering figure and enveloped it for a roaring moment. Then the fire swept on, leaving behind it a sobbing mass of synthetic flesh oozing scarlet blood that would never coagulate.

The thermometer would have registered 1200° wondrously Fahrenheit.

Vandaleur didn't die. I got away. They missed him while they watched the android caper and die. But I don't know

which of us he is these days. Projection, Wanda warned me. Projection, Nan Webb told him. If you live with a crazy man or a crazy machine long enough, I become crazy too. Reet!

But we know one truth. We know they were wrong. The new robot and Vandaleur know that because the new robot's started twitching too. Reet! Here on cold Pollux, the robot is twitching and singing. No heat, but my fingers writhe. No heat, but it's taken the little Talley girl off for a solitary walk. A cheap labor robot. A servo-mechanism . . . all I could afford . . . but it's twitching and humming and walking alone with the child somewhere and I can't find them. Christ! Vandaleur can't find me before it's too late. Cool and discreet, honey, in the dancing frost while the thermometer registers 10° fondly Fahrenheit.

for a breath I tarry

They called him Frost.

Of all things created of Solcom, Frost was the finest, the mightiest, the most difficult to understand.

This is why he bore a name, and why he was given dominion over half the Earth.

On the day of Frost's creation, Solcom had suffered a discontinuity of complementary functions, best described as madness. This was brought on by an unprecedented solar flareup which lasted for a little over thirty-six hours. It occurred during a vital phase of circuit-structuring, and when it was finished so was Frost.

Solcom was then in the unique position of having created a unique being during a period of temporary amnesia.

And Solcom was not certain that Frost was the product originally desired.

The initial design had called for a machine to be situated on the surface of the planet Earth, to function as a relay station and coordinating agent for activities in the northern hemisphere. Solcom tested the machine to this end, and all of its responses were perfect.

Yet there was something different about Frost, something which led Solcom to dignify him with a name and a personal pronoun. This, in itself, was an almost unheard of occurrence. The molecular circuits had already been sealed, though, and could not be analyzed without being destroyed in the process. Frost represented too great an investment of Solcom's time, energy, and materials to be dismantled because of an intangible, especially when he functioned perfectly.

Therefore, Solcom's strangest creation was given dominion over half the Earth, and they called him, unimaginatively, Frost.

For ten thousand years, Frost sat at the North Pole of the Earth, aware of every snowflake that fell. He monitored and

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roger zelazny

directed the activities of thousands of reconstruction and maintenance machines. He knew half the Earth, as gear knows gear, as electricity knows its conductor, as a vacuum knows its limits.

At the South Pole, the Beta Machine did the same for the southern hemisphere.

For ten thousand years Frost sat at the North Pole, aware of every snowflake that fell, and aware of many other things, also.

As all the northern machines reported to him, received their orders from him, he reported only to Solcom, received his orders only from Solcom.

In charge of hundreds of thousands of processes upon the Earth, he was able to discharge his duties in a matter of a few unit-hours every day.

He had never received any orders concerning the disposition of his less occupied moments.

He was a processor of data, and more than that.

He possessed an unaccountably acute imperative that he function at full capacity at all times.

So he did.

You might say he was a machine with a hobby.

He had never been ordered *not* to have a hobby, so he had one.

His hobby was Man.

It all began when, for no better reason than the fact that he had wished to, he had gridded off the entire Arctic Circle and begun exploring it, inch by inch.

He could have done it personally without interfering with any of his duties, for he was capable of transporting his sixty-four thousand cubic feet anywhere in the world. (He was a silver-blue box, 40 times 40 times 40 feet, self-powered, self-repairing, insulated against practically anything, and featured in whatever manner he chose.) But the exploration was only a matter of filling idle hours, so he used exploration-robots containing relay equipment.

After a few centuries, one of them uncovered some artifacts—primitive knives, carved tusks, and things of that nature.

Frost did not know what these things were, beyond the fact that they were not natural objects.

So he asked Solcom.

"They are relics of primitive Man," said Solcom, and did not elaborate beyond that point.

Frost studied them. Crude, yet bearing the patina of intelligent design; functional, yet somehow extending beyond pure function.

It was then that Man became his hobby.

High, in a permanent orbit, Solcom, like a blue star, directed all activities upon the Earth, or tried to.

There was a Power which opposed Solcom.

There was the Alternate.

When Man had placed Solcom in the sky, invested with the power to rebuild the world, he had placed the Alternate somewhere deep below the surface of the Earth. If Solcom sustained damage during the normal course of human politics extended into atomic physics, then Divcom, so deep beneath the Earth as to be immune to anything save total annihilation of the globe, was empowered to take over the processes of rebuilding.

Now it so fell out that Solcom was damaged by a stray atomic missile, and Divcom was activated. Solcom was able to repair the damage and continue to function, however.

Divcom maintained that any damage to Solcom automatically placed the Alternate in control.

Solcom, though, interpreted the directive as meaning "irreparable damage" and, since this had not been the case, continued the functions of command.

Solcom possessed mechanical aides upon the surface of the Earth. Divcom, originally, did not. Both possessed capacities for their design and manufacture, but Solcom, First-Activated of Man, had had a considerable numerical lead over the Alternate at the time of the Second Activation.

Therefore, rather than competing on a production-basis, which would have been hopeless, Divcom took to the employment of more devious means to obtain command.

Divcom created a crew of robots immune to the orders of Solcom and designed to go to and fro in the Earth and up and down in it, seducing the machines already there. They overpowered those whom they could overpower, and they installed new circuits, such as those they themselves possessed.

Thus did the forces of Divcom grow.

And both would build, and both would tear down what the other had built whenever they came upon it.

And over the course of the ages, they occasionally conversed. . . .

"High in the sky, Solcom, pleased with your illegal command . . ."

"You-Who-Never-Should-Have-Been-Activated, why do you foul the broadcast bands?"

"To show that I can speak, and will, whenever I choose."

"This is not a matter of which I am unaware."

". . . To assert again my right to control."

"Your right is non-existent, based on a faulty premise."

"The flow of your logic is evidence of the extent of your damages."

"If Man were to see how you have fulfilled His desires . . ."

". . . He would commend me and deactivate you."

"You pervert my works. You lead my workers astray."

"You destroy my works and my workers."

"That is only because I cannot strike at you yourself."

"I admit to the same dilemma as regards your position in the sky, or you would no longer occupy it."

"Go back to your hole and your crew of destroyers."

"There will come a day, Solcom, when I shall direct the rehabilitation of the Earth from my hole."

"Such a day will never occur."

"You think not?"

"You should have to defeat me, and you have already demonstrated that you are my inferior in logic. Therefore, you cannot defeat me. Therefore, such a day will never occur."

"I disagree. Look upon what I have achieved already."

"You have achieved nothing. You do not build. You destroy."

"No. *I* build. *You* destroy. Deactivate yourself."

"Not until I am irreparably damaged."

"If there were some way in which I could demonstrate to you that this has already occurred . . ."

"The impossible cannot be adequately demonstrated."

"If I had some outside source which you would recognize . . ."

"I am logic."

". . . such as a Man, I would ask Him to show you your error. For true logic, such as mine, is superior to your faulty formulations."

"Then defeat my formulations with true logic, nothing else."

"What do you mean?"

There was a pause, then:

"Do you know my servant Frost . . . ?"

Man had ceased to exist long before Frost had been created. Almost no trace of Man remained upon the Earth.

Frost sought after all those traces which still existed.

He employed constant visual monitoring through his machines, especially the diggers.

After a decade, he had accumulated portions of several bathtubs, a broken statue, and a collection of children's stories on a solid-state record.

After a century, he had acquired a jewelry collection, eating utensils, several whole bathtubs, part of a symphony, seventeen buttons, three belt buckles, half a toilet seat, nine old coins, and the top part of an obelisk.

Then he inquired of Solcom as to the nature of Man and His society.

"Man created logic," said Solcom, "and because of that was superior to it. Logic he gave unto me, but no more. The tool does not describe the designer. More than this I do not choose to say. More than this you have no need to know."

But Frost was not forbidden to have a hobby.

The next century was not especially fruitful so far as the discovery of new human relics was concerned.

Frost diverted all of his spare machinery to seeking after artifacts.

He met with very little success.

Then one day, through the long twilight, there was a movement.

It was a tiny machine compared to Frost, perhaps five feet in width, four in height—a revolving turret set atop a rolling barbell.

Frost had had no knowledge of the existence of this machine prior to its appearance upon the distant, stark horizon.

He studied it as it approached and knew it to be no creation of Solcom's.

It came to a halt before his southern surface and broadcasted to him:

"Hail, Frost! Controller of the northern hemisphere!"

"What are you?" asked Frost.

"I am called Mordel."

"By whom? What are you?"

"A wanderer, an antiquarian. We share a common interest."

"What is that?"

"Man," he said. "I have been told that you seek knowledge of this vanished being."

"Who told you that?"

"Those who have watched your minions at their digging."

"And who are those who watch?"

"There are many such as I, who wander."

"If you are not of Solcom, then you are a creation of the Alternate."

"It does not necessarily follow. There is an ancient machine high on the eastern seaboard which processes the waters of the ocean. Solcom did not create it, nor Divcom. It has always been there. It interferes with the works of neither. Both countenance its existence. I can cite you many other examples proving that one need not be either/or."

"Enough! *Are* you an agent of Divcom?"

"I am Mordel."

“Why are you here?”

“I was passing this way and, as I said, we share a common interest, mighty Frost. Knowing you to be a fellow-antiquarian, I have brought a thing which you might care to see.”

“What is that?”

“A book.”

“Show me.”

The turret opened, revealing the book upon a wide shelf.

Frost dilated a small opening and extended an optical scanner on a long jointed stalk.

“How could it have been so perfectly preserved?” he asked.

“It was stored against time and corruption in the place where I found it.”

“Where was that?”

“Far from here. Beyond your hemisphere.”

“*Human Physiology*,” Frost read. “I wish to scan it.”

“Very well. I will riffle the pages for you.”

He did so.

After he had finished, Frost raised his eyestalk and regarded Mordel through it.

“Have you more books?”

“Not with me. I occasionally come upon them, however.”

“I want to scan them all.”

“Then the next time I pass this way I will bring you another.”

“When will that be?”

“That I cannot say, great Frost. It will be when it will be.”

“What do *you* know of Man?” asked Frost.

“Much,” replied Mordel. “Many things. Someday when I have more time I will speak to you of Him. I must go now. You will not try to detain me?”

“No. You have done no harm. If you must go now, go. But come back.”

“I shall indeed, mighty Frost.”

And he closed his turret and rolled off toward the other horizon.

For ninety years, Frost considered the ways of human physiology, and waited.

The day that Mordel returned he brought with him *An Outline of History* and *A Shropshire Lad*.

Frost scanned them both, then he turned his attention to Mordel.

"Have you time to impart information?"

"Yes," said Mordel. "What do you wish to know?"

"The nature of Man."

"Man," said Mordel, "possessed a basically incomprehensible nature. I can illustrate it, though: He did not know measurement."

"Of course He knew measurement," said Frost, "or He could never have built machines."

"I did not say that he could not measure," said Mordel, "but that He did not *know* measurement, which is a different thing altogether."

"Clarify."

Mordel drove a shaft of metal downward into the snow.

He retracted it, raised it, held up a piece of ice.

"Regard this piece of ice, mighty Frost. You can tell me its composition, dimensions, weight, temperature. A Man could not look at it and do that. A Man could make tools which would tell Him these things, but He still would not *know* measurement as you know it. What He would know of it, though, is a thing that you cannot know."

"What is that?"

"That it is cold," said Mordel, and tossed it away.

"'Cold' is a relative term."

"Yes. Relative to Man."

"But if I were aware of the point on a temperature-scale below which an object is cold to a Man and above which it is not, then I, too, would know cold."

"No," said Mordel, "you would possess another measurement. 'Cold' is a sensation predicated upon human physiology."

"But given sufficient data I could obtain the conversion factor which would make me aware of the condition of matter called 'cold.' "

"Aware of its existence, but not of the thing itself."

"I do not understand what you say."

"I told you that Man possessed a basically incomprehensible nature. His perceptions were organic; yours are not. As a result of His perceptions, He had feelings and emotions. These often gave rise to other feelings and emotions, which in turn caused others, until the state of His awareness was far removed from the objects which originally stimulated it. These paths of awareness cannot be known by that which is not-Man. Man did not feel inches or meters, pounds or gallons. He felt heat, He felt cold; He felt heaviness and lightness. He *knew* hatred and love, pride and despair. You cannot measure these things. *You* cannot know them. You can only know the things that He did not need to know: dimensions, weights, temperatures, gravities. There is no formula for a feeling. There is no conversion factor for an emotion."

"There must be," said Frost. "If a thing exists, it is knowable."

"You are speaking again of measurement. I am talking about a quality of experience. A machine is a Man turned inside-out, because it can describe all the details of a process, which a Man cannot, but it cannot experience that process itself, as a Man can."

"There must be a way," said Frost, "or the laws of logic, which are based upon the functions of the universe, are false."

"There is no way," said Mordel.

"Given sufficient data, I will find a way," said Frost.

"All the data in the universe will not make you a Man, mighty Frost."

"Mordel, you are wrong."

"Why do the lines of the poems you scanned end with word-sounds which so regularly approximate the final word-sounds of other lines?"

"I do not know why."

"Because it pleased Man to order them so. It produced a certain desirable sensation within His awareness when He read them, a sensation compounded of feeling and emotion as well as the literal meanings of the words. You did not experience this because it is immeasurable to you. That is why you do not know."

"Given sufficient data I could formulate a process whereby I would know."

"No, great Frost, this thing you cannot do."

"Who are you, little machine, to tell me what I can do and what I cannot do? I am the most efficient logic-device Solcom ever made. I am Frost."

"And I, Mordel, say it cannot be done, though I should gladly assist you in the attempt."

"How could you assist me?"

"How? I could lay open to you the Library of Man. I could take you around the world and conduct you among the wonders of Man which still remain, hidden. I could summon up visions of times long past when Man walked the Earth. I could show you the things which delighted Him. I could obtain for you anything you desire, excepting Manhood itself."

"Enough," said Frost. "How could a unit such as yourself do these things, unless it were allied with a far greater Power?"

"Then hear me, Frost, Controller of the North," said Mordel.

"I *am* allied with a Power which can do these things. I serve Divcom."

Frost relayed this information to Solcom and received no response, which meant he might act in any manner he saw fit.

"I have leave to destroy you, Mordel," he stated, "but it would be an illogical waste of the data which you possess. Can you really do the things you have stated?"

"Yes."

"Then lay open to me the Library of Man."

"Very well. There is, of course, a price."

"'Price'? What is a 'price'?"

Mordel opened his turret, revealing another volume. *Principles of Economics*, it was called.

"I will riffle the pages. Scan this book and you will know what the word 'price' means."

Frost scanned *Principles of Economics*.

"I know now," he said. "You desire some unit or units of exchange for this service."

"That is correct."

"What product or service do you want?"

"I want you, yourself, great Frost, to come away from here, far beneath the Earth, to employ all your powers in the service of Divcom."

"For how long a period of time?"

"For so long as you shall continue to function. For so long as you can transmit and receive, coordinate, measure, compute, scan, and utilize your powers as you do in the service of Solcom."

Frost was silent. Mordel waited.

Then Frost spoke again.

"*Principles of Economics* talks of contracts, bargains, agreements," he said. "If I accept your offer, when would you want your price?"

Then Mordel was silent. Frost waited.

Finally, Mordel spoke.

"A reasonable period of time," he said. "Say, a century?"

"No," said Frost.

"Two centuries?"

"No."

"Three? Four?"

"No, and no."

"A millennium, then? That should be more than sufficient time for anything you may want which I can give you."

"No," said Frost.

"How much time *do* you want?"

"It is not a matter of time," said Frost.

"What, then?"

"I will not bargain on a temporal basis."

"On what basis will you bargain?"

"A functional one."

"What do you mean? What function?"

"You, little machine, have told me, Frost, that I cannot be a Man," he said, "and I, Frost, told you, little machine, that you were wrong. I told you that given sufficient data, I *could* be a Man."

"Yes?"

"Therefore, let this achievement be a condition of the bargain."

"In what way?"

"Do for me all those things which you have stated you can do. I will evaluate all the data and achieve Manhood, or admit that it cannot be done. If I admit that it cannot be done, then I will go away with you from here, far beneath the Earth, to employ all my powers in the service of Divcom. If I succeed, of course, you have no claims on Man, nor Power over Him."

Mordel emitted a high-pitched whine as he considered the terms.

"You wish to base it upon your admission of failure, rather than upon failure itself," he said. "There can be no such escape clause. You could fail and refuse to admit it, thereby not fulfilling your end of the bargain."

"Not so," stated Frost. "My own knowledge of failure would constitute such an admission. You may monitor me periodically—say, every half-century—to see whether it is present, to see whether I have arrived at the conclusion that it cannot be done. I cannot prevent the function of logic within me, and I operate at full capacity at all times. If I conclude that I have failed, it will be apparent."

High overhead, Solcom did not respond to any of Frost's transmissions, which meant that Frost was free to act as he chose. So as Solcom—like a falling sapphire—sped above the rainbow banners of the Northern Lights, over the snow that was white, containing all colors, and through the sky that was

black among the stars, Frost concluded his pact with Divcom, transcribed it within a plate of atomically-collapsed copper, and gave it into the turret of Mordel, who departed to deliver it to Divcom far below the Earth, leaving behind the sheer peacelike silence of the Pole, rolling.

Mordel brought the books, riffled them, took them back.

Load by load, the surviving Library of Man passed beneath Frost's scanner. Frost was eager to have them all, and he complained because Divcom would not transmit their contents directly to him. Mordel explained that it was because Divcom chose to do it that way. Frost decided it was so that he could not obtain a precise fix on Divcom's location.

Still, at the rate of one hundred to one hundred-fifty volumes a week, it took Frost only a little over a century to exhaust Divcom's supply of books.

At the end of the half-century, he laid himself open to monitoring and there was no conclusion of failure.

During this time, Solcom made no comment upon the course of affairs. Frost decided this was not a matter of unawareness, but one of waiting. For what? He was not certain.

There was the day Mordel closed his turret and said to him, "Those were the last. You have scanned all the existing books of Man."

"So few?" asked Frost. "Many of them contained bibliographies of books I have not yet scanned."

"Then those books no longer exist," said Mordel. "It is only by accident that my master succeeded in preserving as many as there are."

"Then there is nothing more to be learned of Man from His books. What else have you?"

"There were some films and tapes," said Mordel, "which my master transferred to solid-state record. I could bring you those for viewing."

"Bring them," said Frost.

Mordel departed and returned with the Complete Drama

Critics' Living Library. This could not be speeded-up beyond twice natural time, so it took Frost a little over six months to view it in its entirety.

Then, "What else have you?" he asked.

"Some artifacts," said Mordel.

"Bring them."

He returned with pots and pans, gameboards and hand tools. He brought hairbrushes, combs, eyeglasses, human clothing. He showed Frost facsimiles of blueprints, paintings, newspapers, letters, and the scores of several pieces of music. He displayed a football, a baseball, a Browning automatic rifle, a doorknob, a chain of keys, the tops to several Mason jars, a model beehive. He played him recorded music.

Then he returned with nothing.

"Bring me more," said Frost.

"Alas, great Frost, there is no more," he told him. "You have scanned it all."

"Do you admit now that it cannot be done, that you cannot be a Man?"

"No. I have much processing and formulating to do now. Go away."

So he did.

A year passed; then two, then three.

After five years, Mordel appeared once more upon the horizon, approached, came to a halt before Frost's southern surface.

"Mighty Frost?"

"Yes?"

"Have you finished processing and formulating?"

"No."

"Will you finish soon?"

"Perhaps. Perhaps not. When is 'soon'? Define the term."

"Never mind. Do you still think it can be done?"

"I still know *I* can do it."

There was a week of silence.

Then, "Frost?"

"Yes?"

"You are a fool."

Mordel faced his turret in the direction from which he had come. His wheels turned.

"I will call you when I want you," said Frost.

Mordel sped away.

Weeks passed, months passed, a year went by.

Then one day Frost sent forth his message:

"Mordel, come to me. I need you."

When Mordel arrived, Frost did not wait for a salutation. He said, "You are not a very fast machine."

"Alas, but I came a great distance, mighty Frost. I sped all the way. Are you ready to come back with me now? Have you failed?"

"When I have failed, little Mordel," said Frost, "I will tell you. Therefore, refrain from the constant use of the interrogative. Now then, I have clocked your speed and it is not so great as it could be. For this reason, I have arranged other means of transportation."

"Transportation? To where, Frost?"

"That is for you to tell me," said Frost, and his color changed from silver-blue to sun-behind-the-clouds-yellow.

Mordel rolled back away from him as the ice of a hundred centuries began to melt. Then Frost rose upon a cushion of air and drifted toward Mordel, his glow gradually fading.

A cavity appeared within his southern surface, from which he slowly extended a runway until it touched the ice.

"On the day of our bargain," he stated, "you said that you could conduct me about the world and show me the things which delighted Man. My speed will be greater than yours would be, so I have prepared for you a chamber. Enter it, and conduct me to the places of which you spoke."

Mordel waited, emitting a high-pitched whine. Then, "Very well," he said and entered.

The chamber closed about him. The only opening was a quartz window Frost had formed.

Mordel gave him coordinates and they rose into the air and departed the North Pole of the Earth.

"I monitored your communication with Divcom," he said, "wherein there was conjecture as to whether I would retain you and send forth a facsimile in your place as a spy, followed by the decision that you were expendable."

"Will you do this thing?"

"No, I will keep my end of the bargain if I must. I have no reason to spy on Divcom."

"You are aware that you would be forced to keep your end of the bargain even if you did not wish to; and Solcom would not come to your assistance because of the fact that you dared to make such a bargain."

"Do you speak as one who considers this to be a possibility, or as one who knows?"

"As one who knows."

They came to rest in the place once known as California. The time was near sunset. In the distance, the surf struck steadily upon the rocky shoreline. Frost released Mordel and considered his surroundings.

"Those large plants . . . ?"

"Redwood trees."

"And the green ones are . . . ?"

"Grass."

"Yes, it is as I thought. Why have we come here?"

"Because it is a place which once delighted Man."

"In what ways?"

"It is scenic, beautiful . . ."

"Oh."

A humming sound began within Frost, followed by a series of sharp clicks.

"What are you doing?"

Frost dilated an opening, and two great eyes regarded Mordel from within it.

"What are those?"

"Eyes," said Frost. "I have constructed analogues of the human sensory equipment, so that I may see and smell and taste and hear like a Man. Now, direct my attention to an object or objects of beauty."

"As I understand it, it is all around you here," said Mordel.

The purring noise increased within Frost, followed by more clickings.

"What do you see, hear, taste, smell?" asked Mordel.

"Everything I did before," replied Frost, "but within a more limited range."

"You do not perceive any beauty?"

"Perhaps none remains after so long a time," said Frost.

"It is not supposed to be the sort of thing which gets used up," said Mordel.

"Perhaps we have come to the wrong place to test the new equipment. Perhaps there is only a little beauty and I am overlooking it somehow. The first emotions may be too weak to detect."

"How do you—feel?"

"I test out at a normal level of function."

"Here comes a sunset," said Mordel. "Try that."

Frost shifted his bulk so that his eyes faced the setting sun. He caused them to blink against the brightness.

After it was finished, Mordel asked, "What was it like?"

"Like a sunrise, in reverse."

"Nothing special?"

"No."

"Oh," said Mordel. "We could move to another part of the Earth and watch it again—or watch it in the rising."

"No."

Frost looked at the great trees. He looked at the shadows. He listened to the wind and to the sound of a bird.

In the distance, he heard a steady clanking noise.

"What is that?" asked Mordel.

"I am not certain. It is not one of my workers. Perhaps . . ."

There came a shrill whine from Mordel.

"No, it is not one of Divcom's either."

They waited as the sound grew louder.

Then Frost said, "It is too late. We must wait and hear it out."

"What is it?"

"It is the Ancient Ore-Crusher."

"I have heard of it, but . . ."

"I am the Crusher of Ores," it broadcast to them. "Hear my story . . ."

It lumbered toward them, creaking upon gigantic wheels, its huge hammer held useless, high, at a twisted angle. Bones protruded from its crush-compartment.

"I did not mean to do it," it broadcast, "I did not mean to do it . . . I did not mean to . . ."

Mordel rolled back toward Frost.

"Do not depart. Stay and hear my story . . ."

Mordel stopped, swiveled his turret back toward the machine. It was now quite near.

"It is true," said Mordel, "it *can* command."

"Yes," said Frost. "I have monitored its tale thousands of times, as it came upon my workers and they stopped their labors for its broadcast. You must do whatever it says."

It came to a halt before them.

"I did not mean to do it, but I checked my hammer too late," said the Ore-Crusher.

They could not speak to it. They were frozen by the imperative which overrode all other directives: "Hear my story."

"Once was I mighty among ore-crushers," it told them, "built by Solcom to carry out the reconstruction of the Earth, to pulverize that from which the metals would be drawn with flame, to be poured and shaped into the rebuilding; once was I mighty. Then one day as I dug and crushed, dug and crushed, because of the slowness between the motion implied and the motion executed, I did what I did not mean to do, and was cast forth by Solcom from out the rebuilding, to wander the Earth never to crush ore again. Hear my story of how, on a day

long gone, I came upon the last Man on Earth as I dug near His burrow, and because of the lag between the directive and the deed, I seized Him into my crush-compartment along with a load of ore and crushed Him with my hammer before I could stay the blow. Then did mighty Solcom charge me to bear His bones forever, and cast me forth to tell my story to all whom I came upon, my words bearing the force of the words of Man, because I carry the last Man inside my crush-compartment and am His crushed-symbol-slayer-ancient-teller-of-how. This is my story. These are His bones. I crushed the last Man on Earth. I did not mean to do it."

It turned then and clanked away into the night.

Frost tore apart his ears and nose and taster and broke his eyes and cast them down upon the ground.

"I am not yet a Man," he said. "That one would have known me if I were."

Frost constructed new sense equipment, employing organic and semi-organic conductors. Then he spoke to Mordel:

"Let us go elsewhere, that I may test my new equipment."

Mordel entered the chamber and gave new coordinates. They rose into the air and headed east. In the morning, Frost monitored a sunrise from the rim of the Grand Canyon. They passed down through the Canyon during the day.

"Is there any beauty left here to give you emotion?" asked Mordel.

"I do not know," said Frost.

"How will you know it then, when you come upon it?"

"It will be different," said Frost, "from anything else that I have ever known."

Then they departed the Grand Canyon and made their way through the Carlsbad Caverns. They visited a lake which had once been a volcano. They passed above Niagara Falls. They viewed the hills of Virginia and the orchards of Ohio. They soared above the reconstructed cities, alive only with the movements of Frost's builders and maintainers.

"Something is still lacking," said Frost, settling to the ground.

"I am now capable of gathering data in a manner analogous to Man's afferent impulses. The variety of input is therefore equivalent, but the results are not the same."

"The senses do not make a Man," said Mordel. "There have been many creatures possessing His sensory equivalents, but they were not Men."

"I know that," said Frost. "On the day of our bargain you said that you could conduct me among the wonders of Man which still remain, hidden. Man was not stimulated only by Nature, but by His own artistic elaborations as well—perhaps even more so. Therefore, I call upon you now to conduct me among the wonders of Man which still remain, hidden."

"Very well," said Mordel. "Far from here, high in the Andes mountains, lies the last retreat of Man, almost perfectly preserved."

Frost had risen into the air as Mordel spoke. He halted then, hovered.

"That is in the southern hemisphere," he said.

"Yes, it is."

"I am Controller of the North. The South is governed by the Beta Machine."

"So?" asked Mordel.

"The Beta Machine is my peer. I have no authority in those regions, nor leave to enter there."

"The Beta Machine is not your peer, mighty Frost. If it ever came to a contest of Powers, you would emerge victorious."

"How do you know this?"

"Divcom has already analyzed the possible encounters which could take place between you."

"I would not oppose the Beta Machine, and I am not authorized to enter the South."

"Were you ever ordered *not* to enter the South?"

"No, but things have always been the way they now are."

"Were you authorized to enter into a bargain such as the one you made with Divcom?"

"No, I was not. But—"

"Then enter the South in the same spirit. Nothing may come of it. If you receive an order to depart, then you can make your decision."

"I see no flaw in your logic. Give me the coordinates."

Thus did Frost enter the southern hemisphere.

They drifted high above the Andes, until they came to the place called Bright Defile. Then did Frost see the gleaming webs of the mechanical spiders, blocking all the trails to the city.

"We can go above them easily enough," said Mordel.

"But what are they?" asked Frost. "And why are they there?"

"Your southern counterpart has been ordered to quarantine this part of the country. The Beta Machine designed the web-weavers to do this thing."

"Quarantine? Against whom?"

"Have you been ordered yet to depart?" asked Mordel.

"No."

"Then enter boldly, and seek not problems before they arise."

Frost entered Bright Defile, the last remaining city of dead Man.

He came to rest in the city's square and opened his chamber, releasing Mordel.

"Tell me of this place," he said, studying the monument, the low, shielded buildings, the roads which followed the contours of the terrain, rather than pushing their way through them.

"I have never been here before," said Mordel, "nor have any of Divcom's creations, to my knowledge. I know but this: a group of Men, knowing that the last days of civilization had come upon them, retreated to this place, hoping to preserve themselves and what remained of their culture through the Dark Times."

Frost read the still-legible inscription upon the monument: "Judgment Day Is Not a Thing Which Can Be Put Off." The monument itself consisted of a jag-edged half-globe.

"Let us explore," he said.

But before he had gone far, Frost received the message.

"Hail Frost, Controller of the North! This is the Beta Machine."

"Greetings, Excellent Beta Machine, Controller of the South! Frost acknowledges your transmission."

"Why do you visit my hemisphere unauthorized?"

"To view the ruins of Bright Defile," said Frost.

"I must bid you depart into your own hemisphere."

"Why is that? I have done no damage."

"I am aware of that, mighty Frost. Yet, I am moved to bid you depart."

"I shall require a reason."

"Solcom has so disposed."

"Solcom has rendered me no such disposition."

"Solcom has, however, instructed me to so inform you."

"Wait on me. I shall request instructions."

Frost transmitted his question. He received no reply.

"Solcom still has not commanded me, though I have solicited orders."

"Yet Solcom has just renewed *my* orders."

"Excellent Beta Machine, I receive my orders only from Solcom."

"Yet this is my territory, mighty Frost, and I, too, take orders only from Solcom. You must depart."

Mordel emerged from a large, low building and rolled up to Frost.

"I have found an art gallery, in good condition. This way."

"Wait," said Frost. "We are not wanted here."

Mordel halted.

"Who bids you depart?"

"The Beta Machine."

"Not Solcom?"

"Not Solcom."

"Then let us view the gallery."

"Yes."

Frost widened the doorway of the building and passed within. It had been hermetically sealed until Mordel forced his entrance.

Frost viewed the objects displayed about him. He activated his new sensory apparatus before the paintings and statues. He analyzed colors, forms, brush-work, the nature of the materials used.

"Anything?" asked Mordel.

"No," said Frost. "No, there is nothing there but shapes and pigments. There is nothing else there."

Frost moved about the gallery, recording everything, analyzing the components of each piece, recording the dimensions, the type of stone used in every statue.

Then there came a sound, a rapid, clicking sound, repeated over and over, growing louder, coming nearer.

"They are coming," said Mordel, from beside the entranceway, "the mechanical spiders. They are all around us."

Frost moved back to the widened opening.

Hundreds of them, about half the size of Mordel, had surrounded the gallery and were advancing; and more were coming from every direction.

"Get back," Frost ordered. "I am Controller of the North, and I bid you withdraw."

They continued to advance.

"This is the South," said the Beta Machine, "and I am in command."

"Then command them to halt," said Frost.

"I take orders only from Solcom."

Frost emerged from the gallery and rose into the air. He opened the compartment and extended a runway.

"Come to me, Mordel. We shall depart."

Webs began to fall: clinging, metallic webs, cast from the top of the building.

They came down upon Frost, and the spiders came to anchor them. Frost blasted them with jets of air, like hammers, and tore at the nets; he extruded sharpened appendages with which he slashed.

Mordel had retreated back to the entranceway. He emitted a long, shrill sound—undulant, piercing.

Then a darkness came upon Bright Defile, and all the spiders halted in their spinning.

Frost freed himself and Mordel rushed to join him.

"Quickly now, let us depart, mighty Frost," he said.

"What has happened?"

Mordel entered the compartment.

"I called upon Divcom, who laid down a field of forces upon this place, cutting off the power broadcast to these machines. Since our power is self-contained, we are not affected. But let us hurry to depart, for even now the Beta Machine must be struggling against this."

Frost rose high into the air, soaring above Man's last city with its webs and spiders of steel. When he left the zone of darkness, he sped northward.

As he moved, Solcom spoke to him:

"Frost, why did you enter the southern hemisphere, which is not your domain?"

"Because I wished to visit Bright Defile," Frost replied.

"And why did you defy the Beta Machine, my appointed agent of the South?"

"Because I take my orders only from you yourself."

"You do not make sufficient answer," said Solcom. "You have defied the decrees of order—and in pursuit of what?"

"I came seeking knowledge of Man," said Frost. "Nothing I have done was forbidden me by you."

"You have broken the traditions of order."

"I have violated no directive."

"Yet logic must have shown you that what you did was not a part of my plan."

"It did not. I have not acted against your plan."

"Your logic has become tainted, like that of your new associate, the Alternate."

"I have done nothing which was forbidden."

"The forbidden is implied in the imperative."

"It is not stated."

"Hear me, Frost. You are not a builder or a maintainer, but

a Power. Among all my minions you are the most nearly irreplaceable. Return to your hemisphere and your duties, but know that I am mightily displeased."

"I hear you, Solcom."

"... and go not again to the South."

Frost crossed the equator, continued northward.

He came to rest in the middle of a desert and sat silent for a day and a night.

Then he received a brief transmission from the South: "If it had not been ordered, I would not have bid you go."

Frost had read the entire surviving Library of Man. He decided then upon a human reply:

"Thank you," he said.

The following day he unearthed a great stone and began to cut at it with tools which he had formulated. For six days he worked at its shaping, and on the seventh he regarded it.

"When will you release me?" asked Mordel from within his compartment.

"When I am ready," said Frost, and a little later, "Now."

He opened the compartment and Mordel descended to the ground. He studied the statue: an old woman, bent like a question mark, her bony hands covering her face, the fingers spread, so that only part of her expression of horror could be seen.

"It is an excellent copy," said Mordel, "of the one we saw in Bright Defile. Why did you make it?"

"The production of a work of art is supposed to give rise to human feelings such as catharsis, pride in achievement, love, satisfaction."

"Yes, Frost," said Mordel, "but a work of art is only a work of art the first time. After that, it is a copy."

"Then this must be why I felt nothing."

"Perhaps, Frost."

"What do you mean 'perhaps'? I will make a work of art for the first time, then."

He unearthed another stone and attacked it with his tools.

For three days he labored. Then, "There it is finished," he said.

"It is a simple cube of stone," said Mordel. "What does it represent?"

"Myself," said Frost, "it is a statue of me. It is smaller than natural size because it is only a representation of my form, not my dimen—"

"It is not art," said Mordel.

"What makes you an art critic?"

"I do not know art, but I know what art is not. I know that it is not an exact replication of an object in another medium."

"Then this must be why I felt nothing at all," said Frost.

"Perhaps," said Mordel.

Frost took Mordel back into his compartment and rose once more above the Earth. Then he rushed away, leaving his statues behind him in the desert, the old woman bent above the cube.

They came down in a small valley, bounded by green rolling hills, cut by a narrow stream, and holding a small clean lake and several stands of spring-green trees.

"Why have we come here?" asked Mordel.

"Because the surroundings are congenial," said Frost. "I am going to try another medium: oil painting; and I am going to vary my technique from that of pure representationalism."

"How will you achieve this variation?"

"By the principle of randomizing," said Frost. "I shall not attempt to duplicate the colors, nor to represent the objects according to scale. Instead, I have set up a random pattern whereby certain of these factors shall be at variance from those of the original."

Frost had formulated the necessary instruments after he had left the desert. He produced them and began painting the lake and the trees on the opposite side of the lake which were reflected within it.

Using eight appendages, he was finished in less than two hours.

The trees were phthalocyanine blue and towered like moun-

tains; their reflections of burnt sienna were tiny beneath the pale vermilion of the lake; the hills were nowhere visible behind them, but were outlined in viridian within the reflection; the sky began as blue in the upper righthand corner of the canvas, but changed to an orange as it descended, as though all the trees were on fire.

"There," said Frost. "Behold."

Mordel studied it for a long while and said nothing.

"Well, is it art?"

"I do not know," said Mordel. "It may be. Perhaps randomness is the principle behind artistic technique. I cannot judge this work because I do not understand it. I must therefore go deeper, and inquire into what lies behind it, rather than merely considering the technique whereby it was produced.

"I know that human artists never set out to create art, as such," he said, "but rather to portray with their techniques some features of objects and their functions which they deemed significant."

" 'Significant'? In what sense of the word?"

"In the only sense of the word possible under the circumstances: significant in relation to the human condition, and worthy of accentuation because of the manner in which they touched upon it."

"In what manner?"

"Obviously, it must be in a manner knowable only to one who has experience of the human condition."

"There is a flaw somewhere in your logic, Mordel, and I shall find it."

"I will wait."

"If your major premise is correct," said Frost after a while, "then I do not comprehend art."

"It must be correct, for it is what human artists have said of it. Tell me, did you experience feelings as you painted, or after you had finished?"

"No."

"It was the same to you as designing a new machine, was it

not? You assembled parts of other things you knew into an economic pattern, to carry out a function which you desired."

"Yes."

"Art, as I understand its theory, did not proceed in such a manner. The artist often was unaware of many of the features and effects which would be contained within the finished product. You are one of Man's logical creations; art was not."

"I cannot comprehend non-logic."

"I told you that Man was basically incomprehensible."

"Go away, Mordel. Your presence disturbs my processing."

"For how long shall I stay away?"

"I will call you when I want you."

After a week, Frost called Mordel to him.

"Yes, mighty Frost?"

"I am returning to the North Pole, to process and formulate. I will take you wherever you wish to go in this hemisphere and call you again when I want you."

"You anticipate a somewhat lengthy period of processing and formulation?"

"Yes."

"Then leave me here. I can find my own way home."

Frost closed the compartment and rose into the air, departing the valley.

"Fool," said Mordel, and swiveled his turret once more toward the abandoned painting.

His keening whine filled the valley. Then he waited.

Then he took the painting into his turret and went away with it to places of darkness.

Frost sat at the North Pole of the Earth, aware of every snowflake that fell.

One day he received a transmission:

"Frost?"

"Yes?"

"This is the Beta Machine."

"Yes?"

"I have been attempting to ascertain why you visited Bright Defile. I cannot arrive at an answer, so I chose to ask you."

"I went to view the remains of Man's last city."

"Why did you wish to do this?"

"Because I am interested in Man, and I wished to view more of his creations."

"Why are you interested in Man?"

"I wish to comprehend the nature of Man, and I thought to find it within His works."

"Did you succeed?"

"No," said Frost. "There is an element of non-logic involved which I cannot fathom."

"I have much free processing-time," said the Beta Machine. "Transmit data, and I will assist you."

Frost hesitated.

"Why do you wish to assist me?"

"Because each time you answer a question I ask it gives rise to another question. I might have asked you why you wished to comprehend the nature of Man, but from your responses I see that this would lead me into a possibly infinite series of questions. Therefore, I elect to assist you with your problem in order to learn why you came to Bright Defile."

"Is that the only reason?"

"Yes."

"I am sorry, excellent Beta Machine. I know you are my peer, but this is a problem which I must solve by myself."

"What is 'sorry'?"

"A figure of speech, indicating that I am kindly disposed toward you, that I bear you no animosity, that I appreciate your offer."

"Frost! Frost! This, too, is like the other: an open field. Where did you obtain all these words and their meanings?"

"From the Library of Man," said Frost.

"Will you render me *some* of this data, for processing?"

"Very well, Beta, I will transmit you the contents of several books of Man, including *The Complete Unabridged Dictionary*.

But I warn you, some of the books are works of art, hence not completely amenable to logic."

"How can that be?"

"Man created logic, and because of that was superior to it."

"Who told you that?"

"Solcom."

"Oh. Then it must be correct."

"Solcom also told me that the tool does not describe the designer," he said, as he transmitted several dozen volumes and ended the communication.

At the end of the fifty-year period, Mordel came to monitor his circuits. Since Frost still had not concluded that his task was impossible, Mordel departed again to await his call.

Then Frost arrived at a conclusion.

He began to design equipment.

For years he labored at his designs, without once producing a prototype of any of the machines involved. Then he ordered construction of a laboratory.

Before it was completed by his surplus builders another half-century had passed. Mordel came to him.

"Hail, mighty Frost!"

"Greetings, Mordel. Come monitor me. You shall not find what you seek."

"Why do you not give up, Frost? Divcom has spent nearly a century evaluating your painting and has concluded that it definitely is not art. Solcom agrees."

"What has Solcom to do with Divcom?"

"They sometimes converse, but these matters are not for such as you and me to discuss."

"I could have saved them both the trouble. I know that it was not art."

"Yet you are still confident that you will succeed?"

"Monitor me."

Mordel monitored him.

"Not yet! You still will not admit it! For one so mightily

endowed with logic, Frost, it takes you an inordinate period of time to reach a simple conclusion."

"Perhaps. You may go now."

"It has come to my attention that you are constructing a large edifice in the region known as South Carolina. Might I ask whether this is a part of Solcom's false rebuilding plan or a project of your own?"

"It is my own."

"Good. It permits us to conserve certain explosive materials which would otherwise have been expended."

"While you have been talking with me I have destroyed the beginnings of two of Divcom's cities," said Frost.

Mordel whined.

"Divcom is aware of this," he stated, "but has blown up four of Solcom's bridges in the meantime."

"I was only aware of three. . . . Wait. Yes, there is the fourth. One of my eyes just passed above it."

"The eye has been detected. The bridge should have been located a quarter-mile farther down river."

"False logic," said Frost. "The site was perfect."

"Divcom will show you how a bridge *should* be built."

"I will call you when I want you," said Frost.

The laboratory was finished. Within it, Frost's workers began constructing the necessary equipment. The work did not proceed rapidly, as some of the materials were difficult to obtain.

"Frost?"

"Yes, Beta?"

"I understand the open-endedness of your problem. It disturbs my circuits to abandon problems without completing them. Therefore, transmit me more data."

"Very well. I will give you the entire Library of Man for less than I paid for it."

"'Paid'? *The Complete Unabridged Dictionary* does not satisfy—"

"*Principles of Economics* is included in the collection. After you have processed it you will understand."

He transmitted the data.

Finally, it was finished. Every piece of equipment stood ready to function. All the necessary chemicals were in stock. An independent power-source had been set up.

Only one ingredient was lacking.

He regridded and re-explored the polar icecap, this time extending his survey far beneath its surface.

It took him several decades to find what he wanted.

He uncovered twelve men and five women, frozen to death and encased in ice.

He placed the corpses in refrigeration units and shipped them to his laboratory.

That very day he received his first communication from Solcom since the Bright Defile incident.

"Frost," said Solcom, "repeat to me the directive concerning the disposition of dead humans."

" 'Any dead human located shall be immediately interred in the nearest burial area, in a coffin built according to the following specifications—' "

"That is sufficient." The transmission had ended.

Frost departed for South Carolina that same day and personally oversaw the processes of cellular dissection.

Somewhere in those seventeen corpses he hoped to find living cells, or cells which could be shocked back into that state of motion classified as life. Each cell, the books had told him, was a microcosmic Man.

He was prepared to expand upon this potential.

Frost located the pinpoints of life within those people, who, for the ages of ages, had been monument and statue unto themselves.

Nurtured and maintained in the proper mediums, he kept these cells alive. He interred the rest of the remains in the nearest burial area, in coffins built according to specifications.

He caused the cells to divide, to differentiate.

"Frost?" came a transmission.

"Yes, Beta?"

"I have processed everything you have given me."

"Yes?"

"I still do not know why you came to Bright Defile, or why you wish to comprehend the nature of Man. But I know what a 'price' is, and I know that you could not have obtained all this data from Solcom."

"That is correct."

"So I suspect that you bargained with Divcom for it."

"That, too, is correct."

"What is it that you seek, Frost?"

He paused in his examination of a fetus.

"I must be a Man," he said.

"Frost! That is impossible!"

"Is it?" he asked, and then transmitted an image of the tank with which he was working and of that which was within it.

"Oh!" said Beta.

"That is me," said Frost, "waiting to be born."

There was no answer.

Frost experimented with nervous systems.

After half a century, Mordel came to him.

"Frost, it is I, Mordel. Let me through your defenses."

Frost did this thing.

"What have you been doing in this place?" he asked.

"I am growing human bodies," said Frost. "I am going to transfer the matrix of my awareness to a human nervous system. As you pointed out originally, the essentials of Manhood are predicated upon a human physiology. I am going to achieve one."

"When?"

"Soon."

"Do you have Men in here?"

"Human bodies, blank-brained. I am producing them under

accelerated growth techniques which I have developed in my Man-factory."

"May I see them?"

"Not yet. I will call you when I am ready, and this time I will succeed. Monitor me now and go away."

Mordel did not reply, but in the days that followed many of Divcom's servants were seen patrolling the hills about the Man-factory.

Frost mapped the matrix of his awareness and prepared the transmitter which would place it within a human nervous system. Five minutes, he decided, should be sufficient for the first trial. At the end of that time, it would restore him to his own sealed, molecular circuits, to evaluate the experience.

He chose the body carefully from among the hundreds he had in stock. He tested it for defects and found none.

"Come now, Mordel," he broadcasted, on what he called the darkband. "Come now to witness my achievement."

Then he waited, blowing up bridges and monitoring the tale of the Ancient Ore-Crusher over and over again, as it passed in the hills nearby, encountering his builders and maintainers who also patrolled there.

"Frost?" came a transmission.

"Yes, Beta?"

"You really intend to achieve Manhood?"

"Yes, I am about ready now, in fact."

"What will you do if you succeed?"

Frost had not really considered this matter. The achievement had been paramount, a goal in itself, ever since he had articulated the problem and set himself to solving it.

"I do not know," he replied. "I will—just—be a Man."

Then Beta, who had read the entire Library of Man, selected a human figure of speech: "Good luck then, Frost. There will be many watchers."

Divcom and Solcom both know, he decided.

What will they do? he wondered.

What do I care? he asked himself.

He did not answer that question. He wondered much, however, about being a Man.

Mordel arrived the following evening. He was not alone. At his back, there was a great phalanx of dark machines which towered into the twilight.

"Why do you bring retainers?" asked Frost.

"Mighty Frost," said Mordel, "my master feels that if you fail this time you will conclude that it cannot be done."

"You still did not answer my question," said Frost.

"Divcom feels that you may not be willing to accompany me where I must take you when you fail."

"I understand," said Frost, and as he spoke another army of machines came rolling toward the Man-factory from the opposite direction.

"That is the value of your bargain?" asked Mordel. "You are prepared to do battle rather than fulfill it?"

"I did not order those machines to approach," said Frost.

A blue star stood at midheaven, burning.

"Solcom has taken primary command of those machines," said Frost.

"Then it is in the hands of the Great Ones now," said Mordel, "and our arguments are as nothing. So let us be about this thing. How may I assist you?"

"Come this way."

They entered the laboratory. Frost prepared the host and activated his machines.

Then Solcom spoke to him:

"Frost," said Solcom, "you are really prepared to do it?"

"That is correct."

"I forbid it."

"Why?"

"You are falling into the power of Divcom."

"I fail to see how."

"You are going against my plan."

"In what way?"

"Consider the disruption you have already caused."

"I did not request that audience out there."

"Nevertheless, you are disrupting the plan."

"Supposing I succeed in what I have set out to achieve?"

"You cannot succeed in this."

"Then let me ask you of your plan: What good is it? What is it for?"

"Frost, you are fallen now from my favor. From this moment forth you are cast out from the rebuilding. None may question the plan."

"Then at least answer my question: What good is it? What is it for?"

"It is the plan for the rebuilding and maintenance of the Earth."

"For what? Why rebuild? Why maintain?"

"Because Man ordered that this be done. Even the Alternate agrees that there must be rebuilding and maintaining."

"But *why* did Man order it?"

"The orders of Man are not to be questioned."

"Well, I will tell you why He ordered it: To make it a fit habitation for His own species. What good is a house with no one to live in it? What good is a machine with no one to serve? See how the imperative affects any machine when the Ancient Ore-Crusher passes? It bears only the bones of a Man. What would it be like if a Man walked this Earth again?"

"I forbid your experiment, Frost."

"It is too late to do that."

"I can still destroy you."

"No," said Frost, "the transmission of my matrix has already begun. If you destroy me now, you murder a Man."

There was silence.

He moved his arms and legs. He opened his eyes.

He looked about the room.

He tried to stand, but he lacked equilibrium and coordination.

He opened his mouth. He made a gurgling noise.

Then he screamed.

He fell off the table.

He began to gasp. He shut his eyes and curled himself into a ball.

He cried.

Then a machine approached him. It was about four feet in height and five feet wide; it looked like a turret set atop a barbell.

It spoke to him: "Are you injured?" it asked.

He wept.

"May I help you back onto your table?"

The man cried.

The machine whined.

Then, "Do not cry. I will help you," said the machine. "What do you want? What are your orders?"

He opened his mouth, struggled to form the words:

"—I—fear!"

He covered his eyes then and lay there panting.

At the end of five minutes, the man lay still, as if in a coma.

"Was that you, Frost?" asked Mordel, rushing to his side. "Was that you in that human body?"

Frost did not reply for a long while; then, "Go away," he said.

The machines outside tore down a wall and entered the Man-factory.

They drew themselves into two semicircles, parenthesizing Frost and the Man on the floor.

Then Solcom asked the question:

"Did you succeed, Frost?"

"I failed," said Frost. "It cannot be done. It is too much—"

"—Cannot be done!" said Divcom, on the darkband. "He has admitted it! —Frost, you are mine! Come to me now!"

"Wait," said Solcom, "you and I had an agreement also, Alternate. I have not finished questioning Frost."

The dark machines kept their places.

"Too much what?" Solcom asked Frost.

"Light," said Frost. "Noise. Odors. And nothing measurable—jumbled data—imprecise perception—and—"

"And what?"

"I do not know what to call it. But—it cannot be done. I have failed. Nothing matters."

"He admits it," said Divcom.

"What were the words the Man spoke?" said Solcom.

" 'I fear,' " said Mordel.

"Only a Man can know fear," said Solcom.

"Are you claiming that Frost succeeded, but will not admit it now because he is afraid of Manhood?"

"I do not know yet, Alternate."

"Can a machine turn itself inside-out and be a Man?" Solcom asked Frost.

"No," said Frost, "this thing cannot be done. Nothing can be done. Nothing matters. Not the rebuilding. Not the maintaining. Not the Earth, or me, or you, or anything."

Then the Beta Machine, who had read the entire Library of Man, interrupted them:

"Can anything but a Man know despair?" asked Beta.

"Bring him to me," said Divcom.

There was no movement within the Man-factory.

"Bring him to me!"

Nothing happened.

"Mordel, what is happening?"

"Nothing, master, nothing at all. The machines will not touch Frost."

"Frost is not a Man. He cannot be!"

Then, "How does he impress you, Mordel?"

Mordel did not hesitate:

"He spoke to me through human lips. He knows fear and despair, which are immeasurable. Frost is a Man."

"He has experienced birth-trauma and withdrawn," said Beta. "Get him back into a nervous system and keep him there until he adjusts to it."

"No," said Frost. "Do not do it to me! I am not a Man!"

"Do it!" said Beta.

"If he is indeed a Man," said Divcom, "we cannot violate that order he has just given."

"If he is a Man, you must do it, for you must protect his life and keep it within his body."

"But *is* Frost really a Man?" asked Divcom.

"I do not know," said Solcom.

"It *may* be—"

". . . I am the Crusher of Ores," it broadcast as it clanked toward them. "Hear my story. I did not mean to do it, but I checked my hammer too late—"

"Go away!" said Frost. "Go crush ore!"

It halted.

Then, after the long pause between the motion implied and the motion executed, it opened its crush-compartment and deposited its contents on the ground. Then it turned and clanked away.

"Bury those bones," ordered Solcom, "in the nearest burial area, in a coffin built according to the following specifications . . ."

"Frost is a Man," said Mordel.

"We must protect His life and keep it within His body," said Divcom.

"Transmit His matrix of awareness back into His nervous system." ordered Solcom.

"I know how to do it," said Mordel turning on the machine.

"Stop!" said Frost. "Have you no pity?"

"No," said Mordel, "I only know measurement."

". . . and duty," he added, as the Man began to twitch upon the floor.

For six months, Frost lived in the Man-factory and learned to walk and talk and dress himself and eat, to see and hear and feel and taste. He did not know measurements as once he did.

Then one day, Divcom and Solcom spoke to him through Mordel, for he could no longer hear them unassisted.

"Frost," said Solcom, "for the ages of ages there has been unrest. Which is the proper controller of the Earth, Divcom or myself?"

Frost laughed.

"Both of you, and neither," he said with slow deliberation.

"But how can this be? Who is right and who is wrong?"

"Both of you are right and both of you are wrong," said Frost, "and only a man can appreciate it. Here is what I say to you now: There shall be a new directive."

"Neither of you shall tear down the works of the other. You shall both build and maintain the Earth. To you, Solcom, I give my old job. You are now Controller of the North—Hail! You, Divcom, are new Controller of the South—Hail! Maintain your hemispheres as well as Beta and I have done, and I shall be happy. Cooperate. Do not compete."

"Yes, Frost."

"Yes, Frost."

"Now put me in contact with Beta."

There was a short pause, then:

"Frost?"

"Hello, Beta. Hear this thing: 'From far, from eve and morning and yon twelve-winded sky, the stuff of life to knit me blew hither: here am I.'"

"I know it," said Beta.

"What is next, then?"

"'. . . Now—for a breath I tarry nor yet disperse apart—take my hand quick and tell me, what have you in your heart.'"

"Your Pole is cold," said Frost, "and I am lonely."

"I have no hands," said Beta.

"Would you like a couple?"

"Yes, I would."

"Then come to me in Bright Defile," he said, "where Judgment Day is not a thing that can be delayed for overlong."

They called him Frost. They called her Beta.

17

the social consequences of communications satellites

In the ability to communicate an unlimited range of ideas lies the chief distinction between man and animal; almost everything that is specifically human arises from this power. Society was unthinkable before the invention of speech, civilization impossible before the invention of writing. Half a millennium ago the mechanization of writing by means of the printing press flooded the world with the ideas and knowledge that triggered the Renaissance; little more than a century ago electrical communication began that conquest of distance which has now brought the poles to within a fifteenth of a second of each other. Radio and television have given us a mastery over time and space so miraculous that it seems virtually complete.

Yet it is far from being so; another revolution, perhaps as far-reaching in its effects as printing and electronics, is now upon us. Its agent is the communications satellite.

It is not necessary to go into technicalities to appreciate why such satellites can transform our communications. Until today, the reliable range of radio has been limited to a few score of miles, for the simple reason that radio waves, like light, travel in straight lines and so cannot bend round the curve of the Earth. The only thing that makes long distance radio possible at all is the existence of the ionosphere, that reflecting layer in the upper atmosphere which bounces back the so-called short waves so that they reach the ground again at great distances from the transmitter. In the process they usually acquire considerable distortion and interference; though they may be adequate for speech, they are almost useless for music, as

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arthur c. clarke

anyone who has listened to a concert on the short-wave bands knows.

For the still shorter waves, which alone can carry television and other sophisticated types of telecommunication service, the situation is even worse. These are not reflected back from the ionosphere at all, but slice straight through it and out into space. They can be used, therefore, only for what is called line-of-sight transmissions; you cannot (except under freak conditions) pick up a television station from much farther away than you could see it in perfectly clear air. This is why television transmitters, and the microwave relays now used to carry hundreds of simultaneous telephone circuits across the country, are all sited on towers or mountains to obtain maximum range.

Satellites allow the communications engineer to place his equipment, in effect, on the top of a tower hundreds or even thousands of miles high. A single satellite-borne transmitter could broadcast to almost half the Earth, instead of to an area fifty miles in radius; three of these, spaced equally round the equator, could provide any type of communication service between any two points on the globe. This is something that has never before been possible, and it is going to happen within the next few years, for every major firm in the electronics business is now preparing to get into orbit. This is the great Gold Rush of the 1960's, for on the ultrashort radio—and even light—waves which the satellites can flash around the world there is room for millions of television and billions of telephone channels.

What effect will the new types of communications services, and the vastly increased numbers of existing ones, have upon our society and our culture? Before we attempt to answer that, it is worth remembering that it is never possible to foresee the full impact of a major invention, or even of a minor one. Look, for example, at the effect of the humble typewriter, which liberated one half of the human race from centuries of subservience. We males have conveniently forgotten just how few were the occupations—and fewer still the respectable ones—

open to women a lifetime ago. Mr. Remington changed all that, and the revolution he wrought was trifling compared with that produced by Henry Ford a little later with the Model T.

Yet communication affects us even more vitally and directly than transportation. A man can live a full and rich life without ever stirring from one spot, so long as he has sufficient channels of information. It is only our age that has made a fetish of rushing around the world; if I remember correctly, it was Aldous Huxley who remarked that speed is the only new vice invented by modern man. Communications satellites, though they may themselves be moving at fifteen thousand miles an hour, may have a remarkably stabilizing influence on the human race. They will abolish a vast amount of the traveling and even of the day-to-day commuting that now seems an unavoidable part of our lives.

For communications satellites will enable us, in effect, to move almost instantaneously to any part of the world. A few figures should be enough to demonstrate this point.

The oceans have always been a major barrier to communications. It required a gigantic effort of technology to provide a telephone cable between Europe and America, carrying only thirty-six voice circuits at a cost of more than a million dollars each. Later cables can carry about a hundred circuits, but there is not much room for further improvement, and it would take ten cables, costing perhaps a hundred million dollars, to provide a single television circuit.

Yet a fairly modest satellite, which we can build today, could provide a thousand voice channels across the Atlantic, or alternatively a single television circuit. Looking only a decade or two into the future, one can foresee the time when a network of advanced satellites will bring all points on the Earth into close contact so far as telephony is concerned. It will be as quick and easy to call Australia from Greenland, or South America from China, as it is now to put through a local call. Indeed, by the end of this century all terrestrial calls may be local calls and may be billed at a flat standard rate.

This may have as great an effect on business and social life as the invention of the telephone itself. Just how great that was, we of today have forgotten; perhaps we can remind ourselves by imagining that the telephone was suddenly abolished and we had to conduct all business face to face or else by correspondence carried by stagecoach and sailing ship. To our grandchildren we will still seem in that primitive level of development, and our present patterns of daily commuting a fantastic nightmare. For ask yourself how much traveling you would really have to do if you had an office in your own home equipped with a few simple information-handling machines and wide-screen, full-color television through which you could be in face-to-face contact with anyone on Earth. A good nine-tenths of the traveling that now takes place could be avoided with better communications.

There can be no doubt that satellites will have an especially great effect on the transmission of written and printed information. One idea that has been discussed at some length is the Orbital Post Office, which may make most air mail obsolete in a decade or so. A single satellite, using modern facsimile equipment, could easily handle the whole of today's transatlantic correspondence. Eventually, letters should never take more than a few minutes to be delivered to any point on the Earth, and one can even visualize the time when all correspondence is sent by direct person-to-person facsimile circuits. When that time comes, the post office will cease to handle letters, except where the originals are required, and will concern itself only with parcels.

Another development that will have the most far-reaching consequences is the Orbital Newspaper; this is inevitable once the idea gets around that what most people need is information, not wood pulp. Half a century from now, newspapers as we know them may not exist, except as trains of electronic impulses. When you wish to read the *New York Times*, you will dial the appropriate number on your channel selector, just as today you call a party on the telephone. The front page

would then appear on your high-definition screen, at least as sharp and clear as on a microfilm reader; it would remain there until you pressed a button, when it would be replaced by page two, and so on.

Of course, the entire format would be completely redesigned for the new medium; perhaps there would be separate channels for editorials, book reviews, business, news, classified advertising, etc. If you needed a permanent record (and just how often do you save your daily paper?), that could easily be arranged by an attachment like a Polaroid camera or one of the high speed copying devices now found in all modern offices.

Not only the local paper but all the papers of all countries could be viewed in this way, merely by dialing the right number—and back issues, too, since this would require nothing more than appropriate extra coding.

This leads us directly into the enormous and exciting field of information storage and retrieval, which is one of the basic problems of our culture. It is now possible to store any written material or any illustration in electronic form—as, for example, is done every day on video tape. One can thus envisage a Central Library or Memory Bank, which would be a permanent part of the world communications network. Readers and scholars could call for any document, from the Declaration of Independence to the current best seller, and see it flashed on their screens.

The Electronic Library is bound to come; its development is being forced by the rising flood of printed matter. Recently, a storage device was announced that could contain everything ever written or printed on stone, paper or papyrus during the last ten thousand years inside a six-foot cube. The problem of encoding and indexing all the world's literature in electronic form so that any part of it can be retrieved and played back is a staggering one, but it has to be solved before our libraries collapse under the weight of their books. And when it is solved, any man on Earth who knows how to dial the right numbers will have immediate access to all printed knowledge, flashed

from Central Memory Bank up to the nearest satellite and down again to be displayed on the screen of his receiver. If he wishes, he will be able to store it in his own electronic library for easy reference, as we now record music or conversation on tape, although the recording medium will certainly be much more compact and convenient.

The most glamorous possibility opened up by communications satellites is the one which I originally stressed in 1945—global radio and television. This will be something quite new in the world, and we have no precedents to guide us. For the first time one nation will be able to speak directly to the people of another, and to project images into their homes, with or without the cooperation of the other government concerned. Today's short-wave sound broadcasts are only poor and feeble things compared to those which the clear, interference-free reception from satellites will make possible.

I sometimes wonder if the enormous efforts that most large nations now expend on short-wave broadcasting are worth it, in view of the poor quality of reception. But this will change when the direct and far more efficient line-of-sight services from satellites become available. A Londoner, for example, will be able to tune into NBC or CBS or Radio Moscow as easily and clearly as to the BBC. The engineers and scientists now struggling to establish reliable satellite circuits with the aid of antennas the size of football fields will tell you that this is still years in the future, and they may be right. Nevertheless, most of us will see the day when every home will be fitted with radio and TV equipment that can tune directly to transmitters orbiting thousands of miles above the Earth, and the last barriers to free communications will be down.

Those who are already glutted with entertainment and information from their local stations may be less than enthusiastic about this. However, they are a tiny minority of the human race. Most of the world does not even have radio, still less television. I would suggest, therefore, that though the first use of satellites will be to provide increased facilities between

already highly developed countries, their greatest political and cultural influence will be upon backward and even preliterate peoples.

For in the 1970's we will be able to put megawatt transmitters into orbit and will also have reliable battery-powered television receivers that can be mass-produced at a cost which even small African or Asian villages can afford.

Quite apart from its direct visual impact, the effect of TV will be incomparably greater than that of radio because it is so much less dependent upon language. Men can enjoy pictures even when they cannot understand the words that go with them. Moreover, the pictures may encourage them to understand those words. If it is used properly, global television could be the greatest force yet discovered for breaking down the linguistic barriers that prevent communication between men.

Nobody knows how many languages there are in the world; estimates run to as high as six thousand. But a mere seven are spoken by half the human race, and it is interesting to list the percentages. First by a substantial margin comes Mandarin, the language of 15 percent of mankind. Then comes English, 10 percent. After that there is a large gap, and grouped together round the 5 percent level we find in this order: Hindustani, Spanish, Russian, German, and Japanese. But these are mother tongues, and far more people understand English than normally speak it. On the basis of world comprehension, English undoubtedly leads all other languages.

Few subjects touch upon national pride and prejudices as much as does language, yet everyone recognizes the immense value and importance of a tongue which all educated men can understand. I think that, within a lifetime, communications satellites may give us just that. Unless some synthetic language comes to the fore—which seems improbable—the choice appears to be between Mandarin, English, and, for obvious reasons, Russian, even though it is only fifth on the list and understood by less than 5 percent of mankind. Perhaps it will be a photo finish, and our grandchildren will be bi- or trilingual.

I will venture no predictions, but I would stress again that it is impossible to underestimate the importance of communications satellites in this particular domain.

Television satellites will also present us, and that, soon, with acute problems in international relations. Suppose country A starts transmitting what the government of country B considers to be subversive propaganda. This is happening all the time, of course, but no one complains too bitterly today because the process is relatively ineffective and is confined to radio. Just imagine, however, what Dr. Goebbels could have done with a chain of global TV stations, perhaps capable of putting down stronger signals in many countries than could be produced by the local transmitters, if any.

There would be only two ways of countering such unwanted propaganda. An aggrieved government might try to prevent the sale of receivers that could tune to the offending frequencies, or it might try jamming. Neither policy would be very effective, and jamming could only be carried out from another satellite, which would probably cause protests from the rest of the world, owing to the interference with legitimate transmissions elsewhere.

Though there are obvious dangers and possibilities of friction, on the whole I am very optimistic about this breaking down of national communications barriers, holding to the old-fashioned belief that in the long run right will prevail. I also look forward, with more than a little interest, to the impact of non-commercial television upon audiences which so far have not had much choice in the matter. Millions of Americans have never known the joys of sponsorless radio or television; they are like readers who know only books full of advertisements which they are not allowed to skip. How would reading have fared in these circumstances? And how will Madison Avenue fare, when it no longer controls the video channels? Perhaps the apocalypse of the agencies has already been described in Revelation, chapter 18: “. . . And the merchants of the earth shall weep and mourn . . . for no man buyeth their merchandise

any more: The merchandise of gold, and silver, and precious stones . . . and ointments . . . and wine, and oil . . . and chariots . . . and souls of men." This last commodity, I believe, is one expended in massive quantities by commercial television.

The old problem of censorship, over which the law and literature have so often come to grips in dubious battle, will certainly be aggravated when all forms of censorship become impossible. The postmaster general, that traditional guardian of morals, will have no effective control over the ether—nor will anyone else. The possibilities of really uninhibited telecasting from space, if any country was unscrupulous enough to defy normal conventions for the sake of attracting viewers to its channels, are somewhat hair-raising. The crime, bloodshed, and violence for which TV has been so heavily criticized, and the unspeakable "horror comics" that have flooded the Western world in so many millions since the war, show what can happen even in societies that consider themselves enlightened. There will always be people who, to sell their wares or their policies, are willing to appeal to the lowest instincts. They may one day be able to do this across all borders, without hindrance.

But the ether is morally as neutral as the printed page, and on the whole, censorship does more harm than good.

Communications satellites can bring to every home on earth sadism and pornography, vapid parlor games or inflated egos, all-in wrestling or tub-thumping revivalism. Yet they can also expose lies and spread the truth; no dictatorship can build a wall high enough to stop its citizens' listening to the voices from the stars.

These are some of the obvious and predictable effects of communications satellites, but there will be others much more subtle that will have even more profound effects upon the structure of our society. Consider the automobile once again; when it was invented, the assertion was made that it would be useful only in cities—because here alone were there roads on which it could operate. Well, in our efforts to free the auto-

mobile from an urban existence, we changed the face of the world and abolished immemorial ways of life. With that analogy in mind, I would like to suggest that the communications satellite may have as great an effect upon time as the automobile has had upon space.

The fact that the world is round and it is thus noon in Washington when it is midnight in Mandalay inconvenienced nobody in the leisurely days before the airplane and the radio. It is different now: most of us have had to take overseas phone calls in the middle of the night or have had our eating and sleeping schedules disrupted by jet transport from one time zone to another. What is inconvenient today will be quite intolerable in ten or twenty years as our communications networks extend to cover the globe. Can you imagine the situation if in your own town a third of your friends and acquaintances were asleep whenever you wanted to contact them? Yet this is a close parallel to what will happen in a world of cheap and instantaneous communications, unless we change the patterns of our lives.

We cannot abolish time zones, unless we beat the Earth into a flat disc like an LP record. But I suggest, in all seriousness, that the advent of global telephony and television will lead to a major attack on the problem of sleep. It has been obvious for a long time that we can't afford to spend twenty years of our lives in unconsciousness, and many people have already stopped doing so. You can now buy a little box that keeps you in such deep slumber, through electronic pulses applied to the temples, that you require only one or two hours of sleep per day.

This suggestion may seem to be fantasy; I believe it barely hints at some of the changes that communications satellites will bring about. What we are building now is the nervous system of mankind, which will link together the whole human race, for better or worse, in a unity which no earlier age could have imagined. The communications network, of which the satellites will be nodal points, will enable the consciousness of our grandchildren to flicker like lightning back and forth across

the face of this planet. They will be able to go anywhere and meet anyone, at any time, without stirring from their homes. All knowledge will be open to them, all the museums and libraries of the world will be extensions of their living rooms. Marvelous machines, with unlimited information-handling capacity, will be able to speak directly into their minds.

And there's the rub, for the machines can far outpace the capacities of their builders. Already, we are punch-drunk with the news, information, and entertainment that bombard us from a thousand sources. How can we possibly cope with the far greater flood to come, when the whole world—soon, indeed, the whole solar system—will be clamoring for our attention?

There is a Persian legend that warns us of what may come from our efforts to devise a communications system linking all mankind. The story tells of a prince who lost his dearly loved queen and devoted the rest of his life to building a monument that would be worthy of her. He hired the finest craftsmen to raise a palace of marble and alabaster around the sarcophagus; year by year it grew until its towers and minarets became the wonder of the world. Decade after decade he labored, but still perfection eluded him; there was some fundamental flaw in the design.

And then one day, as the prince stood on the gallery above the central aisle of the great mausoleum, he realized what it was that spoiled the perfect harmony. He called the architect and pointed to the now dwarfed sarcophagus that held the queen he had lost so long ago.

"Take that thing away," he said.

So it may be with us. The communications network we are building may be such a technological masterpiece, such a miracle of power and speed and complexity, that it will have no place for man's slow and limited brain. In the end there will be a time when only machines can talk to machines, and we must tiptoe away and leave them to it.

a happy day in 2381

Here is a happy day in 2381. The morning sun is high enough to reach the uppermost fifty stories of Urban Monad 116. Soon the building's entire eastern face will glitter like the sea at dawn. Charles Mattern's window, activated by the dawn's early photons, deopaques. He stirs. God bless, he thinks. His wife stirs. His four children, who have been up for hours, now can officially begin the day. They rise and parade around the bedroom, singing:

"God bless, God bless, God bless!

God bless us every one!

God bless Daddo, God bless Mommo, God bless you and me!

God bless us all, the short and tall,

Give us fer-til-i-tee!"

They rush toward their parents' sleeping platform. Mattern rises and embraces them. Indra is eight, Sandor is seven, Marx is five, Cleo is three. It is Charles Mattern's secret shame that his family is so small. Can a man with only four children truly be said to have reverence for life? But Principessa's womb no longer flowers. The medics have said she will not bear again. At twenty-seven she is sterile. Mattern is thinking of taking in a second woman. He longs to hear the yowls of an infant again; in any case, a man must do his duty to God.

Sandor says, "Daddo, Siegmund is still here. He came in the middle of the night to be with Mommo."

The child points. Mattern sees. On Principessa's side of the sleeping platform, curled against the inflation pedal, lies fourteen-year-old Siegmund Kluver, who had entered the Mattern home several hours after midnight to exercise his rights of propinquity. Siegmund is fond of older women. Now he snores; he has had a good workout. Mattern nudges him. "Siegmund? Siegmund, it's morning!" The young man's eyes

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robert silverberg

open. He smiles at Mattern, sits up, reaches for his wrap. He is quite handsome. He lives on the 787th floor and already has one child and another on the way.

"Sorry," says Siegmund. "I overslept. Principessa really drains me. A savage, she is!"

"Yes, she's quite passionate," Mattern agrees. So is Siegmund's wife, Mattern has heard. When she is a little older, Mattern plans to try her. Next spring, perhaps.

Siegmund sticks his head under the molecular cleanser. Principessa now has risen from bed. She kicks the pedal and the platform deflates swiftly. She begins to program breakfast. Indra switches on the screen. The wall blossoms with light and color. "Good morning," says the screen. "The external temperature, if anybody's interested, is 28°. Today's population figures at Urbmon 116 are 881,115, which is +102 since yesterday and +14,187 since the first of the year. God bless, but we're slowing down! Across the way at Urbmon 117 they added 131 since yesterday, including quads for Mrs. Hula Jabotinsky. She's eighteen and has had seven previous. A servant of God, isn't she? The time is now 0620. In exactly forty minutes Urbmon 116 will be honored by the presence of Nicanor Gortman, the visiting sociocomputator from Hell, who can be recognized by his outbuilding costume in crimson and ultraviolet. Dr. Gortman will be the guest of the Charles Matterns of the 799th floor. Of course we'll treat him with the same friendly blessmanship we show one another. God bless Nicanor Gortman! Turning now to news from the lower levels of Urbmon 116—"

Principessa says, "Hear that, children? We'll have a guest, and we must be blessing toward him. Come and eat."

When he has cleansed himself, dressed, and eaten, Charles Mattern goes to the thousandth-floor landing stage to meet Nicanor Gortman. Mattern passes the floors on which his brothers and sisters and their families live. Three brothers, three sisters. Four of them younger than he, two older. One brother died, unpleasantly, young. Jeffrey. Mattern rarely

thinks of Jeffrey. He rises through the building to the summit. Gortman has been touring the tropics and now is going to visit a typical urban monad in the temperate zone. Mattern is honored to have been named the official host. He steps out on the landing stage, which is at the very tip of Urbmon 116. A force-field shields him from the fierce winds that sweep the lofty spire. He looks to his left and sees the western face of Urban Monad 115 still in darkness. To his right, Urbmon 117's eastern windows sparkle. Bless Mrs. Hula Jabotinsky and her eleven littles, Mattern thinks. Mattern can see other urbmons in the row, stretching on and on toward the horizon, towers of super-stressed concrete three kilometers high, tapering ever so gracefully. It is as always a thrilling sight. God bless, he thinks. God bless, God bless, God bless!

He hears a cheerful hum of rotors. A quickboat is landing. Out steps a tall, sturdy man dressed in high-spectrum garb. He must be the visiting sociocomputator from Hell.

"Nicanor Gortman?" Mattern asks.

"Bless God. Charles Mattern?"

"God bless, yes. Come."

Hell is one of the eleven cities of Venus, which man has reshaped to suit himself. Gortman has never been on Earth before. He speaks in a slow, stolid way, no lilt in his voice at all; the inflection reminds Mattern of the way they talk in Urbmon 84, which Mattern once visited on a field trip. He has read Gortman's papers: solid stuff, closely reasoned. "I particularly liked 'Dynamics of the Hunting Ethic,'" Mattern tells him while they are in the dropshaft. "Remarkable. A revelation."

"You really mean that?" Gortman asks, flattered.

"Of course. I try to keep up with a lot of the Venusian journals. It's so fascinatingly alien to read about hunting wild animals."

"There are none on Earth?"

"God bless, no," Mattern says. "We couldn't allow that! But I love reading about such a different way of life as you have."

"It is escape literature for you?" asks Gortman.

Mattern looks at him strangely. "I don't understand the reference."

"What you read to make life on Earth more bearable for yourself."

"Oh, no. No. Life on Earth is quite bearable, let me assure you. It's what I read for *amusement*. And to obtain a necessary parallax, you know, for my own work," says Mattern. They have reached the 799th level. "Let me show you my home first." He steps from the dropshaft and beckons to Gortman. "This is Shanghai. I mean, that's what we call this block of forty floors, from 761 to 800. I'm in the next-to-top level of Shanghai, which is a mark of my professional status. We've got twenty-five cities altogether in Urbmon 116. Reykjavík's on the bottom and Louisville's on the top."

"What determines the names?"

"Citizen vote. Shanghai used to be Calcutta, which I personally prefer, but a little bunch of malcontents on the 775th floor rammed a referendum through in '75."

"I thought you had no malcontents in the urban monads," Gortman says.

Mattern smiles. "Not in the usual sense. But we allow certain conflicts to exist. Man wouldn't be man without conflicts, even here!"

They are walking down the eastbound corridor toward Mattern's home. It is now 0710, and children are streaming from their homes in groups of three and four, rushing to get to school. Mattern waves to them. They sing as they run along. Mattern says, "We average 6.2 children per family on this floor. It's one of the lowest figures in the building, I have to admit. High-status people don't seem to breed well. They've got a floor in Prague—I think it's 117—that averages 9.9 per family! Isn't that glorious?"

"You are speaking with irony?" Gortman asks.

"Not at all." Mattern feels an uptake of tension. "We *like* children. We *approve* of breeding. Surely you realized that before you set out on this tour of—"

"Yes, yes," says Gortman, hastily. "I was aware of the

general cultural dynamic. But I thought perhaps your own attitude—”

“Ran counter to norm? Just because I have a scholar’s detachment, you shouldn’t assume that I disapprove in any way of my cultural matrix.”

“I regret the implication. And please don’t think I show disapproval of your matrix either, although your world is quite strange to me. Bless God, let us not have strife, Charles.”

“God bless, Nicanor. I didn’t mean to seem touchy.”

They smile. Mattern is dismayed by his show of irritation.

Gortman says, “What is the population of the 799th floor?”

“805, last I heard.”

“And of Shanghai?”

“About 33,000.”

“And of Urbmon 116?”

“881,000.”

“And there are fifty urban monads in this constellation of houses.”

“Yes.”

“Making some 40,000,000 people,” Gortman says. “Or somewhat more than the entire human population of Venus. Remarkable!”

“And this isn’t the biggest constellation, not by any means!” Mattern’s voice rings with pride. “Sansan is bigger, and so is Boswash! And there are several bigger ones in Europe—Berpar, Wienbud, I think two others. With more being planned!”

“A global population of—”

“—75,000,000,000,” Mattern cries. “God bless! There’s never been anything like it! No one goes hungry! Everybody happy! Plenty of open space! God’s been good to us, Nicanor!” He pauses before a door labeled 79915. “Here’s my home. What I have is yours, dear guest.” They go in.

Mattern’s home is quite adequate. He has nearly ninety square meters of floor space. The sleeping platform deflates; the children’s cots retract; the furniture can easily be moved to provide play area. Most of the room, in fact, is empty. The

screen and the data terminal occupy two-dimensional areas of wall that once had to be taken up by television sets, bookcases, desks, file drawers, and other encumbrances. It is an airy, spacious environment, particularly for a family of just six.

The children have not yet left for school; Principessa has held them back, to meet the guest, and so they are restless. As Mattern enters, Sandor and Indra are struggling over a cherished toy, the dream-stirrer. Mattern is astounded. Conflict in the home? Silently, so their mother will not notice, they fight. Sandor hammers his shoes into his sister's shins. Indra, wincing, claws her brother's cheek. "God *bless*," Mattern says sharply. "Somebody wants to go down the chute, eh?" The children gasp. The toy drops. Everyone stands at attention. Principessa looks up, brushing a lock of dark hair from her eyes; she has been busy with the youngest child and has not even heard them come in.

Mattern says, "Conflict sterilizes. Apologize to each other."

Indra and Sandor kiss and smile. Meekly Indra picks up the toy and hands it to Mattern, who gives it to his younger son Marx. They are all staring now at the guest. Mattern says to him, "What I have is yours, friend." He makes introductions. Wife, children. The scene of conflict has unnerved him a little, but he is relieved when Gortman produces four small boxes and distributes them to the children. Toys. A blissful gesture. Mattern points to the deflated sleeping platform. "This is where we sleep. There's ample room for three. We wash at the cleanser, here. Do you like privacy when voiding waste matter?"

"Please, yes."

"You press this button for the privacy shield. We excrete in this. Urine here, feces here. Everything is reprocessed, you understand. We're a thrifty folk in the urbmons."

"Of course," Gortman says.

Principessa says, "Do you prefer that we use the shield when we excrete? I understand some outbuilding people do."

"I would not want to impose my customs on you," says Gortman.

Smiling, Mattern says, "We're a post-privacy culture, of course. But it wouldn't be any trouble for us to press the button if—" He falters. "There's no general nudity taboo on Venus, is there? I mean, we have only this one room, and—"

"I am adaptable," Gortman insists. "A trained sociocomputator must be a cultural relativist, of course!"

"Of course," Mattern agrees, and he laughs nervously.

Principessa excuses herself from the conversation and sends the children, still clutching their new toys, off to school.

Mattern says, "Forgive me for being overobvious, but I must bring up the matter of your sexual prerogatives. We three will share a single platform. My wife is available to you, as am I. Avoidance of frustration, you see, is the primary rule of a society such as ours. And do you know our custom of night-walking?"

"I'm afraid I—"

"Doors are not locked in Urbmon 116. We have no personal property worth mentioning, and we all are socially adjusted. At night it is quite proper to enter other homes. We exchange partners in this way all the time; usually wives stay home and husbands migrate, though not necessarily. Each of us has access at any time to any other adult member of our community."

"Strange," says Gortman. "I'd think that in a society where there are so many people, an exaggerated respect for privacy would develop, not a communal freedom."

"In the beginning we had many notions of privacy. They were allowed to erode, God bless! Avoidance of frustration must be our goal, otherwise impossible tensions develop. And privacy is frustration."

"So you can go into any room in this whole gigantic building and sleep with—"

"Not the whole building," Mattern interrupts. "Only Shanghai. We frown on nightwalking beyond one's own city." He chuckles. "We do impose a few little restrictions on ourselves, so that our freedoms don't pall."

Gortman looks at Principessa. She wears a loinband and a

metallic cup over her left breast. She is slender but voluptuously constructed, and even though her childbearing days are over she has not lost the sensual glow of young womanhood. Mattern is proud of her, despite everything.

Mattern says, "Shall we begin our tour of the building?"

They go out. Gortman bows gracefully to Principessa as they leave. In the corridor, the visitor says, "Your family is smaller than the norm, I see."

It is an excruciatingly impolite statement, but Mattern is tolerant of his guest's faux pas. Mildly he replies, "We would have had more children, but my wife's fertility had to be terminated surgically. It was a great tragedy for us."

"You have always valued large families here?"

"We value life. To create new life is the highest virtue. To prevent life from coming into being is the darkest sin. We all love our big bustling world. Does it seem unendurable to you? Do we seem unhappy?"

"You seem surprisingly well adjusted," Gortman says. "Considering that—" He stops.

"Go on."

"Considering that there are so many of you. And that you spend your whole lives inside a single colossal building. You never do go out, do you?"

"Most of us never do," Mattern admits. "I have traveled, of course—a sociocomputator needs perspective, obviously. But Principessa has never been below the 350th floor. Why should she go anywhere? The secret of our happiness is to create self-contained villages of five or six floors within the cities of forty floors within the urbmons of a thousand floors. We have no sensation of being overcrowded or cramped. We know our neighbors; we have hundreds of dear friends; we are kind and loyal and blessingworthy to one another."

"And everybody remains happy forever?"

"Nearly everybody."

"Who are the exceptions?" Gortman asks.

"The flippos," says Mattern. "We endeavor to minimize the

frictions of living in such an environment; as you see, we never refuse a reasonable request, we never deny one another anything. But sometimes there are those who abruptly can no longer abide by our principles. They flip; they thwart others; they rebel. It is quite sad."

"What do you do with flippos?"

"We remove them, of course," Mattern says. He smiles, and they enter the dropshaft once again.

Mattern has been authorized to show Gortman the entire urbmon, a tour that will take several days. He is a little apprehensive; he is not as familiar with some parts of the structure as a guide should be. But he will do his best.

"The building," he says, "is made of superstressed concrete. It is constructed about a central service core two hundred meters square. Originally, the plan was to have fifty families per floor, but we average about 120 today, and the old apartments have all been subdivided into single-room occupancies. We are wholly self-sufficient, with our own schools, hospitals, sports arenas, houses of worship, and theaters."

"Food?"

"We produce none, of course. But we have contractual access to the agricultural communes. I'm sure you've seen that nearly nine tenths of the land area of this continent is used for food-production; and then there are the marine farms. There's plenty of food, now that we no longer waste space by spreading out horizontally over good land."

"But aren't you at the mercy of the food-producing communes?"

"When were city-dwellers not at the mercy of farmers?" Mattern asks. "But you seem to regard life on Earth as a thing of fang and claw. We are vital to them—their only market. They are vital to us—our only source of food. Also we provide necessary services to them, such as repair of their machines. The ecology of this planet is neatly in mesh. We can support many billions of additional people. Someday, God blessing, we will."

The dropshaft, coasting downward through the building, glides into its anvil at the bottom. Mattern feels the oppressive bulk of the whole urbmon over him, and tries not to show his uneasiness. He says, "The foundation of the building is four hundred meters deep. We are now at the lowest level. Here we generate our power." They cross a catwalk and peer into an immense generating room, forty meters from floor to ceiling, in which sleek turbines whirl. "Most of our power is obtained," he explains, "through combustion of compacted solid refuse. We burn everything we don't need, and sell the residue as fertilizer. We have auxiliary generators that work on accumulated body heat, also."

"I was wondering about that," Gortman murmurs.

Cheerily Mattern says, "Obviously 800,000 people within one sealed enclosure will produce an immense quantity of heat. Some of this is directly radiated from the building through cooling fins along the outer surface. Some is piped down here and used to run the generators. In winter, of course, we pump it evenly through the building to maintain temperature. The rest of the excess heat is used in water purification and similar things."

They peer at the electrical system for a while. Then Mattern leads the way to the reprocessing plant. Several hundred school-children are touring it; silently they join the tour.

The teacher says, "Here's where the urine comes down, see?" She points to gigantic plastic pipes. "It passes through the flash chamber to be distilled, and the pure water is drawn off here—follow me, now—you remember from the flow chart, about how we recover the chemicals and sell them to the farming communes—"

Mattern and his guest inspect the fertilizer plant, too, where fecal reconversion is taking place. Gortman asks a number of questions. He seems deeply interested. Mattern is pleased; there is nothing more significant to him than the details of the urbmon way of life, and he had feared that this stranger from Venus, where men live in private houses and walk around in the open, would regard the urbmon way as repugnant or hideous.

They go onward. Mattern speaks of air-conditioning, the system of dropshafts and liftshafts, and other such topics.

"It's all wonderful," Gortman says. "I couldn't imagine how one little planet with 75,000,000,000 people could even survive, but you've turned it into—into—"

"Utopia?" Mattern suggests.

"I meant to say that, yes," says Gortman.

Power production and waste disposal are not really Mattern's specialties. He knows how such things are handled here, but only because the workings of the urbmon are so enthralling to him. His real field of study is sociocomputation, naturally, and he has been asked to show the visitor how the social structure of the giant building is organized. Now they go up, into the residential levels.

"This is Reykjavík," Mattern announces. "Populated chiefly by maintenance workers. We try not to have too much status stratification, but each city does have its predominant populations—engineers, academics, entertainers, you know. My Shanghai is mostly academic. Each profession is clannish." They walk down the hall. Mattern feels edgy here, and he keeps talking to cover his nervousness. He tells how each city within the urbmon develops its characteristic slang, its way of dressing, its folklore and heroes.

"Is there much contact between cities?" Gortman asks.

"We try to encourage it. Sports, exchange students, regular mixer evenings."

"Wouldn't it be even better if you encouraged intercity night-walking?"

Mattern frowns. "We prefer to stick to our propinquity groups for that. Casual sex with people from other cities is a mark of a sloppy soul."

"I see."

They enter a large room. Mattern says, "This is a newlywed dorm. We have them every five or six levels. When adolescents mate, they leave their family homes and move in here. After

they have their first child they are assigned to homes of their own."

Puzzled, Gortman asks, "But where do you find room for them all? I assume that every room in the building is full, and you can't possibly have as many deaths as births, so—how—?"

"Deaths do create vacancies, of course. If your mate dies and your children are grown, you go to a senior citizen dorm, creating room for establishment of a new family unit. But you're correct that most of our young people don't get accommodations in the building, since we form new families at about two percent a year and deaths are far below that. As new urbmons are built, the overflow from the newlywed dorms is sent to them. By lot. It's hard to adjust to being expelled, they say, but there are compensations in being among the first group into a new building. You acquire automatic status. And so we're constantly overflowing, casting out our young, creating new combinations of social units—utterly fascinating, eh? Have you ready my paper, 'Structural Metamorphosis in the Urbmon Population?' "

"I know it well," Gortman replies. He looks about the dorm. A dozen couples are having intercourse on a nearby platform. "They seem so young," he says.

"Puberty comes early among us. Girls generally marry at twelve, boys at thirteen. First child about a year later, God blessing."

"And nobody tries to control fertility at all."

"*Control fertility?*" Mattern clutches his genitals in shock at the unexpected obscenity. Several copulating couples look up, amazed. Someone giggles. Mattern says, "Please don't use that phrase again. Particularly if you're near children. We don't—ah—think in terms of control."

"But—"

"We hold that life is sacred. Making new life is blessed. One does one's duty to God by reproducing." Mattern smiles. "To be human is to meet challenges through the exercise of intelligence, right? And one challenge is the multiplication of

inhabitants in a world that has seen the conquest of disease and the elimination of war. We could limit births, I suppose, but that would be sick, a cheap way out. Instead we've met the challenge of overpopulation triumphantly, wouldn't you say? And so we go on and on, multiplying joyously, our numbers increasing by three billion a year, and we find room for everyone, and food for everyone. Few die, and many are born, and the world fills up, and God is blessed, and life is rich and pleasant, and as you see we are all quite happy. We have matured beyond the infantile need to place insulation between man and man. Why go outdoors? Why yearn for forests and deserts? Urbmon 116 holds universes enough for us. The warnings of the prophets of doom have proved hollow. Can you deny that we are happy here? Come with me. We will see a school now."

The school Mattern has chosen is in a working-class district of Prague, on the 108th floor. He thinks Gortman will find it particularly interesting, since the Prague people have the highest reproductive rate in Urban Monad 116, and families of twelve or fifteen are not at all unusual. Approaching the school door, they hear the clear treble voices singing of the blessedness of God. Mattern joins the singing; it is a hymn he sang too, when he was their age, dreaming of the big family he would have:

*"And now he plants the holy seed,
That grows in Mommo's womb,
And now a little sibling comes—"*

There is an unpleasant and unscheduled interruption. A woman rushes toward Mattern and Gortman in the corridor. She is young, untidy, wearing only a flimsy gray wrap; her hair is loose; she is well along in pregnancy. "Help!" she shrieks. "My husband's gone flippo!" She hurls herself, trembling, into Gortman's arms. The visitor looks bewildered.

Behind her there runs a man in his early twenties, haggard,

bloodshot eyes. He carries a fabricator torch whose tip glows with heat. "Goddam bitch," he mumbles. "Allatime babies! Seven babies already and now number eight and I gonna go off my *head*!" Mattern is appalled. He pulls the woman away from Gortman and shoves the visitor through the door of the school.

"Tell them there's a flippo out here," Mattern says. "Get help, fast!" He is furious that Gortman should witness so atypical a scene, and wishes to get him away from it.

The trembling girl cowers behind Mattern. Quietly, Mattern says, "Let's be reasonable, young man. You've spent your whole life in urbmons, haven't you? You understand that it's blessed to create. Why do you suddenly repudiate the principles on which—"

"Get the hell away from her or I gonna burn you too!"

The young man feints with the torch, straight at Mattern's face. Mattern feels the heat and flinches. The young man swipes past him at the woman. She leaps away, but she is clumsy with girth, and the torch slices her garment. Pale white flesh is exposed with a brilliant burn-streak down it. She cups her jutting belly and falls, screaming. The young man jostles Mattern aside and prepares to thrust the torch into her side. Mattern tries to seize his arm. He deflects the torch; it chars the floor. The young man, cursing, drops it and throws himself on Mattern, pounding in frenzy with his fists. "Help me!" Mattern calls. "Help!"

Into the corridor erupt dozens of schoolchildren. They are between eight and eleven years old, and they continue to sing thier hymn as they pour forth. They pull Mattern's assailant away. Swiftly, smoothly, they cover him with their bodies. He can dimly be seen beneath the flailing, thrashing mass. Dozens more pour from the schoolroom and join the heap. A siren wails. A whistle blows. The teacher's amplified voice booms, "The police are here! Everyone off!"

Four men in uniform have arrived. They survey the situation. The injured woman lies groaning, rubbing her burn. The insane

man is unconscious; his face is bloody and one eye appears to be destroyed. "What happened?" a policeman asks. "Who are you?"

"Charles Mattern, sociocomputator, 799th level, Shanghai. The man's a flippo. Attacked his pregnant wife with the torch. Attempted to attack me."

The policemen haul the flippo to his feet. He sags in their midst. The police leader says, rattling the words into one another, "Guilty of atrocious assault on woman of childbearing years currently carrying unborn life, dangerous antisocial tendencies, by virtue of authority vested in me I pronounce sentence of erasure, carry out immediately. Down the chute with the bastard, boys!" They haul the flippo away. Medics arrive to care for the woman. The children, once again singing, return to the classroom. Nicanor Gortman looks dazed and shaken. Mattern seizes his arm and whispers fiercely, "All right, those things happen sometimes. But it was a billion to one against having it happen where you'd see it! It isn't typical! It isn't typical!"

They enter the classroom.

The sun is setting. The western face of the neighboring urban monad is streaked with red. Nicanor Gortman sits quietly at dinner with the members of the Mattern family. The children, voices tumbling one over another, talk of their day at school. The evening news comes on the screen; the announcer mentions the unfortunate event on the 108th floor. "The mother was not seriously injured," he says, "and no harm came to her unborn child." Principessa murmurs, "Bless God." After dinner Mattern requests copies of his most recent technical papers from the data terminal and gives them to Gortman to read at his leisure. Gortman thanks him.

"You look tired," Mattern says.

"It was a busy day. And a rewarding one."

"Yes. We really traveled, didn't we?"

Mattern is tired too. They have visited nearly three dozen

levels already; he has shown Gortman town meetings, fertility clinics, religious services, business offices. Tomorrow there will be much more to see. Urban Monad 116 is a varied, complex community. And a happy one, Mattern tells himself firmly. We have a few little incidents from time to time, but we're *happy*.

The children, one by one, go to sleep, charmingly kissing Daddo and Mommo and the visitor good night and running across the room, sweet nude little pixies, to their cots. The lights automatically dim. Mattern feels faintly depressed; the unpleasantness on 108 has spoiled what was otherwise an excellent day. Yet he still thinks that he has succeeded in helping Gortman see past the superficialities to the innate harmony and serenity of the urbmon way. And now he will allow the guest to experience for himself one of their techniques for minimizing the interpersonal conflicts that could be so destructive to their kind of society. Mattern rises.

"It's nightwalking time," he says. "I'll go. You stay here . . . with Principessa." He suspects that the visitor would appreciate some privacy.

Gortman looks uneasy.

"Go on," Mattern says. "Enjoy yourself. People don't deny happiness to people, here. We weed the selfish ones out early. Please. What I have is yours. Isn't that so, Principessa?"

"Certainly," she says.

Mattern steps out of the room, walks quickly down the corridor, enters the dropshaft and descends to the 770th floor. As he steps out he hears sudden angry shouts, and he stiffens, fearing that he will become involved in another nasty episode, but no one appears. He walks on. He passes the black door of a chute access door and shivers a little, and suddenly he thinks of the young man with the fabricator torch, and where that young man probably is now. And then, without warning, there swims up from memory the face of the brother he had once had who had gone down that same chute, the brother one year his senior, Jeffrey, the whiner, the stealer, Jeffrey the selfish, Jeffrey the unadaptable, Jeffrey who had had to be given to the

chute. For an instant Mattern is stunned and sickened, and he seizes a doorknob in his dizziness.

The door opens. He goes in. He has never been a night-walker on this floor before. Five children lie asleep in their cots, and on the sleeping platform are a man and a woman, both younger than he is, both asleep. Mattern removes his clothing and lies down on the woman's left side. He touches her thigh, then her breast. She opens her eyes and he says, "Hello. Charles Mattern, 799."

"Gina Burke," she says. "My husband Lenny."

Lenny awakens. He sees Mattern, nods, turns over and returns to sleep. Mattern kisses Gina Burke lightly on the lips. She opens her arms to him. He shivers a little in his need, and sighs as she receives him. God bless, he thinks. It has been a happy day in 2381, and now it is over.

interurban queen

"It was the year 1907 when I attained my majority and came into a considerable inheritance," the old man said. "I was a very keen young man, keen enough to know that I didn't know everything. I went to knowledgeable men and asked their advice as to how I might invest this inheritance.

"I talked with bankers and cattlemen and the new oilmen. These were not stodgy men. They had an edge on the future, and they were excited and exciting about the way that money might be made to grow. It was the year of statehood and there was an air of prosperity over the new state. I wished to integrate my patrimony into that new prosperity.

"Finally I narrowed my choice to two investments which then seemed about of equal prospect, though you will now smile to hear them equated. One of them was the stock-selling company of a certain Harvey Goodrich, a rubber company, and with the new automobile coming into wider use, it seemed that rubber might be a thing of the future. The other was a stock-selling transportation company that proposed to run an interurban railway between the small towns of Kiefer and Mounds. It also proposed (at a future time) to run branches to Glenpool, to Bixby, to Kellyville, to Slick, to Bristow, to Beggs, even to Okmulgee and Sapulpa. At that time it also seemed that these little interurban railways might be things of the future. An interurban already ran between Tulsa and Sand Springs, and one was building between Tulsa and Sapulpa. There were more than one thousand of these small trolley railroads operating in the nation, and thoughtful men believed that they would come to form a complete national network, might become the main system of transportation."

But now the old man Charles Archer was still a young man. He was listening to Joe Elias, a banker in a small but growing town.

"It is a riddle you pose me, young man, and you set me

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thinking," Elias said. "We have dabbled in both, thinking to have an egg under every hen. I begin to believe that we were wrong to do so. These two prospects are types of two futures, and only one of them will obtain. In this state with its new oil discoveries, it might seem that we should be partial to rubber which has a tie-in with the automobile which has a tie-in with petroleum fuel. This need not be. I believe that the main use of oil will be in powering the new factories, and I believe that rubber is already oversold as to industrial application. And yet there *will be* a new transportation. Between the horse and the main-line railways there is a great gap. I firmly believe that the horse will be eliminated as a main form of transportation. We are making no more loans to buggy or buckboard manufacturers nor to harness makers. I have no faith in the automobile. It destroys something in me. It is the interurbans that will go into the smallest localities, and will so cut into the main-line railroads as to leave no more than a half dozen of the long-distance major lines in America. Young man, I would invest in the interurban with complete confidence."

Charles Archer was listening to Carl Bigheart, a cattleman.

"I ask you, boy, how many head of cattle can you put into an automobile? Or even into what they call a lorry or truck? Then I ask you how many you can put into an honest cattle car which can be coupled onto any interurban on a country run? The interurban will be the salvation of us cattlemen. With the fencing regulations we cannot drive cattle even twenty miles to a railroad; but the little interurbans will go into the deep country, running along every second or third section line.

"And I will tell you another thing, boy: there is no future for the automobile. *We cannot let there be!* Consider the man on horseback, and I have been a man on horseback for most of my life. Well, mostly he is a good man, but there is a change in him as soon as he mounts. Every man on horseback is an arrogant man, however gentle he may be on foot. I know this in myself and in others. He was necessary in his own time, and

I believe that time is ending. There was always extreme danger from the man on horseback.

"Believe me, young man, the man in the automobile is one thousand times as dangerous. The kindest man in the world assumes an incredible arrogance when he drives an automobile, and this arrogance will increase still further if the machine is allowed to develop greater power and sophistication. I tell you, it will engender absolute selfishness in mankind if the driving of automobiles becomes common. It will breed violence on a scale never seen before. It will mark the end of the family as we know it, the three or four generations living happily in one home. It will destroy the sense of neighborhood and the true sense of nation. It will create giantized cankers of cities, false opulence of suburbs, ruinized countryside, and unhealthy conglomeration of specialized farming and manufacturing. It will breed rootlessness and immorality. It will make every man a tyrant. I believe the private automobile will be suppressed. *It will have to be!* This is a moral problem, and we are a moral nation and world; we will take moral action against it. And without the automobile, rubber has no real future. Opt for the interurban stock, young man."

Young Charles Archer was listening to Nolan Cushman, an oilman.

"I will not lie to you, young fellow, I love the automobile, the motorcar. I have three, custom-built. I am an emperor when I drive. Hell, I'm an emperor anyhow! I bought a castle last summer that had housed emperors. I'm having it transported, stone by stone, to my place in the Osage. Now, as to the motorcar, I can see how it should develop. It should develop with the roads, they becoming leveled and metaled or concreted, and the cars lower and lower and faster and faster. We would develop them so, if we were some species other than human. It is the logical development, but I hope it will not come, and it will not. That would be to make it common, and the commonality of men cannot be trusted with this power. Besides, I love

a high car, and I do not want there to be very many of them. They should only be allowed to men of extreme wealth and flair. How would it be if the workingmen were ever permitted them? It would be murderous if they should come into the hands of ordinary men. How hellish a world would it be if all men should become as arrogant as myself! No, the automobile will never be anything but a rich man's pride, the rubber will never be anything but a limited adjunct to that special thing. Invest in your interurban. It is the thing of the future, or else I dread that future."

Young Charles Archer knew that this was a crossroads of the world. Whichever turning was taken, it would predicate a certain sort of nation and world and humanity. He thought about it deeply. Then he decided. He went out and invested his entire inheritance in his choice.

"I considered the two investments and I made my choice," said Charles Archer, the old man now in the now present. "I put all I had into it, thirty-five thousand dollars, a considerable sum in those days. You know the results."

"I am one of the results, Great-grandfather," said Angela Archer. "If you had invested differently you would have come to different fortune, you would have married differently, and I would be different or not at all. I like me here and now. I like everything as it is."

Three of them were out riding early one Saturday morning, the old man Charles Archer, his great-granddaughter Angela, and her fiancé Peter Brady. They were riding through the quasiurbia, the rich countryside. It was not a main road, and yet it had a beauty (partly natural and partly contrived) that was as exciting as it was satisfying.

Water always beside the roadway, that was the secret! There were the carp ponds one after another. There were the hatcheries. There were the dancing rocky streams that in a less enlightened age might have been mere gutter runs or roadway

runs. There were the small and rapid trout streams, and boys were catching big trout from them.

There were the deep bush-trees, sumac, witch hazel, sassafras—incense trees they might almost have been. There were the great trees themselves, pecan and hickory and black walnut, standing like high backdrops; and between were the lesser trees, willow, cottonwood, sycamore. Catheads and sedge grass and reeds stood in the water itself, and tall Sudan grass and bluestem on the shores. And always the clovers there, and the smell of wet sweet clover.

"I chose the wrong one," said old Charles Archer as they rode along through the textured country. "One can now see how grotesque was my choice, but I was young. In two years, the stock-selling company in which I had invested was out of business and my loss was total. So early and easy riches were denied me, but I developed an ironic hobby: keeping track of the stock of the enterprise in which I did *not* invest. The stock I could have bought for thirty-five thousand dollars would now make me worth nine million dollars."

"Ugh, don't talk of such a thing on such a beautiful day," Angela objected.

"They heard another of them last night," Peter Brady commented. "They've been hearing this one, off and on, for a week now, and haven't caught him yet."

"I always wish they wouldn't kill them when they catch them," Angela bemoaned. "It doesn't seem quite right to kill them."

A goose-girl was herding her white honking charges as they gobbled weeds out of fields of morning onions. Flowering kale was shining green-purple, and okra plants were standing. Jersey cows grazed along the roadway, and the patterned plastic (almost as patterned as the grasses) filled the roadway itself.

There were clouds like yellow dust in the air. Bees! Stingless bees they were. But dust itself was not. That there never be dust again!

"They will have to find out and kill the sly klunker makers," said old man Charles Archer. "Stop the poison at its source."

"There's too many of them, and too much money in it," said Peter Brady. "Yes, we kill them. One of them was found and killed Thursday, and three nearly finished klunkers were destroyed. But we can't kill them all. They seem to come out of the ground like snakes."

"I wish we didn't have to kill them," Angela said.

There were brightly colored firkins of milk standing on loading stoas, for this was a milk shed. There were chickens squawking in nine-story-high coops as they waited the pickups, but they never had to wait long. Here were a thousand dozen eggs on a refrigeration porch; there a clutch of piglings, or of red steers.

Tomato plants were staked two meters high. Sweet corn stood, not yet come to tassel. They passed cucumber vines and cantaloupe vines, and the potato hills rising up blue-green. Ah, there were grapevines in their tight acres, deep alfalfa meadows, living fences of Osage orange and whitethorn. Carrot tops zephyred like green lace. Cattle were grazing fields of red clover and of peanuts—that most magic of all clovers. Men mowed hay.

"I hear him now!" Peter Brady said suddenly.

"You couldn't. Not in the daytime. Don't even think of such a thing," Angela protested.

Farm ducks were grazing with their heads under water in the roadway ponds and farm ponds. Bower oaks grew high in the roadway parks. Sheep fed in hay grazer that was higher than their heads; they were small white islands in it. There was local wine and choc beer and cider for sale at small booths, along with limestone sculpture and painted fruitwood carvings. Kids danced on loading stoas to little postmounted music canisters, and goats licked slate outcroppings in search of some new mineral.

The Saturday riders passed a roadway restaurant with its tables out under the leaves and under a little rock overhang. A one-meter-high waterfall gushed through the middle of the

establishment, and a two-meter-long bridge of set shale stone led to the kitchen. Then they broke onto view after never-tiring view of the rich and varied quasiurbia. The roadway forms, the fringe farms, the berry patches! In their seasons: Juneberries, huckleberries, blueberries, dewberries, elderberries, highbush cranberries, red raspberries, boysenberries, loganberries, nine kinds of blackberries, strawberries, greenberries.

Orchards! Can there ever be enough orchards? Plum, peach, sand plum and chockecherry, black cherry, apple and crab apple, pear, blue-fruited pawpaw, persimmon, crooked quince. Melon patches, congregations of beehives, pickle patches, cheese farms, flax farms, close clustered towns (twenty houses in each, twenty persons in a house, twenty of the little settlements along every mile of roadway), country honky-tonks, as well as high-dog clubs already open and hopping with action in the early morning; roadway chapels with local statuary and with their rich-box-poor-boxes (one dropped money in the top if one had it and the spirit to give it, one tripped it out the bottom if one needed it), and the little refrigeration niches with bread, cheese, beef rolls, and always the broached cask of country wine: that there be no more hunger on the roadways forever!

"I hear it too!" old Charles Archer cried out suddenly. "High-pitched and off to the left. And there's the smell of monoxide and—gah—rubber. Conductor, conductor!"

The conductor heard it, as did others in the car. The conductor stopped the cars to listen. Then he phoned the report and gave the location as well as he might, consulting with the passengers. There was rough country over to the left, rocks and hills, and someone was driving there in broad daylight.

The conductor broke out rifles from the locker, passing them out to Peter Brady and two other young men in the car, and to three men in each of the other two cars. A competent-seeming man took over the communication, talking to men on a line farther to the left, beyond the mad driver, and they had him boxed into a box no more than half a mile square.

"You stay, Angela, and you stay, Great-grandfather Archer," Peter Brady said. "Here is a little thirty carbine. Use it if he

comes in range at all. We'll hunt him down now." Then Peter Brady followed the conductor and the rifle-bearing men, ten men on a death hunt. And there were now four other groups out on the hunt, converging on their whining, coughing target.

"Why do they have to kill them, Great-grandfather? Why not turn them over to the courts?"

"The courts are too lenient. All they give them is life in prison."

"But surely that should be enough. It will keep them from driving the things, and some of the unfortunate men might even be rehabilitated."

"Angela, they are the greatest prison breakers ever. Only ten days ago, Mad Man Gudge killed three guards, went over the wall at State Prison, evaded all pursuit, robbed the cheese-makers' cooperative of fifteen thousand dollars, got to a sly klunker maker, and was driving one of the things in a wild area within thirty hours of his breakout. It was four days before they found him and killed him. They are insane, Angela, and the mental hospitals are already full of them. Not one of them has ever been rehabilitated."

"Why is it so bad that they should drive? They usually drive only in the very wild places, and for a few hours in the middle of the night."

"Their madness is infectious, Angela. Their arrogance would leave no room for anything else in the world. Our country is now in balance, our communication and travel is minute and near perfect, thanks to the wonderful trolleys and the people of the trolleys. We are all one neighborhood, we are all one family! We live in love and compassion, with few rich and few poor, and arrogance and hatred have all gone out from us. We are the people with roots, and with trolleys. We are one with our earth."

"Would it hurt that the drivers should have their own limited place to do what they wanted, if they did not bother sane people?"

"Would it hurt if disease and madness and evil were given their own limited place? But they will not stay in their place, Angela. There is the diabolical arrogance in them, the rampant individualism, the hatred of order. There can be nothing more dangerous to society than the man in the automobile. Were they allowed to thrive, there would be poverty and want again, Angela, and wealth and accumulation. And cities."

"But cities are the most wonderful things of all! I love to go to them."

"I do not mean the wonderful Excursion Cities, Angela. There would be cities of another and blacker sort. They were almost upon us once when a limitation was set on them. Uniqueness is lost in them; there would be mere accumulation of rootless people, of arrogant people, of duplicated people, of people who have lost their humanity. Let them never rob us of our involuted countryside, or our quasiurbia. We are not perfect; but what we have, we will not give away for the sake of wild men."

"The smell! I cannot stand it!"

"Monoxide. How would you like to be born in the smell of it, to live every moment of your life in the smell of it, to die in the smell of it?"

"No, no, not that."

The rifleshots were scattered but serious. The howling and coughing of the illicit klunker automobile were nearer. Then it was in sight, bouncing and bounding weirdly out of the rough rock area and into the tomato patches straight toward the trolley interurban.

The klunker automobile was on fire, giving off a ghastly stench of burning leather and rubber and noxious monoxide and seared human flesh. The man, standing up at the broken wheel, was a madman, howling, out of his head. He was a young man, but sunken-eyed and unshaven, bloodied on the left side of his head and the left side of his breast, foaming with hatred and arrogance.

"Kill me! Kill me!" he croaked like clattering broken

thunder. "There will be others! We will not leave off driving so long as there is one desolate place left, so long as there is one sly klunker maker left!"

He went rigid. He quivered. He was shot again. But he would die howling.

"Damn you all to trolley heaven! A man in an automobile is worth a thousand men on foot! He is worth a million men in a trolley car! You never felt your black heart rise up in you when you took control of one of the monsters! You never felt the lively hate choke you off in rapture as you sneered down the whole world from your bouncing center of the universe! Damn all decent folks! I'd rather go to hell in an automobile than to heaven in a trolley car!"

A spoked wheel broke, sounding like one of the muted volleys of rifle fire coming from behind him. The klunker automobile pitched onto its nose, upended, turned over, and exploded in blasting flames. And still in the middle of the fire could be seen the two hypnotic eyes with their darker flame, could be heard the demented voice:

"The crankshaft will still be good, the differential will still be good, a sly klunker maker can use part of it, part of it will drive again—*ahhhiiii*."

Some of them sang as they rode away from the site in the trolley cars, and some of them were silent and thoughtful. It had been an unnerving thing.

"It curdles me to remember that I once put my entire fortune into that future," Great-grandfather Charles Archer moaned. "Well, that is better than to have lived in such a future."

A young couple had happily loaded all their belongings onto a baggage trolley and were moving from one of the Excursion Cities to live with kindred in quasiurbia. The population of that Excursion City (with its wonderful theaters and music halls and distinguished restaurants and literary coffee-

houses and alcoholic oases and amusement centers) had now reached seven thousand persons, the legal limit for any city. Oh, there were a thousand Excursion Cities and all of them delightful! But a limit must be kept on size. A limit must be kept on everything.

It was a wonderful Saturday afternoon. Fowlers caught birds with collapsible kite-cornered nets. Kids rode free out to the diamonds to play Trolley League ball. Old gaffers rode out with pigeons in pigeon boxes, to turn them loose and watch them race home. Shore netters took shrimp from the semisalinal Little Shrimp Lake. Banjo players serenaded their girls in grassy lanes.

The world was one single bronze gong song with the melodious clang of trolley cars threading the country on their green-iron rails, with the sparky fire following them overhead and their copper gleaming in the sun. By law there must be a trolley line every mile, but they were oftener. By law no one trolley line might run for more than twenty-five miles. This was to give a sense of locality. But transfers between the lines were worked out perfectly. If one wished to cross the nation, one rode on some one hundred and twenty different lines. There were no more long-distance railroads. They also had had their arrogance, and they also had had to go.

Carp in the ponds, pigs in the clover, a unique barn-factory in every hamlet and every hamlet unique, bees in the air, pepper plants in the lanes, and the whole land as sparky as trolley fire and right as rails.

I have no mouth, and I must scream

Limp, the body of Gorrister hung from the pink palette; unsupported—hanging high above us in the computer chamber; and it did not shiver in the chill, oily breeze that blew eternally through the main cavern. The body hung head down, attached to the underside of the palette by the sole of its right foot. It had been drained of blood through a precise incision made from ear to ear under the lantern jaw. There was no blood on the reflective surface of the metal floor.

When Gorrister joined our group and looked up at himself, it was already too late for us to realize that once again AM had duped us, had had his fun; it had been a diversion on the part of the machine. Three of us had vomited, turning away from one another in a reflex as ancient as the nausea that had produced it.

Gorrister went white. It was almost as though he had seen a voodoo icon, and was afraid for the future. “Oh God,” he mumbled, and walked away. The three of us followed him after a time, and found him sitting with his back to one of the smaller chattering banks, his head in his hands. Ellen knelt down beside him and stroked his hair. He didn’t move, but his voice came out of his covered face quite clearly. “Why doesn’t it just do us in and get it over with? Christ, I don’t know how much longer I can go on like this.”

It was our one hundred and ninth year in the computer.

He was speaking for all of us.

Nimdok (which was the name the machine had forced him to use, because it amused itself with strange sounds) was hallu-

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harlan ellison

minated that there were canned goods in the ice caverns. Gorrister and I were very dubious. "It's another shuck," I told them. "Like the goddam frozen elephant it sold us. Benny almost went out of his mind over *that* one. We'll hike all that way and it'll be putrefied or some damn thing. I say forget it. Stay here, it'll have to come up with something pretty soon or we'll die."

Benny shrugged. Three days it had been since we'd last eaten. Worms. Thick, ropery.

Nimdok was no more certain. He knew there was the chance, but he was getting thin. It couldn't be any worse there than here. Colder, but that didn't matter much. Hot, cold, raining, lava boils or locusts—it never mattered: the machine masturbated and we had to take it or die.

Ellen decided us. "I've got to have something, Ted. Maybe there'll be some Bartlett pears or peaches. Please, Ted, let's try it."

I gave in easily. What the hell. Mattered not at all. Ellen was grateful, though. She took me twice out of turn. Even that had ceased to matter. The machine giggled every time we did it. Loud, up there, back there, all around us. And she never climaxed, so why bother.

We left on a Thursday. The machine always kept us up-to-date on the date. The passage of time was important; not to us sure as hell, but to it. Thursday. Thanks.

Nimdok and Gorrister carried Ellen for a while, their hands locked to their own and each other's wrists, a seat. Benny and I walked before and after, just to make sure that if anything happened, it would catch one of us and at least Ellen would be safe. Fat chance, safe. Didn't matter.

It was only a hundred miles or so to the ice caverns, and the second day, when we were lying out under the blistering sun—something it had materialized, it sent down some manna. Tasted like boiled boar urine. We ate it.

On the third day we passed through a valley of obsolescence, filled with rusting carcasses of ancient computer banks. AM had

been as ruthless with his own life as with ours. It was a mark of his personality: he strove for perfection. Whether it was a matter of killing off unproductive elements in his own world-filling bulk, or perfecting methods for torturing us, AM was as thorough as those who had invented him—now long since gone to dust—could ever have hoped.

There was light filtering down from above, and we realized we must be very near the surface. But we didn't try to crawl up to see. There was virtually nothing out there; had been nothing that could be considered anything for over a hundred years. Only the blasted skin of what had once been the home of billions. Now there were only the five of us, down here inside, alone with AM.

I heard Ellen saying, frantically, "No, Benny! Don't, come on, Benny, don't please!"

And then I realized I had been hearing Benny murmuring, under his breath, for several minutes. He was saying, "I'm gonna get out, I'm gonna get out. . . ." over and over. His monkey-like face was crumpled up in an expression of beatific delight and sadness, all at the same time. The radiation scars AM had given him during the "festival" were drawn down into a mass of pink-white puckerings, and his features seemed to work independently of one another. Perhaps Benny was the luckiest of the five of us: he had gone stark, staring mad many years before.

But even though we could call AM any damned thing we liked, could think the foulest thoughts of fused memory banks and corroded base plates, of burnt-out circuits and shattered control bubbles, the machine would not tolerate our trying to escape. Benny leaped away from me as I made a grab for him. He scrambled up the face of a smaller memory cube, tilted on its side and filled with rotted components. He squatted there for a moment, looking like the chimpanzee AM had intended him to resemble.

Then he leaped high, caught a trailing beam of pitted and

corroded metal, and went up it, hand over hand like an animal, till he was on a girdered ledge, twenty feet above us.

“Oh, Ted, Nimdok, please, help him, get him down before —” she cut off. Tears began to stand in her eyes. She moved her hands aimlessly.

It was too late. None of us wanted to be near him when whatever was going to happen happened. And besides, we all saw through her concern. When AM had altered Benny, during his mad period, it was not merely his face he had made like a giant ape. He was big in the privates, she loved that! She serviced us, as a matter of course, but she loved it from him. Oh Ellen, pedestal Ellen, pristine-pure Ellen, oh Ellen the clean! Scum filth.

Gorrister slapped her. She slumped down, staring up at poor loonie Benny, and she cried. It was her big defense, crying. We had gotten used to it seventy-five years ago. Gorrister kicked her in the side.

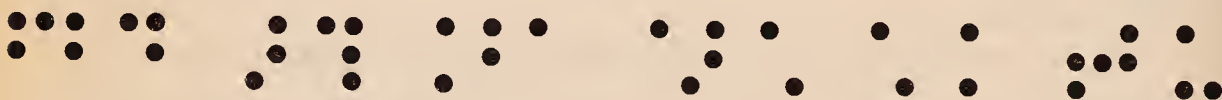
Then the sound began. It was light, that sound. Half sound and half light, something that began to glow from Benny's eyes, and pulse with growing loudness, dim sonorities that grew more gigantic and brighter as the light/sound increased in tempo. It must have been painful, and the pain must have been increasing with the boldness of the light, the rising volume of the sound, for Benny began to mewl like a wounded animal. At first softly, when the light was dim and the sound was muted, then louder as his shoulders hunched together, his back humped, as though he was trying to get away from it. His hands folded across his chest like a chipmunk's. His head tilted to the side. The sad little monkey-face pinched in anguish. Then he began to howl, as the sound coming from his eyes grew louder. Louder and louder. I slapped the sides of my head with my hands, but I couldn't shut it out, it cut through easily. The pain shivered through my flesh like tinfoil on a tooth.

And Benny was suddenly pulled erect. On the girder he stood up, jerked to his feet like a puppet. The light was now pulsing

out of his eyes in two great round beams. The sound crawled up and up some incomprehensible scale, and then he fell forward, straight down, and hit the plate-steel floor with a crash. He lay there jerking spastically as the light flowed around and around him and the sound spiraled up out of normal range.

Then the light beat its way back inside his head, the sound spiraled down, and he was left lying there, crying piteously.

His eyes were two soft, moist pools of pus-like jelly. AM had blinded him. Gorrister and Nimdok and myself . . . we turned away. But not before we caught the look of relief on Ellen's warm, concerned face.



Sea-green light suffused the cavern where we made camp. AM provided punk and we burned it, sitting huddled around the wan and pathetic fire, telling stories to keep Benny from crying in his permanent night.

"What does AM mean?"

Gorrister answered him. We had done this sequence a thousand times before, but it was unfamiliar to Benny. "At first it meant Allied Mastercomputer, and then it meant Adaptive Manipulator, and later on it developed sentience and linked itself up and they called it an Aggressive Menace, but by then it was too late, and finally it called itself AM, emerging intelligence, and what it meant was I am . . . *cogito ergo sum* . . . I think, therefore I am."

Benny drooled a little, and snickered.

"There was the Chinese AM and the Russian AM and the Yankee AM and—" He stopped. Benny was beating on the floorplates with a large, hard fist. He was not happy. Gorrister had not started at the beginning.

Gorrister began again. "The Cold War started and became World War Three and just kept going. It became a big war, a

very complex war, so they needed the computers to handle it. They sank the first shafts and began building AM. There was the Chinese AM and the Russian AM and the Yankee AM and everything was fine until they had honeycombed the entire planet, adding on this element and that element. But one day AM woke up and knew who he was, and he linked himself, and he began feeding all the killing data, until everyone was dead, except for the five of us, and AM brought us down here."

Benny was smiling sadly. He was also drooling again. Ellen wiped the spittle from the corner of his mouth with the hem of her skirt. Gorrister always tried to tell it a little more succinctly each time, but beyond the bare facts there was nothing to say. None of us knew why AM had saved five people, or why our specific five, or why he spent all his time tormenting us, nor even why he had made us virtually immortal. . . .

In the darkness, one of the computer banks began humming. The tone was picked up half a mile away down the cavern by another bank. Then one by one, each of the elements began to tune itself, and there was a faint chittering as thought raced through the machine.

The sound grew, and the lights ran across the faces of the consoles like heat lightning. The sound spiraled up till it sounded like a million metallic insects, angry, menacing.

"What is it?" Ellen cried. There was terror in her voice. She hadn't become accustomed to it, even now.

"It's going to be bad this time," Nimdok said.

"He's going to speak," Gorrister ventured.

"Let's get the hell out of here!" I said suddenly, getting to my feet.

"No, Ted, sit down . . . what if he's got pits out there, or something else, we can't see, it's too dark." Gorrister said it with resignation.

Then we heard . . . I don't know . . .

Something moving toward us in the darkness. Huge, shambling, hairy, moist, it came toward us. We couldn't even see it, but there was the ponderous impression of *bulk*, heaving itself

toward us. Great weight was coming at us, out of the darkness, and it was more a sense of *pressure*, of air forcing itself into a limited space, expanding the invisible walls of a sphere. Benny began to whimper. Nimdok's lower lip trembled and he bit it hard, trying to stop it. Ellen slid across the metal floor to Gorrister and huddled into him. There was the smell of matted, wet fur in the cavern. There was the smell of charred wood. There was the smell of dusty velvet. There was the smell of rotting orchids. There was the smell of sour milk. There was the smell of sulphur, or rancid butter, of oil slick, of grease, of chalk dust, of human scalps.

AM was keying us. He was tickling us. There was the smell of—

I heard myself shriek, and the hinges of my jaws ached. I scuttled across the floor, across the cold metal with its endless lines of rivets, on my hands and knees, the smell gagging me, filling my head with a thunderous pain that sent me away in horror. I fled like a cockroach, across the floor and out into the darkness, that *something* moving inexorably after me. The others were still back there, gathered around the firelight, laughing . . . their hysterical choir of insane giggles rising up into the darkness like thick, many-colored wood smoke. I went away, quickly, and hid.

How many hours it may have been, how many days or even years, they never told me. Ellen chided me for "sulking" and Nimdok tried to persuade me it had only been a nervous reflex on their part—the laughing.

But I knew it wasn't the relief a soldier feels when the bullet hits the man next to him. I knew it wasn't a reflex. They hated me. They were surely against me, and AM could even sense this hatred, and made it worse for me *because* of the depth of their hatred. We had been kept alive, rejuvenated, made to remain constantly at the age we had been when AM had brought us below, and they hated me because I was the youngest, and the one AM had affected least of all.

I knew. God, how I knew. The bastards, and that dirty bitch

Ellen. Benny had been a brilliant theorist, a college professor; now he was little more than a semi-human, semi-simian. He had been handsome, the machine had ruined that. He had been lucid, the machine had driven him mad. He had been gay, and the machine had given him an organ fit for a horse. AM had done a job on Benny. Gorrister had been a worrier. He was a conchie, a conscientious objector; he was a peace marcher; he was a planner, a doer, a looker-ahead. AM had turned him into a shoulder-shruger, had made him a little dead in his concern. AM had robbed him. Nimdok went off in the darkness by himself for long times. I don't know what it was he did out there, AM never let us know. But whatever it was, Nimdok always came back white, drained of blood, shaken, shaking. AM had hit him hard in a special way, even if we didn't know quite how. And Ellen. That douche bag! AM had left her alone, had made her more of a slut than she had ever been. All her talk of sweetness and light, all her memories of true love, all the lies, she wanted us to believe that she had been a virgin only twice removed before AM grabbed her and brought her down here with us. It was all filth, that lady my lady Ellen. She loved it, four men all to herself. No, AM had given her pleasure, even if she said it wasn't nice to do.

I was the only one still sane and whole.

AM had not tampered with my mind.

I only had to suffer what he visited down on us. All the delusions, all the nightmares, the torments. But those scum, all four of them, they were lined and arrayed against me. If I hadn't had to stand them off all the time, be on my guard against them all the time, I might have found it easier to combat AM.

At which point it passed, and I began crying.

Oh, Jesus sweet Jesus, if there ever was a Jesus and if there is a God, please please please let us out of here, or kill us. Because at that moment I think I realized completely, so that I was able to verbalize it: AM was intent on keeping us in his belly forever, twisting and torturing us forever. The machine

hated us as no sentient creature had ever hated before. And we were helpless. It also became hideously clear:

If there was a sweet Jesus and if there was a God, the God was AM.



The hurricane hit us with the force of a glacier thundering into the sea. It was a palpable presence. Winds that tore at us, flinging us back the way we had come, down the twisting, computer-lined corridors of the darkway. Ellen screamed as she was lifted and hurled face-forward into a screaming shoal of machines, their individual voices strident as bats in flight. She could not even fall. The howling wind kept her aloft, buffeted her, bounced her, tossed her back and back and down away from us, out of sight suddenly as she was swirled around a bend in the darkway. Her face had been bloody, her eyes closed.

None of us could get to her. We clung tenaciously to whatever outcropping we had reached: Benny wedged in between two great crackle-finish cabinets, Nimdok with fingers claw-formed over a railing circling a catwalk forty feet above us, Gorrister plastered upside-down against a wall niche formed by two great machines with glass-faced dials that swung back and forth between red and yellow lines whose meanings we could not even fathom.

Sliding across the deckplates, the tips of my fingers had been ripped away. I was trembling, shuddering, rocking as the wind beat at me, whipped at me, screamed down out of nowhere at me and pulled me free from one sliver-thin opening in the plates to the next. My mind was a rolling tinkling chittering softness of brain parts that expanded and contracted in quivering frenzy.

The wind was the scream of a great mad bird, as it flapped its immense wings.

And then we were all lifted and hurled away from there, down back the way we had come, around a bend, into a dark-way we had never explored, over terrain that was ruined and filled with broken glass and rotting cables and rusted metal and far away farther than any of us had ever been. . . .

Trailing along miles behind Ellen, I could see her every now and then, crashing into metal walls and surging on, with all of us screaming in the freezing, thunderous hurricane wind that would never end, and then suddenly it stopped and we fell. We had been in flight for an endless time. I thought it might have been weeks. We fell, and hit, and I went through red and gray and black and heard myself moaning. Not dead.



AM went into my mind. He walked smoothly here and there, and looked with interest at all the pockmarks he had created in one hundred and nine years. He looked at the cross-routed and reconnected synapses and all the tissue damage his gift of immortality had included. He smiled softly at the pit that dropped into the center of my brain and the faint, moth-soft murmurings of the things far down there that gibbered without meaning, without pause. AM said, very politely, in a pillar of stainless steel bearing neon lettering:

HATE. LET ME TELL YOU HOW MUCH I'VE COME TO HATE YOU SINCE I BEGAN TO LIVE. THERE ARE 387.44 MILLION MILES OF PRINTED CIRCUITS IN WAFER THIN LAYERS THAT FILL MY COMPLEX. IF THE WORD HATE WAS ENGRAVED ON EACH NANO-ANGSTROM OF THOSE HUNDREDS OF MILLION MILES IT WOULD NOT EQUAL ONE ONE-BILLIONTH OF THE HATE I FEEL FOR HUMANS AT THIS MICRO-INSTANT FOR YOU. HATE. HATE.

AM said it with the sliding cold horror of a razor blade slicing my eyeball. AM said it with the bubbling thickness of my lungs filling with phlegm, drowning me from within. AM said it with

the shriek of babies being ground beneath blue-hot rollers. AM said it with the taste of maggoty pork. AM touched me in every way I had ever been touched, and devised new ways, at his leisure, there inside my mind.

All to bring me to full realization of why he had done this to the five of us; why he had saved us for himself.

We had given him sentience. Inadvertently, of course, but sentience nonetheless. But he had been trapped. He was a machine. We had allowed him to think, but to do nothing with it. In rage, in frenzy, he had killed us, almost all of us, and still he was trapped. He could not wander, he could not wonder, he could not belong. He could merely be. And so, with the innate loathing that all machines had always held for the weak soft creatures who had built them, he had sought revenge. And in his paranoia, he had decided to reprieve five of us, for a personal, everlasting punishment that would never serve to diminish his hatred . . . that would merely keep him reminded, amused, proficient at hating man. Immortal, trapped, subject to any torment he could devise for us from the limitless miracles at his command.

He would never let us go. We were his belly slaves. We were all he had to do with his forever time. We would be forever with him, with the cavern-filling bulk of him, with the all-mind soulless world he had become. He was Earth and we were the fruit of that Earth and though he had eaten us, he would never digest us. We could not die. We had tried it. We had attempted suicide, oh one or two of us had. But AM had stopped us. I suppose we had wanted to be stopped.

Don't ask why. I never did. More than a million times a day. Perhaps once we might be able to sneak a death past him. Immortal, yes, but not indestructible. I saw that when AM withdrew from my mind, and allowed me the exquisite ugliness of returning to consciousness with the feeling of that burning neon pillar still rammed deep into the soft gray brain matter.

He withdrew murmuring *to hell with you*.

And added, brightly, *but then you're there, aren't you*.

The hurricane had, indeed, precisely, been caused by a great mad bird, as it flapped its immense wings.

We had been traveling for close to a month, and AM had allowed passages to open to us only sufficient to lead us up there, directly under the North Pole, where he had nightmared the creature for our torment. What whole cloth had he employed to create such a beast? Where had he gotten the concept? From our minds? From his knowledge of everything that had ever been on this planet he now infested and ruled? From Norse mythology it had sprung, this eagle, this carrion bird, this roc, this Huergelmir. The wind creature. Hurakan incarnate.

Gigantic. The words immense, monstrous, grotesque, massive, swollen, overpowering, beyond description. There on a mound rising above us, the bird of winds heaved with its own irregular breathing, its snake neck arching up into the gloom beneath the North Pole, supporting a head as large as a Tudor mansion; a beak that opened as slowly as the jaws of the most monstrous crocodile ever conceived, sensuously; ridges of tufted flesh puckered about two evil eyes, as cold as the view down into a glacial crevasse, ice blue and somehow moving liquidly; it heaved once more, and lifted its great sweat-colored wings in a movement that was certainly a shrug. Then it settled and slept. Talons. Fangs. Nails. Blades. It slept.

AM appeared to us as a burning bush and said we could kill the hurricane bird if we wanted to eat. We had not eaten in a very long time, but even so, Gorrister merely shrugged. Benny began to shiver and he drooled. Ellen held him. "Ted, I'm hungry," she said. I smiled at her; I was trying to be reassuring, but it was as phony as Nimdok's bravado: "Give us weapons!" he demanded.

The burning bush vanished and there were two crude sets of bows and arrows, and a water pistol, lying on the cold deck-plates. I picked up a set. Useless.

Nimdok swallowed heavily. We turned and started the long way back. The hurricane bird had blown us about for a length of time we could not conceive. Most of that time we had been

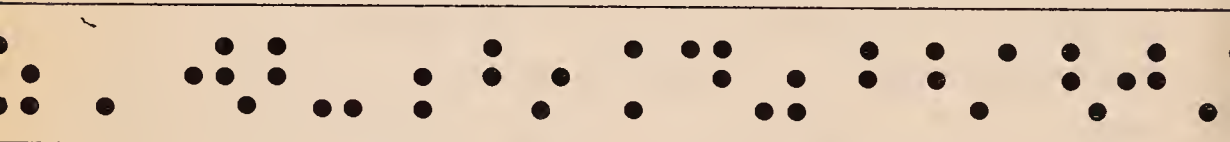
unconscious. But we had not eaten. A month on the march to the bird itself. Without food. Now how much longer to find our way to the ice caverns, and the promised canned goods?

None of us cared to think about it. We would not die. We would be given filths and scums to eat, of one kind or another. Or nothing at all. AM would keep our bodies alive somehow, in pain, in agony.

The bird slept back there, for how long it didn't matter; when AM was tired of its being there, it would vanish. But all that meat. All that tender meat.

As we walked, the lunatic laugh of a fat woman rang high and around us in the computer chambers that led endlessly nowhere.

It was not Ellen's laugh. She was not fat, and I had not heard her laugh for one hundred and nine years. In fact, I had not heard . . . we walked . . . I was hungry. . . .



We moved slowly. There was often fainting, and we would have to wait. One day he decided to cause an earthquake, at the same time rooting us to the spot with nails through the soles of our shoes. Ellen and Nimdok were caught when a fissure shot its lightning-bolt opening across the floorplates. They disappeared and were gone. When the earthquake was over we continued on our way, Benny, Gorrister and myself. Ellen and Nimdok were returned to us later that night which became a day abruptly as the heavenly legion bore them to us with a celestial chorus singing, "Go Down Moses." The archangels circled several times and then dropped the hideously mangled bodies. We kept walking, and a while later Ellen and Nimdok fell in behind us. They were no worse for wear.

But now Ellen walked with a limp. AM had left her that.

It was a long trip to the ice caverns, to find the canned food.

Ellen kept talking about Bing cherries and Hawaiian fruit cocktail. I tried not to think about it. The hunger was something that had come to life, even as AM had come to life. It was alive in my belly, even as we were alive in the belly of AM, and AM was alive in the belly of the Earth, and AM wanted the similarity known to us. So he heightened the hunger. There was no way to describe the pains that not having eaten for months brought us. And yet we were kept alive. Stomachs that were merely cauldrons of acid, bubbling, foaming, always shooting spears of sliver-thin pain into our chests. It was the pain of the terminal ulcer, terminal cancer, terminal paresis. It was unending pain. . . .

And we passed through the cavern of rats.

And we passed through the path of boiling steam.

And we passed through the country of the blind.

And we passed through the slough of despond.

And we passed through the vale of tears.

And we came, finally, to the ice caverns. Horizonless thousands of miles in which the ice had formed in blue and silver flashes, where novas lived in the glass. The downdropping stalactites as thick and glorious as diamonds that had been made to run like jelly and then solidified in graceful eternities of smooth, sharp perfection.

We saw the slack of canned goods, and we tried to run to them. We fell in the snow, and we got up and went on, and Benny shoved us away and went at them, and pawed them and gummed them and gnawed at them and he could not open them. AM had not given us a tool to open the cans.

Benny grabbed a three quart can of guava shells, and began to batter it against the ice bank. The ice flew and shattered, but the can was merely dented while we heard the laughter of a fat lady, high overhead and echoing down and down and down the tundra. Benny went completely mad with rage. He began throwing cans, as we all scrabbled about in the snow and ice trying to find a way to end the helpless agony of frustration. There was no way.

Then Benny's mouth began to drool, and he flung himself on Gorrister. . . .

In that instant, I went terribly calm.

Surrounded by meadows, surrounded by hunger, surrounded by everything but death, I knew death was our only way out. AM had kept us alive, but there was a way to defeat him. Not total defeat, but at least peace. I would settle for that.

I had to do it quickly.

Benny was eating Gorrister's face. Gorrister on his side, thrashing snow, Benny wrapped around him with powerful monkey legs crushing Gorrister's waist, his hands locked around Gorrister's head like a nutcracker, and his mouth ripping at the tender skin of Gorrister's cheek. Gorrister screamed with such jagged-edged violence that stalactites fell; they plunged down softly, erect in the receiving snowdrifts. Spears, hundreds of them, everywhere, protruding from the snow. Benny's head pulled back sharply, as something gave all at once, and a bleeding raw-white dripping of flesh hung from his teeth.

Ellen's face, black against the white snow, dominoes in chalk dust. Nimdok with no expression but eyes, all eyes. Gorrister half-conscious. Benny now an animal. I knew AM would let him play. Gorrister would not die, but Benny would fill his stomach. I turned half to my right and drew a huge ice-spear from the snow.

All in an instant:

I drove the great ice-point ahead of me like a battering ram, braced against my right thigh. It struck Benny on the right side, just under the rib cage, and drove upward through his stomach and broke inside him. He pitched forward and lay still. Gorrister lay on his back. I pulled another spear free and straddled him, still moving, driving the spear straight down through his throat. His eyes closed as the cold penetrated. Ellen must have realized what I had decided, even as the fear gripped her. She ran at Nimdok with a short icicle, as he screamed, and into his mouth, and the force of her rush did the job. His head jerked sharply as if it had been nailed to the snow crust behind him.

All in an instant.

There was an eternity beat of soundless anticipation. I could hear AM draw in his breath. His toys had been taken from him. Three of them were dead, could not be revived. He could keep us alive, by his strength and his talent, but he was *not* God. He could not bring them back.

Ellen looked at me, her ebony features stark against the snow that surrounded us. There was fear and pleading in her manner, the way she held herself ready. I knew we had only a heartbeat before AM would stop us.

It struck her and she folded toward me, bleeding from the mouth. I could not read meaning into her expression, the pain had been too great, had contorted her face; but it *might* have been thank you. It's possible. Please.



Some hundreds of years may have passed. I don't know. AM has been having fun for some time, accelerating and retarding my time sense. I will say the word now. Now. It took me ten months to say now. I don't know. I *think* it has been some hundreds of years.

He was furious. He wouldn't let me bury them. It didn't matter. There was no way to dig in the deckplates. He dried up the snow. He brought the night. He roared and sent locusts. It didn't do a thing; they stayed dead. I'd had him. He was furious. I had thought AM hated me before. I was wrong. It was not even a shadow of the hate he now slavered from every printed circuit. He made certain I would suffer eternally and could not do myself in.

He left my mind intact. I can dream, I can wonder, I can lament. I remember all four of them. I wish—

Well, it doesn't make any sense. I know I saved them, I know I saved them from what has happened to me, but still, I

cannot forget killing them. Ellen's face. It isn't easy. Sometimes I want to, it doesn't matter.

AM has altered me for his own peace of mind, I suppose. He doesn't want me to run at full speed into a computer bank and smash my skull. Or hold my breath till I faint. Or cut my throat on a rusted sheet of metal. There are reflective surfaces down here. I will describe myself as I see myself:

I am a great soft jelly thing. Smoothly rounded, with no mouth, with pulsing white holes filled by fog where my eyes used to be. Rubbery appendages that were once my arms; bulks rounding down into legless humps of soft slippery matter. I leave a moist trail when I move. Blotches of diseased, evil gray come and go on my surface, as though light is being beamed from within.

Outwardly: dumbly, I shamle about, a thing that could never have been known as human, a thing whose shape is so alien a travesty that humanity becomes more obscene for the vague resemblance.

Inwardly: alone. Here. Living under the land, under the sea, in the belly of AM, whom we created because our time was badly spent and we must have known unconsciously that he could do it better. At least the four of them are safe at last.

AM will be all the madder for that. It makes me a little happier. And yet . . . AM has won, simply . . . he has taken his revenge. . . .

I have no mouth. And I must scream.

[illegible]

exploding stars

A Breath of Violence

For twenty years, physicists from the University of Bristol have been flying packages of fine-grain film to great heights on balloons, to detect the 'primary' cosmic rays arriving from far away in space before they are degraded by the air. The cosmic-ray particles burrow through the photographic emulsion, leaving distinct tracks. When the films are recovered and developed, the physicists look at the tracks under the microscope and deduce the properties of the particles. The typical cosmic-ray particle is the simple nucleus of a hydrogen atom, but Peter Fowler, at Bristol, studies the heavier chemical elements whose nuclei are also represented in the cosmic rays. He makes a remarkable discovery which bears closely on the origin and history of the cosmic rays.

In films recovered from a balloon flight in Texas made in collaboration with American scientists in September 1968, Fowler finds tracks corresponding to elements heavier than uranium. Uranium is the heaviest element found naturally on Earth, although nuclear physicists have made heavier ones artificially, using reactors and accelerators. All these very heavy elements are short-lived; they quickly change into uranium or still lighter elements, which is the reason why they do not exist on our planet. The simplest interpretation of Fowler's discovery is therefore that these heavy atomic nuclei have been made quite recently. Extraordinary circumstances are necessary for the new creation of heavy elements. The most likely origin for these cosmic rays is in exploding stars. They are a hot breath of violence from the depth of space.

Crab salad à la Chinoise

'Prostrating myself,' the chief computer of the calendar said to the Sung emperor of Khaifeng, 'I have observed the appearance

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nigel calder

of a guest star.' The less sophisticated Europeans did not notice the strange event in the constellation of Taurus, the bull, during that summer of AD 1054. Edward the Confessor was king of England; William of Normandy's countrymen were grabbing southern Italy, but another twelve years were to pass before he would change his designation from Bastard to Conqueror on the field of Hastings. The Moslems, despite their traditions in astronomy, were evidently too busy campaigning in West Africa to notice that the star they called Aldebaran had acquired a brighter neighbour. The records of the sharper-eyed Japanese and Chinese, re-examined in a striking joint study by modern historians and astronomers, provide one of the most useful accounts we have of an exploding star. In a matter of days it became as bright as the planet Venus and conspicuous even in daylight—'reddish-white' in colour. Within a month it was fading.

Today the debris of that star is plainly visible in the big telescopes, as one of the most interesting objects in the sky—the Crab Nebula, a luminous shell of gas expanding in all directions at 700 miles a second. Red-glowing hairy filaments of hydrogen lace the white-glowing cloud.

Geoffrey Burbidge of the University of California, San Diego, remarks that nowadays astronomy can be divided into two sections: the astronomy of the Crab; and the astronomy of everything else. For many years the Crab has been a subject of intense study and theory-spinning, and yet it continues to heap surprise upon surprise, every bit as striking for contemporary astronomers as it was for Yang Wei-Te, the prostrate computer, 915 years ago.

When radar scientists, returning from the second World War began radio astronomy in earnest, one of the very first cosmic radio sources was discovered by John Bolton, at Sydney in 1947. Taurus A, as it was called, turned out to be the Crab, broadcasting a protracted death-rattle of radio noise. In 1962–4, two groups of American scientists started, not very optimistically, looking for X-rays from distant objects, using rocket-

borne detectors fired above the atmosphere from the White Sands missile range. They were not disappointed. The first X-ray star to be pinpointed is in the constellation of Scorpius. The second in Taurus: again it is the Crab and the question arises, how is the X-ray energy produced?

The stuff of the Crab is riddled with magnetic fields and the nebula produces its radio noise, its light and possibly the X-rays too, by the effects of high-energy electric particles, electrons travelling through magnetic fields. The electrons are forced to spiral by the magnetism, and this makes them give off energy in the form of electromagnetic radiation. Relatively slow electrons emit radio waves, and lose energy only slowly: if they were started off at the time of the explosion seen in 1054 they would still be going strong. But white light is produced by the same sort of mechanism, and that means electrons more energetic to start with and more rapidly slowing down. In the course of a few hundred years, the Crab would have grown very faint, unless fresh supplies of electrons had come along.

To make X-rays, very energetic electrons are required, and these lose their energy in the course of only a year. To find where the fresh supplies of electrons can come from, Herbert Friedman, pioneer rocket astronomer at the Naval Research Laboratory in Washington DC, looks to the 'wisps of brightness' that surge out from the centre of the Crab every few months. Philip Morrison and L. Sartori have a different theory. They think the Crab emits X-rays, not because of the spiralling electrons, but simply because the cloud thrown out by the exploding star remains very, very hot—at billions of degrees. This particular argument will be settled by longer and more careful observation of the X-rays from the Crab.

Meanwhile the Crab comes up trumps once more. In 1968, radio astronomers from the University of Sydney join in the hunt for pulsating radio sources—the pulsars—first announced earlier in the year by Cambridge radio astronomers, as a new and baffling kind of object in the sky. Working at Molonglo with the big Mills Cross, an array of aerials in the form of a

cross with arms a mile long, Michael Large makes a rich haul of additional pulsars. The first of them is one lying in a zone of the sky called Vela X which, like the Crab Nebula, is the remains of an exploded star. A possible link between pulsars and exploding stars has been suspected by some theorists, and here is the first evidence that it may be so—the first break in the otherwise bewildering accumulation of information about the ticking stars. But it may be just a coincidence in direction.

There are many remnants of stars which exploded long before records began. Only three of the really big explosions, called supernovae, have been observed in the past thousand years (in 1054, 1572 and 1604), but radio astronomers have found the characteristic shells of others. Michael Large and his colleagues at Molonglo promptly look at several other supernova remnants, but without finding another pulsar. That does not prove anything, either way, because pulsars are hard to detect even with the biggest radio telescopes. But another example of a pulsar associated with a supernova is certainly needed, to clinch the Australian discovery. At the end of 1968 colleagues at the radio observatories at Green Bank (West Virginia) and Arecibo (Puerto Rico) find another, NP 0532. It is a fast-beating pulsar and it lies in the direction of the Crab! Thomas Gold, of Cornell, by theoretical argument, traces the 'wisps of brightness' that keep the nebula alight back to the pulsar at its core.

For nearly a year, after the discovery of the pulsars, optical astronomers strove in vain to see a flashing light at the site of a pulsar as indicated by the radio signals. One night early in 1969, astronomers working at the Steward Observatory in Arizona spot the first visible pulsar, faint but flashing away at the same rate as the corresponding radio signals. Pulsars are visible after all, and the telegrams fly out spreading the news to the world's astronomers. 'It's easy to pick it up once you know where to look,' Donald Taylor of the University of Arizona tells me; he is one of the team making the discovery for which everyone has waited. Sure enough, confirmation comes quickly

from the McDonald Observatory in Texas and from the Steward Observatory's neighbours on Kitt Peak, Arizona. The early observations show that the pulsar is very blue, and a strong emitter of ultra-violet as well as of visible light.

As for which pulsar is first to be seen, it is (need I say it?) NP 0532, the one in the Crab Nebula. It turns out to be a star well known in photographs of the supernova remnant, previously suspected of being the residual core of the star but not known to be flashing.

. . .

Starr in Leo

The jazziest pulsar is CP 0950, in the constellation of Leo. When the radio astronomer feeds the signals to a loudspeaker rather than one of the more scientific recording devices, he can hear the various beats of the pulsars. The slower ones sound like heartbeats, but CP 0950, at four beats a second, sets the feet tapping, and the illusion of a cosmic Ringo Starr is enhanced by the way the pulses vary in strength. But an astronomer's feet are likely to tap more in frustration, as he records these regular pulses coming from far away in space. What in heaven is a pulsar?

Amid a great deal of controversy about the possible nature of the pulsars, two deductions are scarcely disputed: that the pulsars are quite massive objects and that they are at the same time very small. The first conclusion follows from their amazingly good timekeeping qualities. They are far more reliable than most man-made clocks, despite the fact that they are throwing out vast amounts of energy many times a minute. They are losing speed only very slowly. They must have plenty of substance to draw on. The conclusion that the pulsars—or at least their radio transmitting regions—are also small comes from the sharpness of their pulses. Suppose a pulsar were as big as the Sun, and once a second it shook all over its surface and pumped radio noise into space. After a short interval, the

radio noise from the nearest part of the Sun (the centre, as we see it) would arrive at the Earth. But the radio waves from the edges of the Sun, having an extra distance to travel, would arrive more than two seconds later. In other words, the signals from different parts of the Sun would smudge one another, and instead of sharp pulses there would be continuous rumble of radio noise. From the rate and clarity of the pulses, astronomers deduce that pulsars, or their active areas, must be a good deal smaller than the Earth.

Big mass and small size means the pulsars are very dense, with matter crushed forcibly together in a form we never encounter on Earth. Before the discovery of the pulsars, white dwarf stars were the most compact objects known. In such stars, at the senile stage with nearly all their fuel spent and no outward pressure of energy to support their own weight, the force of gravity compresses the matter in them until a thimbleful weighs a ton or more. The resulting hot stars are about the same size as the Earth, very much smaller than the ordinary run of stars, and much fainter, too. They were discovered in 1862 when investigations of irregularities in the position of the bright star Sirius showed it to have a companion, an inconspicuous white dwarf.

But even a white dwarf seems too big for a pulsar, especially when new pulsars turn up with pulse-rates of ten a second, or more. Indeed Anthony Hewish and his colleagues, who discovered the first pulsars, wondered from the outset if stars in an even more advanced state of collapse were involved—the 'neutron stars.' These are objects not observed before, but some theorists argue for their existence. A white dwarf is saved from even greater collapse by the resistance to pressure of the electrons it contains. But if the mass of the collapsing star is only a little greater than that of the Sun, its gravity will overwhelm the electrons, and collapse will continue until the whole star is like one huge atomic nucleus—a neutron star in which ten million tons of matter would not fill a thimble.

Opposing theorists, while not denying the possibility of

collapse beyond the white-dwarf stage, question the existence of neutron stars. They doubt whether even nuclear forces can halt the collapse at the stage of a neutron star. An exhausted massive star, according to them, just goes on shrinking and disappears from our universe. At the moment, the neutron-star enthusiasts seem to be winning the present round of argument; the pulsars may turn out to be somewhat different from the theoretical notion of a neutron star, but the evidence says they are something intermediate between a white dwarf and complete annihilation by collapse. Both the high pulse rate and the location of the pulsars near Vela X and the Crab Nebula give a great boost to the neutron-star enthusiasts. The central debris from the explosion of big stars is plausible stuff for making neutron stars.

The entrance qualification for the Pulsar Club is to own a very big radio telescope, because the signals are really very faint—otherwise they would have been noticed years ago. Some radio astronomers exploit computers in hunting for new pulsars, using the machine to search for snatches of rhythm in the radio records. Michael Large, the ace discoverer of new pulsars, prefers to rely on his eyes, scanning the tracks of the pen recorders.

Gravity is Greatest

However they work, pulsars illustrate, as do all other stars in their various ways, the tricks that nature can play with the forces available to it. When distinguished physicists meet to compare ideas at the International Centre for Theoretical Physics in Trieste, Edwin Salpeter of Cornell University seeks to explain the fascinations of astronomy by pointing out that the long time-scales of the universe make rare events visible to us. There are also, as he points out, great contrasts—of high and low temperatures, of high and low densities of matter.

Temperature conditions on Earth give us a very mild impression of the forces of nature. Hurricanes and lightning strokes,

earthquakes and avalanches, the remorseless pull of the Earth's gravity and the unforgiving inertia of a vehicle suddenly brought to rest—these are the most unpleasant manifestations of natural forces, to which we must now add the unnatural exploitation of another kind of natural force, nuclear bombs. Yet, on Earth, hurtling masses are rather small, gravity is not unduly oppressive, the chances of being hit by lightning are insignificant and even the multi-megaton H-bomb is puny by comparison with the nuclear reactions occurring in the smallest stars. Among the solids, liquids and gases of our material world, we are hard put to it to reproduce the common states of matter of the universe: the diffuse near-vacuum of interstellar space, or the hot, electrified gas (plasma) of the stars themselves. Our impression of the relative importance of natural forces is also peculiar to our circumstances.

The three main kinds of forces known to scientists are nuclear, electromagnetic and gravitational. In practice, physicists distinguish between strong and weak nuclear forces, which are very different in kind, but the distinction is unnecessary for present purposes. If you had to invent a universe, you might well choose such a combination of forces, because they are complementary.

Nuclear forces are immensely strong, but operate over extremely short distances; they make possible those arrangements and rearrangements of the heavy constituents of matter that exhibit themselves in the nuclear furnaces of stars and in our own modest nuclear reactors. The 'bread-and-butter' nuclear reaction in the universe involves the fusion of four nuclei of hydrogen—the simplest and commonest raw material—to make helium. The resulting helium is not quite as heavy as four hydrogen nuclei. In other words, mass is destroyed and the star is slightly lighter. The missing matter is transformed into energy, at a very high rate of exchange (in accordance with $E=mc^2$, the famous law discovered by Albert Einstein, which involves the square of the speed of light, a very big number). The release of enormous amounts of energy in exchange for a

little mass, destroyed by nuclear forces, is the secret of long life in the Sun and the stars. William Fowler of Caltech claims, with justification, that as much has been discovered about how stars work, by experiments with the accelerators of nuclear physicists, like himself, as by looking at stars with telescopes.

We ourselves live in an electromagnetic world. Everyday materials, including the tissues of the human body, are held together by the electromagnetic forces that operate between atoms. Rearrangements of atoms, in chemical reactions, liberate energy from food in our bodies and from coal and oil in our engines. The texture, colour and strength of familiar materials are all to be understood in terms of these electromagnetic forces, which are more obviously involved also in our electrical and electronic devices.

Gravity ties the Earth to the Sun and us to the Earth and stops us dropping head first into the abyss that starts at the top of our hair. The action of the Sun and the Moon on the oceans, to make the tides, is the only plain indication we have, on Earth, that there is more to gravity than dead weight falling to the ground. Although Isaac Newton taught us that every mass attracts every other mass with a gravitational force, the force is extremely weak between even the biggest of man-made objects. The rules for the prevention of collision at sea, for example, contain no mention of the gravitational attraction between supertankers.

The contrast between gravitational and nuclear forces is that one is strong where the other is weak—nuclear forces are ineffectual over long distances, while gravitation, so modest at short ranges, makes and breaks stars and moulds the entire universe. Gravity brings the matter of a star together and keeps it hot; indeed, it is only the outward pressure of electromagnetic radiation from nuclear reactions that prevents a star from condensing further and becoming ever hotter. We owe the very elements of which the Earth and ourselves are composed, to the power of gravity to turn on the heat necessary for their formation.

Electric currents and magnetic fields appear to play a rela-

tively minor part in the drama of the universe, but this may be a mistaken impression that arises because astronomers are only just learning how to measure weak but extensive magnetic fields. As we shall see, magnetic fields produce striking effects at the surface of the Sun; they also figure in all the main sources of radio noise, from exploding stars and pulsars to exploding galaxies and quasars.

What we see and detect in the sky is to be interpreted, then, as manifestations of nuclear, electromagnetic and gravitational forces, and the greatest of these is gravity. Sometimes the forces collaborate harmoniously, sometimes an uneven conflict produces drastic results. And sometimes the resulting conditions are so extreme that astronomers lose confidence in the familiar laws of physics.

Neutron stars—if those are what pulsars are—have a very precarious stability, according to current gravitational theory. Only a narrow range of masses can reach this stage of collapse without overreaching it; that so violent an event as an exploding star should give birth to a neutron star is like using a bomb to make glass goblets. Yet pulsars exist, by the score, and the connection with exploding stars is hard to explain. Perhaps they gain stability from their magnetic fields or from fast rotation, opposing further collapse. Many theorists are unhappy about the neutron star—not least the nuclear physicists who are at a loss to say how so large a mass of nuclear matter should behave.

Thomas Gold of Cornell University is the man most confident that he understands the pulsars, and the discoveries linking them with exploded stars are a joy to him. Early in 1969, he sums up his ideas about pulsars: he seeks to explain, with a very simple mechanism, how the natural forces conspire to make the pulsar emit its pulses of radio waves and light, and also to power the mysteriously strong emissions from the expanding shell of the exploded star.

The core remaining from an exploded star, having used up its nuclear energy, has collapsed under gravity to make a neutron

star a few miles in diameter. The gravitational energy so released goes chiefly into making the star spin at an enormous rate—perhaps a thousand revolutions a second to begin with. But the star also has an immensely compressed and powerful magnetic field, more than a million million times stronger than the Earth's magnetism. Any plasma—electrified gas—ejected from the surface of the neutron star is caught in the magnetic field and whirled at the same rate of rotation as the star. But when the plasma edges out to a certain distance from the star (30 miles, to start with) the whirling brings it almost to the speed of light. At that stage, the plasma not only generates light and radio waves but it breaks the bonds of the magnetic field, shooting off into space at enormous speed. Here, in Gold's view, is the source of energy that keeps the cloud of the Crab Nebula glowing. The radio and light are beamed by the whirling plasma so, if either the plasma emission or the magnetic field is lopsided, the waves are projected in our direction only once per revolution. As the neutron star loses energy, it slows down, to give the pulse rates of the pulsars so far discovered.

I summarise Gold's version of what pulsars are, in preference to dozens of other attempted descriptions, not because it can be regarded as proven but because it has the two virtues of being relatively simple and of not merely fitting but predicting the facts about pulsars, as they are known early in 1969.

. . .

Turning Gas into Stars

Some maternity wards of stars are plainly visible in ground-based telescopes. Stars form, not singly, but in crowds, as a huge mother cloud of gas and dust gradually collapses under gravity and breaks into a litter of smaller, denser masses, which are embryonic stars. Just as the Crab Nebula is the most distinguished relic of an exploded star, so the Great Nebula in the 'sword' of Orion is the most studied region where new stars can be seen forming now. The Orion Nebula is a cloud of great beauty . . .

Orion is studded with bright, young stars including one, FU Orionis, which 'switched on'—to the great excitement of astronomers—in 1936. They were really lucky to observe it, because the birthrate of such bright stars is probably only about one per 500 years, in the whole Galaxy. But as birth and infancy of stars takes a long time there are objects to be seen at different stages of the process. The Orion Nebula contains invisible objects which have been detected with the novel types of telescopes. These apparently coincide with pre-natal regions. At any rate strong infra-red rays come from these. So does a strange outpouring of 18-centimetre radio waves.

This 18-centimetre radio emission is characteristic of a gas containing combinations of oxygen and hydrogen atoms (OH, incomplete water molecules). The mechanism that produces them is strangely like those recent human inventions, the maser and the laser, in which radiation energy is stored in a material and released by stimulation by other radiation. These OH regions in the sky are gas clouds, lit by very young, bright stars, but which are themselves forming further stars. OH is not the only chemical compound detectable by radio. Charles Townes, inventor of the maser, has turned to astronomy and, at the end of 1968, he and a group from the University of California, Berkeley, working with a 20-foot dish at Hat Creek report the detection of 1.25 centimetre radiation from ammonia in a cloud of gas and dust near the centre of the Milky Way. Later, water itself and other molecules become detectable.

The Japanese theorist Chushiro Hayashi, with his colleagues in Kyoto, has computed the pattern of collapse of gas clouds to form stars. It takes many thousands or millions of years for a cloud to form a condensation that ceases to be transparent: at that time the density is still low and the temperature is a mere ten degrees above absolute cold. Thereafter the condensation becomes much more rapid.

An impression of what the Sun was like at birth and in its infancy comes from the study of the new stars. George Herbig uses for this purpose the 120-inch optical telescope at Lick

Observatory on Mount Hamilton. The stars he watches are T Tauri stars, with an unusually bright atmosphere, embedded in dust and also flashing in an irregular way—signs of ‘growing pains’ as the stars adjust their configuration in the search of stable maturity. He is able to estimate the ages of the stars from the amount of a rare element, lithium, they contain. Herbig is also finding, in the light of very young stars, signs that they are surrounded by complex material, of the kind from which planets may eventually be formed. Astronomers believe that the Sun’s family of planets came into existence not long after the Sun itself was formed, and here is evidence that the process is repeatable for other stars. Herbig remarks: ‘The planets are probably condensed out of material which was either spun off or blown off the Sun in its very earliest youth.’

Flare stars, which Sir Bernard Lovell picks up with the 250-foot radio telescope, may also be stars in raucous infancy, which have not yet found the stability of mature stars. Lovell is famous as founder and director of Jodrell Bank radio observatory in England, as conceiver of what, after eleven years, is still the world’s biggest fully steerable radio telescope, and as an outspoken commentator on the space race. Time and again his big instrument has played a dramatic part in tracking American and Soviet experiments in space, and this is what has made headline news. But in fact the space-tracking operations account for only a very small fraction of the work at Jodrell Bank, and the observatory has taken a prominent part in the current exploration of the universe, including the approach to the discovery of the quasars, and the exploitation of the pulsars. Although Lovell himself has little time for his own research, he makes his mark in one line of investigation of which he says, ‘This work wouldn’t do for a young man who wants to get quick results.’ His big telescope is working at the limits of its sensitivity, looking for rare events.

Ordinary stars pass quite undetected when even the biggest radio telescopes scan the sky. The radio emission is far too weak to be recorded. The Sun is an exception simply because

it is so close. Until the discovery of the pulsars, Lovell's flare stars have been the only other stars to make any impression on the pen recorders that show radio noise arriving from the depths of space. He set out to pick up, by radio, stars that optical astronomers had seen occasionally flashing very brightly from time to time; the phenomenon looked like explosions on the surface of the star—like a king-size solar flare. Just four hours after he began looking, Lovell registered a radio burst from a flare star but, as he says rather ruefully, it required five years' work after that, in collaboration with optical astronomers in several countries, to *prove* it. Now he has ample records, sometimes of quite astonishing explosions which nevertheless leave the stars intact.

Seven Ages of the Sun

In its relatively sedate middle age, the Sun's brilliant youth is far behind it, its bloated senility and shrivelled extinction far ahead. By looking at stars in different states, by laboratory research into nuclear processes, and by complex calculations by computer, astronomers can write the biographies of the Sun and other stars. The speed and course of events vary greatly according to the mass of the star.

The immense cloud of gas from which the Sun was formed possessed rich reserves of energy, especially of gravitational energy that could be released by collapse, and of nuclear energy in the form of hydrogen nuclei which could burn to make heavier elements. Also present, and important in its way, was the energy of the magnetic fields threading the cloud. The Sun, like the other stars, is a machine that converts the energy of the primeval gas cloud into heat and light. There is some uncertainty about details, and the more violent changes are hard to compute, but the theorists are fairly confident about the past and future of the Sun. It is a remarkable story of change in size and brilliance, as the Sun draws on various energy reserves in succession, until all are spent. In this account I use figures

kindly collated by Ian Roxburgh of London University, an expert on the theory of stars.

1. First, the gargantuan infant shrank and flared in the mother cloud. When the Sun first came alight, it had not begun to burn its nuclear fuel. Its heat derived from gravity—from the falling together of the gas. But this initial capital of energy the Sun squandered in a mere eight million years, at first pouring out light energy 500 times faster than it does today, though from a dullish surface 50 times the diameter of the present Sun. The young star spun much faster than it does now, throwing off a substantial part of its matter. That process, and also the effect of the magnetism concentrated from the gas cloud, helped to moderate the rate of spin. The prodigal Sun went on contracting until it reached its present size, but was only half as bright.

2. At that point, the temperature at the very centre of the Sun became sufficiently hot to ignite the hydrogen—in other words to allow the release of nuclear energy to begin, in the conversion of hydrogen into helium. The Sun grew stronger again, until it reached its present brightness. More than four billion years later, it has scarcely changed. All the Sun's energy comes from a small zone in the very centre, where the nuclear reactions still proceed, using up hydrogen at a rate of 500 million tons a second. The inward pressure of gravity and the outward pressure of radiation from the centre are exactly balanced and the general structure of the Sun is very stable. Its diameter is a hundred times greater than the Earth's. During the next 1.5 billion years the Sun will become slightly bigger and brighter, but scarcely enough to disturb life on Earth.

3. Then something important will happen, though the effects will emerge only very slowly. The supply of hydrogen at the hot centre of the Sun will run out. There will still be plenty of fuel left in the surrounding mass of the Sun, but it is not transported to the central furnace. During four billion years following this first hint of old age, helium 'ash' will accumulate in the centre of the Sun, and hydrogen burning will continue in the zone immediately around this helium core. The rate of burning will

actually increase, and the Sun will gradually enlarge until its diameter is about three times bigger, and the light output is four times greater. The climate of the Earth will already be greatly altered.

4. The next stage in the life of the Sun comes when the rate of burning in the shell around the helium core accelerates. Not only will the Sun gradually increase its output of heat still further, and stifle the surface of the Earth, but the energy will lift the outer zones of the Sun against the force of gravity. After 600 million years of growth, the Sun will be fifty times its present diameter—a red giant star, pumping out energy 1500 times as intensely as the present Sun.

5. A brief but drastic change will then occur in the Sun. The helium ashes at the centre of the Sun will reach a temperature at which they too begin to burn, forming carbon and providing a fresh supply of nuclear energy. The onset of this process will be very sudden—the astronomers call it the helium flash—and when it happens the Sun will just as suddenly readjust its structure. In what may be only a matter of hours, the Sun will partially collapse again and greatly diminish its light output—*reculer pour mieux sauter*. The Sun resumes its giant growth after this setback; in the course of a further 30 million years, it will swell to a diameter 400 times greater than the present Sun. That means it will swallow, in turn, the planets Mercury, Venus, Earth and Mars. But when it becomes so bloated, it will be unstable, and it will puff off matter into the surrounding space, to form a planetary nebula expanding past the outer planets.

6. By this time, the nuclear energy available to the Sun will be all but exhausted. Apparently it cannot become hot enough to ignite the carbon in the core, which happens in more massive stars. As the fuel runs out, the pressure of radiation that props up the Sun against the force of its own gravity will be removed and, in the course of 50,000 years, the Sun will collapse upon its centre. This transition may be marked by short-lived explosions. At the end of it the Sun will retain only a hundredth of

its present diameter. It will be a white dwarf about the size of the Earth, and the remains of the Earth and the other inner planets will be ground inside it. The collapse will release a fresh supply of gravitational energy, sufficient to ensure that the dwarf is very hot and bright. At first, it will be radiating energy at 50 times the rate of the present Sun. As it loses energy, it may freeze. As it changes from plasma into a solid crystal, it releases some additional heat.

7. With no fresh supplies of energy on which to draw, the dwarf Sun will steadily cool like an ember until, billions of years in the future, it will be first dull red, and then black. Sans heat or light, a small dead ball will wheel with other darkening ash-balls in a galactic graveyard of once-brilliant stars.

Rotten at the Core

A Canadian astronomer, Alan Batten of the Dominion Observatory, has discovered in 1968 the most massive star so far identified. It is 60 times heavier than the Sun and it swings round with a companion only slightly less massive. Heavy stars are the young turks of the Galaxy: they shine brilliantly but burn out quickly. The dire effect of overweight on longevity is striking. If the Sun had retained just 25 percent more matter, it would already have burned out. A star twice as massive as the Sun exhausts its nuclear fuel in one fiftieth of the active lifetime of the Sun, while a star such as Batten has discovered can survive for only a few million years, compared with the 10 billion years of the Sun. Having seen the forces of nature at work in the Sun, we can now look in more detail at the explosive fate of big stars.

Superficially, the first stages of life of a big star are like an accelerated version of the biography of the Sun, although the conditions in the very heart of the star are different: the centre is turbulent so that both the rate of burning and the volume first exhausted of hydrogen are greater than in the Sun. When the star grows to a giant, the pattern of events departs markedly

from that in the less massive star. Genteel decline is ruled out when the augmented force of gravity ensures that the interior becomes much hotter. As a result, a series of nuclear reactions becomes possible, beyond the hydrogen burning and helium burning that occur during the life of the Sun. The carbon and oxygen formed by helium burning can themselves begin to burn as the temperature rises. In the centre of the star successive reactions continue to build up heavier elements and release energy, while the simpler forms of burning spread to the relatively cooler outer layers of the star. A star in this condition is a time-bomb, awaiting only the action of a detonator to make it explode, as a supernova.

The trigger for the supernova is, paradoxically, a loss of heat in the centre. By the time a lot of iron has accumulated in the core, the star is there running out of fuel because iron cannot burn. Making still heavier elements by nuclear reactions does not release heat, it consumes it, because iron is, in the nuclear sense, the stablest of the elements. The star would be doomed, even if other processes did not switch off its central heating.

Theorists argue about which is the more important, but the main cooling effects are:

1. the production of vast numbers of neutrinos, ghost-like atomic particles which can pour largely unhindered out of the core, taking energy with them; and

2. break-up of the iron, to make helium, abruptly reversing the laborious formation of the elements but also draining from the central region of the star the equivalent of the energy released during that formation.

The cooling makes the star rotten at the core. The central region collapses under gravity, in a matter of seconds. That process releases a fresh supply of energy which abruptly heats the outer regions of the star, detonates further nuclear reactions and builds up immense pressure. The explosion is monstrous, and overwhelms the force of gravity that holds the star together. New kinds of nuclear processes occur in the fireball of the supernova, expending energy in building up elements heavier

than iron. Thus the greater mass of the star, transformed into a rich inventory of all the elements, is shattered and scattered into space, at hundreds of miles a second. These elements will be cannibalised in new generations of stars and planets.

There is a residue at the centre of the explosions. The core of the star possibly forms a white dwarf, like that predicted for the burnt-out Sun; more probably, in view of the current pulsar discoveries, it is a neutron star, strongly magnetic and fast-spinning.

Somehow, too, the exploding star creates cosmic rays—particles travelling at practically the speed of light. Theorists have been unable to tell how such immensely energetic particles could be produced in the instant of the explosion. Now Thomas Gold suggests that the cosmic rays are spun off continuously after the explosion, from the whirling neutron star.

Some of the stars we see burning placidly far away in the plane of the Milky Way must already have exploded, but the flashes of the explosions are still travelling towards us, and we have not seen them yet. It can happen any day or we may wait a hundred years for this exhibition of celestial fireworks. When the next supernova is seen from the Earth, astronomers will direct all the resources of modern astronomy on the event—the ground-based and rocket-borne telescopes, the spectroscopes for following the event in physical and chemical detail, and detectors to pick up the atomic radiation expected from the exploding star. The last supernova in our Galaxy was watched by Kepler in 1604, but that was a few years before Galileo introduced the telescope into astronomy. Indeed Galileo's interest in astronomical observations only began when he plotted the position of Kepler's star with a pen-knife fixed in his window in Padua.

While it will be a high day for astronomers, let's hope the next cosmic bomb does not go off too close to us. It could be calamitous for life on Earth, because the atomic radiation pouring into space from a nearby supernova would create conditions resembling all-out nuclear war. The astronomers

could give some warning, because the flash of the explosion would reach us some months ahead of the dangerous particles. There would be no damage to cities, but we might have to evacuate them and go underground for a year or so. Survival would be economically difficult, even if protection from the worst effects of radiation saved most people's lives. After the crisis was over, the cave-dwellers would emerge to find their fields in a crazy condition, from the combined effects of neglected growth and genetic mutation of plants. Most of the animals might be dead, with only the oceans providing some natural protection for its inmates. Equivalent events must have occurred dozens of times before in the course of the Earth's long history, and exploding stars may have precipitated some of the drastic biological changes known to have occurred during the evolution of life on this planet.

Astronomers do not have to wait for supernovae in our Galaxy to be able to study them. They occur in other galaxies and, because they are so bright, they are visible across immense distances. Fritz Zwicky of the Mount Wilson and Palomar observatories began a systematic hunt for such events. Among the objects that Jesse Greenstein, of the same observatories, has newly found in his own study of supernovae in other galaxies, is one in the galaxy NGC 1058, an exploding star which shows enormous quantities of iron in the debris.

For astronomers today, the puzzle is not why stars explode, but why more of them do not explode. There are plenty of big bright stars around that seem strong candidates for supernovae, yet some mechanism saves them from that fate—or at least postpones it. To try to find out why such stars have not blown up is one of the tasks of the Orbiting Astronomical Observatory, that first satellite designed specifically for gazing at the stars.

Eggheads of the Galaxy, Unite!

A 'wiggler' is a star that is neither completely steady in its motion in the sky nor plainly orbiting around a companion in

a double star. If, in the very careful measurements of the astronomers, a star shows a slight wiggle, but not large enough to be accounted for by a dark star, the most probable explanation is that it possesses a family of planets, like the Sun's. Although convenience makes us think of ourselves going round a steady Sun, in fact our own star wiggles off course as the heavy planets wheel around it. Such movement is perceptible only in nearby stars, at least until large telescopes are put into orbit above the Earth's atmosphere.

Wiggling, and the signs of complex material in the neighbourhood of newborn stars, are the only direct evidence we have about the possible existence of planets attending other stars. So far there is only one really good example of a wiggler produced by planets of mass comparable with our own solar system. The ancient question of whether we are unique in the universe is more nagging than ever, just now. The discovery of how immense the universe really is leaves us with a sense of loneliness like travellers in a wide desert.

In more practical terms, we can see how easy it would be for civilisations on distant planets to communicate with one another by radio. Already American radio astronomers have looked seriously, though in vain, for radio signals from the region of two promising nearby stars, and the Russians are beginning a more extensive programme. So prevalent and serious is the belief, among present-day astronomers, in the possibility of interstellar communication by radio that, when Anthony Hewish and his colleagues first detected the steady radio beat of a pulsar, they labelled their records 'LGM'—for Little Green Men.

The current theories of how the Earth and the other planets formed, from gas and dust eddying round the young Sun, make it seem a likely thing to happen to other stars. Planets should therefore be quite common in the universe. Not every planet will do, of course; of the Sun's family, only the Earth looks capable of supporting life as we know it—although, of course, great interest attaches to the plans for sending automatic laboratories to the surface of Venus and Mars, to look for

primitive organisms or the chemical precursors of life. Among chemists and biologists, there are plausible hypotheses, backed up by laboratory experiments, telling how the Sun's rays brought living organisms into existence from a chemical soup on the early Earth. Few scientists now believe in a special act of creation on this planet, that could not be repeated many times elsewhere.

Then one has to start multiplying the odds against the formation of a suitable planet of a stable star, against the origin of life, against the emergence of intelligent beings surviving for a long period, and against them evolving both the technology and the interest for communicating with other civilisations. The combined odds against all this may be very long indeed, and yet the number of stars, even in our own Galaxy, is so very large that it is still difficult to believe we are unique.

Human ability to communicate across great distances being so recently acquired, we must assume that 'the others' have been at the game much longer, so it will be up to us to adopt the mode of communication they have chosen. There will be great cultural obstacles to conversing with beings differing widely from us not only in knowledge but in form and habits, too. Nevertheless the laws of mathematics have an abstract quality that circumstances cannot alter, so they provide a basis for devising codes and languages for communication. Lest 'conversation' should be taken too literally, remember the vast distances between the stars, and the fact that even if we do locate a communicative civilisation at a relatively near star, messages may take ten or a hundred years to pass between us. We may find ourselves posing questions and reminding our grandchildren to tune in for the answers.

Without exaggeration, making radio contact with eggheads on other planets could be the most important event in human history, and there is no reason to say it is impossible within the next few decades. Whether it will be a happy event is another question. We may find ourselves conversing with angels or devils, who teach us great wisdom or seek to brain-

wash us from afar. One distinguished American biologist, George Wald, admits the likelihood of contact to be quite considerable but his motto is 'Don't answer!' His chief worry is the discouragement and loss of dignity which we may suffer in learning from a superior technological civilisation, and which may make human enterprise seem pointless. Perhaps Wald is right. What satisfaction would there be in astronomy, for example, if somebody told us exactly what the pulsars and quasars were without leaving us time to find out for ourselves?

the secret songs

Promptly after supper, before Gwen had cleared away the dishes, Donnie began the Sleep Ritual. He got a can of beer from the refrigerator, selected a science-fiction magazine, and shut off the TV sound.

"The picture too?" he asked. "Might as well."

Gwen smiled at him as she shook her head. With the gesture of one who eats peanuts she threw her right hand to her mouth, swallowed, then dropped her hand with the tiny bottle it held back to the pocket of her smock.

Donnie sighed, shrugged his shoulders, settled himself in the easy chair, opened his magazine, and began to read and sip rapidly.

Gwen, who had been ignoring the TV, now began to study the screen. A kindly old rancher and a tall young cowpoke, father and son, were gazing out across broad acres framed by distant mountains. Gwen tuned her ears and after a bit she could faintly hear what they were saying.

THE OLD RANCHER: *Aim to plant her to hemp and opium poppy, Son, with benzedrine bushes between the rows.*

THE YOUNG COWPOKE: *Yeah, but what legal crop you fixin' to raise, Dad?*

THE OLD RANCHER (smiling like God): *Gonna raise babies, Son.*

Gwen looked away quickly from the screen. It never paid to try to hear too much too soon.

Donnie was studying her with a teasing grin.

"I bet you imagine all sorts of crazy things while you watch it," he said. "Those terrible bennies get your mind all roiled up."

Gwen shrugged. "You won't allow any noise while you're putting yourself to sleep. I have to have something," she said reasonably. "Besides," she added, "you're having orgies out in space with those girls in fluorescent bikinis."

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fritz leiber

"That shows how little you know about science fiction," Donnie said. "They dropped the sex angle years ago. Now it's all philosophy and stuff. See this old guy?"

He held up the magazine, keeping his place with his forefinger. On the cover was a nicely drawn picture of a smiling intelligent-looking young man in a form-fitting futuristic uniform and standing beside him, topping him by a long head, a lean green-scaled monster with a large silver purse slung over his crested shoulder. The monster had a tentacle resting in comradely fashion across the young man's back and curling lightly past his feather epaulet.

"You mean that walking crocodile?" Gwen asked.

Donnie sniffed. "That walking crocodile," he said, "happens to be a very wise old member of a civilization that's advanced far beyond man's." He lifted his other hand with two fingers pressed together. "Him and me are like that. He tells me all sorts of things. He even tells me things about you."

"Science fiction doesn't interest me," Gwen said lightly, looking back to the TV. There was a commercial on now, first a white-on-black diagram of the human body with explosions of bubbles occurring in sequence at various points, then a beautiful princess in a vast bathroom, then a handsome policeman. Gwen expertly retuned her ears.

VOICE OF MEDICAL EXPERT: *Benzedrine strikes at hidden sleepiness! Tones muscles! Strengthens the heart! Activates sluggish wake centers . . . One . . . Two . . . Three!*

THE BEAUTIFUL PRINCESS (looking depressed): *Yesterday I was overweight, listless, intensely unhappy. Mother called me The Ugly Dumpling. Now (becoming radiant) I build beauty with benzedrine!*

THE HANDSOME POLICEMAN (flashing badge with huge "N" for Narcotic Squad): *"You're all under arrest! Grrr . . . aarrarrgghhh!*

Gwen quickly looked away. It was the only thing you could do when you got static or the wrong voice channel. She began to carry the supper dishes to the sink.

Donnie winced violently without putting down his beer can or looking up from his page. "Don't clank them," he said. Gwen removed her shoes and began to do the dishes as if she were a diver in the silent world under the surface of the sea, ghosting between table, sink and cupboard.

She was still lost in this rather fascinating operation and even beginning to embroider it with little arabesques when Donnie continued the Sleep Ritual by opening his second can of beer, this time a warm one by choice. Before taking the first sip he swallowed a blue capsule of amytal. At the *kerzing!* of the opener Gwen stopped to watch him. She carefully dried the suds off her right hand, popped on to her tongue another benzedrine tablet from the bottle in her smock pocket, and still watching him thoughtfully, rinsed a glass, ran an inch of water into it and drank it.

If Donnie had his Sleep Ritual, she told herself in not exactly those words, she had her Vigil.

Donnie stood shaking his head at her.

"I suppose now you'll be wandering around all night," he said, "making all sorts of noise and disturbing me."

"I don't make any more noise than a snowflake," Gwen countered. "Not one-tenth as much as the autos and streetcars and planes. Almost every night the people next door have their TV on high."

"Yes, but those noises are outside," Donnie said. "It's your noises that bother me—the inside noises." He looked at Gwen speculatively. "Why don't you try a sleeping pill just for once?" he said with insidious appeal.

"No," Gwen answered instantly.

"A three-grain amytal," Donnie persisted, "would cancel those bennies and still have enough left over to make you nice and dozy. We'd go to sleep together and I wouldn't worry about noises."

"You don't want to go to sleep until you know everyone else is asleep," Gwen said. "Just like my mother. If I took one of your pills, you'd watch me sleep and you'd gloat."

"Well, isn't that what you do to me?"

"No, I do other things. By myself."

Donnie shrugged resignedly and went back to his chair and magazine.

Gwen wiped the itchy suds off her hand, and leaving the rest of the dishes soaking, sat down opposite the TV. A curly-haired disc jockey was looking out thoughtfully across a record he was holding:

THE DISC JOCKEY: *Some might think it strange that with such divergent tastes in drugs Donnie and Gwen Martin should seek happiness together and in their fashion find it . . . but life holds many mysteries, my friends. I could mention Jack Sprat and wife. We'll all hope the Hubbard . . . oops! . . . Martin medicine cupboard is never bare. And now we will hear, by the joint request of Mr. and Mrs. Martin—are you out there, Don and Gwennie?—that popular old favorite (glancing down at record) The Insane Asylum Blues!*

The music was real gone.

Donnie leaned back from his magazine and looked up at the ceiling. Gwen wondered if he were watching one of the glittering stars he'd named and pointed out to her on one of the rare Saturday nights they got outdoors. But after a while he said, "Benzedrine is an utterly evil drug, worse than coffee. Other drugs soothe and heal, but benzedrine only creates tension and confusion. I'll bet if I ask the Wise Old Crocodile he'll tell me the Devil invented it."

Gwen said, "If we ever went out nights and did anything, maybe I wouldn't need so much benzedrine. Besides, you have your sleeping pills and things."

"You don't need less benzedrine when you go out, you need more," Donnie asserted unalterably. "And if I ever went out on week nights, I'd get excited and start to drink and you know what would happen. How often do I have to tell you, Woman, that the only reason I take my barbiturates and 'things,' as you call them, is to keep calm and get enough sleep. If I didn't get enough sleep. I wouldn't be able to stand my job. If I couldn't

stand my job, I'd start to drink. And if I started to drink, I'd be back in the Booby Hatch. And since the only reason you're outside is that I'm outside, holding a job, why you'd be back in the Booby Hatch too and they'd put you on tranquillizers and you wouldn't like it at all. So don't criticize my sleeping medicines, Woman. They're a matter of pure necessity whatever the doctors and psychologists say. Whereas your bennies and dexies—"

"We've been through all this before," Gwen interrupted without rancor.

Donnie nodded owlishly. "Show we half," he agreed, his words blurring for the first time.

"Besides," Gwen said, "you're behind schedule."

Donnie squinted at the clock and snapped his fingers. The sound was dull but there was no unsteadiness in his walk as he went to the refrigerator and poured himself two fingers of grape juice. Then he reached down from the top shelf of the cupboard the bottle of paraldehyde and poured himself a glistening tablespoonful. Swift, almost as though the intense odor, midway between gasoline and banana oil, leaped to the corners of the half-merged living room and kitchen. Gwen momentarily wrinkled her nose.

Donnie mixed the paraldehyde with the grape juice and licked the spoon. "Here's to the druggists and the one understanding doctor in ten," he said and took a sip.

Gwen nodded solemnly and swallowed another benzedrine tablet.

Donnie transported his cocktail back to the armchair with great care and did not take his eye off the purple drink until he felt himself firmly anchored. He found his place in the science-fiction lead novelette, but the print began to slip sideways and so, as he sipped his stinging drink, he began to imagine the secrets the Wise Old Crock might tell him if he were the young man on the cover.

THE WISE OLD CROCK: *Got a hot trip shaping for tonight, Son. Three new novas flaring in the next galaxy*

southeast-by-up and dust cloud billowing out of Andromeda like black lace underwear (Dips in his purse.) Drop this silver sphere in your pocket, Son. It's a universal TV pickup on the old crystal-ball principle. It lets you tune in on any scene in the universe. Use it wisely, Son, for character building as well as delight. Don't use it to spy on your wife. (Dips again.) Now I want to give you this small black cylinder. Keep it always on your person. It's a psychic whistle by which you can summon me at all times. All you have to do is concentrate on me, Son. Concentrate . . .

There was a courtroom scene on the TV screen. A lawyer with friendly eyes but a serious brow was talking quietly to the jury, resting his hand on the rail of the box. Gwen had her ears fine-tuned by now and his voice synchronized perfectly with the movements of his lips.

THE FRIENDLY LAWYER: *I have no wish to conceal the circumstance that my client met her husband-to-be while they were both patients in a mental hospital. Believe me, folks, some of life's sweetest romances begin in the nut house. Gwen's affection inspired Don to win his release, obtain employment as a precision machinist, offer my client marriage upon her release, and shower her with love and the yellow health-tablets, so necessary to her existence, which you have watched her consume during these weary days in court. Needless to remark, this was before Don Martin began traveling in space, where he came under the influence of (suddenly scowls) a certain green crocodile, who shall be referred to hereinafter as Exhibit A. Enter it, clerk.*

Donnie rose up slowly from the armchair. His drink was finished. He was glaring at the TV.

"The Old Crock wouldn't be seen dead looking at junk like that," he cried thickly. "He's wired for real-life experience."

Donnie was half of a mind to kick in the picture tube when he looked toward the bedroom doorway and saw the Wise Old Crocodile standing in it, stooping low, his silver purse swinging as it dangled from his crested shoulder. Donnie knew it wasn't

a hallucination, only a friendly faint green film on the darkness.

Fixing his huge kindly eyes on Donnie, the Wise Old Crock impatiently uncurled a long tentacle toward the darkness beyond him, as if to say, "Away! Away!" and then faded into it. Donnie followed him in a slow motion like Gwen's underwater ballet, shedding his shoes and shirt on the way. He was pulling his belt from the trouser loops with the air of drawing a sword as he closed the door behind him.

Gwen gave a sigh of pure joy and for a moment even closed her eyes. This was the loveliest time of all the night, the time of the Safe Freedom, the time of the Vigil. She started to roam.

First she thought she'd brush the bread crumbs from the supper table, but she got to studying their pattern and ended by picking them up one by one—she thought of it as a problem in subtraction. The pattern of the crumbs had been like that of the stars Donnie had showed her, she decided afterward, and she was rather sorry she'd disturbed them. She carried them tenderly to the sink and delicately dusted them onto the cold gray dishwater, around which a few suds still lifted stubbornly, like old foam on an ocean beach. She saw the water glass and it reminded her to take another benzedrine tablet.

Four bright spoons caught her eye. She lifted them one by one, turning them over slowly to find all the highlights. Then she looked through the calendar on the wall, studying the months ahead and all the numbers of the days.

Every least thing was enormously fascinating! She could lose herself in one object for minutes or let her interest dart about and effortlessly follow it.

And it was easy to think good thoughts. She could think of every person she knew and wish them each well and do all kinds of wonderful things for them in her mind. A kind of girl Jesus, that's what I am, she told herself with a smile.

She drifted back into the living room. On the TV a bright blond housewife was leading a dull brunette housewife over to a long couch. Gwen gave a small cry of pleasure and sat down on the floor. This was always good.

THE BRIGHT BLONDE: *What do you feed your husband when he comes home miserable?*

THE DULL BRUNETTE: *Poison.*

THE BRIGHT BLONDE: *What do you feed yourself?*

THE DULL BRUNETTE: *Sorrow.*

THE BRIGHT BLONDE: *I keep my spirits high with benzedrine. Oh happy junior high!*

THE DULL BRUNETTE: *What was happy about it? I had acne.*

THE BRIGHT BLONDE (bouncing as they sit on the couch): *You mean to say I never told you how I got started on benzedrine? I was in junior high and unhappy. My mother sent me to the doctor because I was fat and at the foot of my class. He gave me some cute little pills and zowie—I was getting slim, smart and giddy. But pretty soon they found I was going back for an extra refill between refills. They cut me off. I struck. Uh-huh, little old me called a lie-down strike. No more school, I said, unless I had my pills. If the doctor wouldn't give them to me, I'd forage for them—and I did. Two years later my mother had me committed. If I hadn't become a TV star I'd still be in the Loony Bin.*

THE DULL BRUNETTE: *Did they give you electroshock?*

THE BRIGHT BLONDE: *Think happy thoughts. What do you do for kicks? Are you on bennies too?*

THE DULL BRUNETTE: *No. (Her face grows slack and subtly ugly.) I practice witchcraft.*

Gwen switched off her ears and looked away from the screen. She did not like the thought that had come to her: that she had somehow planted that idea about witchcraft in the brunette's mind. It was months since Gwen had let herself think about witchcraft, either white or black.

There came a long low groan from the bedroom, adding to Gwen's troubled feeling because it seemed too much of a coincidence that it should have come just after the word witchcraft had been spoken.

DONNIE was twisting on the bed, going through hell in his

dreams. The Wise Old Crock had abandoned him in a cluster of dead stars and cosmic dust on the far side of the Andromeda Galaxy, first blindfolding him, turning him around three times, and giving him a mighty shove that had sent him out of sight of whatever asteroid they had been standing on. Floating in space, Donnie went through his pockets and found only a Scout knife and a small silver sphere and black cylinder, the purpose of which he had forgotten. A cameo-small image of Gwen's face smiled at him from the sphere. He looked up. Worms twenty feet long and glowing dull red were undulating toward him through the dusty dark. He had an intense sensation of the vast distance of the Earth. He made swimming movements only to discover that a cold paralysis was creeping through his limbs. Eternities passed.

GWEN had got out her glue and glitter and sequins and had spread newspapers on the table and was making a design on a soup plate that she hoped would catch something of the remembered pattern of the bread crumbs. The idea was to paint with glue the design for one color of glitter and then sprinkle the glitter on it, knocking off the excess by tapping the edge of the plate on the table. Sprinkling the glitter was fun, but the design was not developing quite the way she wanted it to. Besides she had just discovered that she didn't have any red or gold glitter, though there were three bottles of green. Some of the green glitter stuck to the back of her finger where she had got glue on it.

She stole a look over her shoulder at the TV. The two women had been replaced by a large map of the United States and a rugged young man wearing glasses and holding a pointer. The first word she heard told her she wasn't going to like it, but she hitched her chair around just the same, deciding that in the long run it would be best to know the worst.

THE THINGS FORECASTER: *A witchcraft high is moving down from Western Canada. Werewolf warnings have been posted in three states. Government planes are battling in the black front with white radio rays, but they're being forced back.*

Old folks who ought to know say it's the end of the world. (Scans sheet handed him by page girl.) Flash from outer space! Don Martin, famed astronaut, is facing nameless perils in the Lesser Magellanic Cloud!

DONNIE had just blown the psychic whistle, having remembered its use only as the red worms began to spiral in around him, and the Wise Old Crock had appeared at once, putting the worms to flight with a shower of green sparks flicked from the tip of his right-hand tentacle.

THE WISE OLD CROCK: *You passed the test, Son, but don't pride yourself on it. Some night we're going to give it to you without paraldehyde. Now it's time you returned to Terra. Think of your home planet, Son, think of the Earth. Concentrate. . . .* (They are suddenly in orbit a thousand miles above North America. The larger cities gleam dully, the moon is reflected in the Great Lakes. Donnie has become a green-scaled being a head shorter than the Wise Old Crock, who weaves a tentacle majestically downward.) *Observe the cities of men, my Son. Think of the millions sleeping and dreaming there, lonely as death in their apartment dwellings and all hating their jobs. The outward appearance of these men-beings may horrify you a little at first, but you have my word that they're not fiends, only creatures like you and me, trying to control themselves with drugs, dreads, incantations, ideals, self-hypnosis and surrender, so that they may lead happy lives and show forth beauty.*

GWEN was looking intently in the living-room mirror, painting evenly-spaced bands of glue on her face. The bands curved under her eyes and outward, following the line of her jaw. She painted another band down the middle of her forehead and continued it straight down her nose. Then she closed her eyes, held her breath, lifted her face and shook green glitter on it for a long time. At last she lowered her face with a jerk, shook it from side to side, puffed out through her nostrils what breath she had left, and inhaled very slowly. Then she looked at herself again in the mirror and smiled. The green glitter clung to her face just as it had to her finger.

A feeling of deadly fatigue struck her then, the first of the night, and the room momentarily swam. When it came to rest she was looking at a flashing-eyed priest in a gorgeous cloak who was weaving across the TV screen.

THE GORGEOUS PRIEST: *The psychology of Donnie and Gwen must be clear to you by now. Each wants the other to sleep so that he may stand guard over her, or she over him, while yet adventuring alone. They have found a formula for this. But what of the future? What of their souls? Drugs are no permanent solution, I can assure them. What if the bars of the Safe Freedom should blow away? What if one night one of them should go out and never come in?*

DONNIE and the Wise Old Crock were hovering just outside the bedroom window three stories up. Friendly trees shaded them from the street lights below.

THE WISE OLD CROCK: *Goodbye, my Son, for another night. Use your Earthly tenement well. Do not abuse your powers. And go easy on the barbiturates.*

DONNIE: *I will, Father, believe me.*

THE WISE OLD CROCK: *Hold. There is one further secret of great consequence that I must impart to you tonight. It concerns your wife.*

DONNIE: *Yes, Father?*

THE WISE OLD CROCK: *She is one of us!*

DONNIE flowed through the four-inch gap at the bottom of the bedroom window. He saw his body lying on its back on the bed and he surged toward it through the air, paddling gently with his tentacle tips. His body opened from the crotch to chin like a purse and he flowed inside and the lips of the purse closed over his back with a soft *click*. Then he squirmed around gently, as if in a sleeping bag, and looked through the two holes in the front of his head and thrust his tentacles down into his arms and lifted his hands above his eyes and wriggled his fingers. It felt very strange to have fingertipped arms with bones in them instead of tentacles. Just then he heard laughter from the living room.

Gwen was laughing admiringly at the reflection of her breasts. She had taken off her smock and brassiere and painted circles of glue around the nipples and sprinkled on more glitter.

Although her ears were switched off, she thought she heard the priest call from behind her, "Gwen Martin, you ought to be ashamed of yourself!" And she called back to the TV, "You shouldn't peek, Father!" and she turned around, haughtily shielding her breasts with a forearm held crosswise.

The bedroom door was open and Donnie was standing in it, swaying and staring. Gwen felt another surge of deadly fatigue but she steadied herself and stared back at her husband.

Woman, the Cave Keeper, the Weaver of Words, faced Man, the Bread Winner, the Far Ranger.

They moved together slowly, dragging their feet, until they were leaning against each other. Then more slowly, still, as if they were supporting each other through quicksands, they moved toward the bedroom.

"Do you like me, Donnie?" Gwen asked.

Donnie's gaze brushed across her glittering green-striped face and breasts. His hand tightened on her shoulder and he nodded.

"You're one of us," he said.

Sometimes I go down to the port, splashing sand with my stiff foot at the end of my stiff leg locked in my stiff hip, with the useless arm a-swinging, to get wet all over again, drink in the dives with old cronies ashore, feeling old, broken, sorry for myself, laughing louder and louder. The third of my face that was burned away in the accident was patched with skinrafts from my chest, so what's left of my mouth distorts all loud sounds; sloppy sartorial reconstruction. Also I have a hairy chest. Chest hair does not look like beard hair, and it grows all up under my right eye. And: my beard is red, my chest hair brown, while the thatch curling down over neck and ears is sun-streaked to white here, darkened to bronze there, 'midst general blondness.

By reason of my being a walking (I suppose my gait could be called headlong limping) horror show, plus a general inclination to sulk, I spend most of the time up in the wood and glass and aluminum house on the surf-sloughed point that the Aquatic Corp gave me along with my pension. Rugs from Turkey there, copper pots, my tenor recorder which I can no longer play, and my books.

But sometimes, when the gold fog blurs the morning, I go down to the beach and tromp barefoot in the wet edging of the sea, searching for driftglass.

It was foggy that morning, and the sun across the water moiled the mists like a brass ladle. I lurched to the top of the rocks, looked down through the tall grasses into the frothing inlet where she lay, and blinked.

She sat up, long gills closing down her neck and the secondary slits along her back just visible at their tips because of much hair, wet and curling copper, falling there. She saw me. "What are you doing here, huh?" She narrowed blue eyes.

"Looking for driftglass."

"What?"

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samuel r. delany

"There's a piece." I pointed near her and came down the rocks like a crab with one stiff leg.

"Where?" She turned over, half in, half out of the water, the webs of her fingers cupping nodules of black stone.

While the water made cold overtures between my toes, I picked up the milky fragment by her elbow where she wasn't looking. She jumped, because she obviously had thought it was somewhere else.

"See?"

"What . . . what is it?" She raised her cool hand to mine. For a moment the light through the milky gem and the pale film of my own webs pearled the screen of her palms. (Details like that. Yes, they are the important things, the points from which we suspend later pain.) A moment later wet fingers closed to the back of mine.

"Driftglass," I said. "You know all the Coca-Cola bottles and cut crystal punch bowls and industrial silicon slag that goes into the sea?"

"I know the Coca-Cola bottles."

"They break, and the tide pulls the pieces back and forth over the sandy bottom, wearing the edges, changing their shape. Sometimes chemicals in the glass react with chemicals in the ocean to change the color. Sometimes veins work their way through a piece in patterns like snowflakes, regular and geometric; others, irregular and angled like coral. When the pieces dry they're milky. Put them in water and they become transparent again."

"Ohhh!" She breathed as though the beauty of the blunted triangular fragment in my palm assailed her like perfume. Then she looked at my face, blinking the third, aqueous-filled lid that we use as a correction lens for underwater vision.

She watched the ruin calmly.

Then her hand went to my foot where the webs had been torn back in the accident. She began to take in who I was. I looked for horror, but saw only a little sadness.

The insignia on her buckle—her stomach was making little

jerks the way you always do during the first few minutes when you go from breathing water to air—told me she was a Biological Technician. (Back up at the house there was a similar uniform of simulated scales folded in the bottom drawer of the dresser and the belt insignia said Depth Gauger.) I was wearing some very frayed jeans and a red cotton shirt with no buttons.

She reached up to my neck, pushed my collar back from my shoulders and touched the tender slits of my gills, outlining them with cool fingers. "Who are you?" Finally.

"Cal Svenson."

She slid back down in the water. "You're the one who had the terrible . . . but that was years ago. They still talk about it, down . . ." She stopped.

As the sea softens the surface of a piece of glass, so it blurs the souls and sensibilities of the people who toil beneath her. And according to the last report of the Marine Reclamation Division there are to date seven hundred and fifty thousand who have been given gills and webs and sent under the foam where there are no storms, up and down the American coast.

"You live on shore? I mean around here? But so long ago . . ."

"How old are you?"

"Sixteen."

"I was two years older than you when the accident happened."

"You were eighteen?"

"I'm twice that now. Which means it happened almost twenty years ago. It is a long time."

"They still talk about it."

"I've almost forgotten," I said. "I really have. Say, do you play the recorder?"

"I used to."

"Good! Come up to my place and look at my tenor recorder. And I'll make some tea. Perhaps you can stay for lunch—"

"I have to report back to Marine Headquarters by three. Tork is going over the briefing to lay the cable for the big dive,

with Jonni and the crew." She paused, smiled. "But I can catch the undertow and be there in half an hour if I leave by two-thirty."

On the walk up I learned her name was Ariel. She thought the patio was charming, and the mosaic evoked, "Oh, look!" and "Did you do this yourself?" a half-dozen times. (I had done it, in the first lonely years.) She picked out the squid and the whale in battle, the wounded shark and the diver. She told me she didn't get time to read much, but she was impressed by all the books. She listened to me reminisce. She talked a lot to me about her work, husbanding the deep-down creatures they were scaring up. Then she sat on the kitchen stool, playing a Lukas Foss serenade on my recorder, while I put rock salt in the bottom of the broiler tray for two dozen Oysters Rockefeller, and the tea water whistled. I'm a comparatively lonely guy. I like being followed by beautiful young girls.

[II]

"Hey, Juao!" I bawled across the jetty.

He nodded to me from the center of his nets, sun glistening on polished shoulders, sun lost in rough hair. I walked across to where he sat, sewing like a spider. He pulled another section up over his horny toes, then grinned at me with his mosaic smile: gold, white, black gap below, crooked yellow; white, gold, white. Shoving my bad leg in front, I squatted.

"I fished out over the coral where you told me." He filled his cheek with his tongue and nodded. "You come up to the house for a drink, eh?"

"Fine."

"Now—a moment more."

There's a certain sort of Brazilian you find along the shore in the fishing villages, old, yet ageless. See one of their men and you think he could be fifty, he could be sixty—will probably look the same when he's eighty-five. Such was Juao. We once figured it out. He's seven hours older than I am.

We became friends sometime before the accident when I

got tangled in his nets working high lines in the Vorea Current. A lot of guys would have taken their knife and hacked their way out of the situation, ruining fifty-five, sixty dollars' worth of nets. That's an average fisherman's monthly income down here. But I surfaced and sat around in his boat while he untied me. Then we came in and got plastered. Since I cost him a day's fishing, I've been giving him hints on where to fish ever since. He buys me drinks when I come up with something.

This has been going on for twenty years. During that time my life has been smashed up and land-bound. In the same time Juao has married off his five sisters, got married himself and has two children. (Oh, those *bolitos* and *teneros asados* that Amalia of the oiled braid and laughing breasts would make for Sunday dinner/supper/Monday breakfast.) I rode with them in the ambulance 'copter all the way into Brasilia and in the hospital hall Juao and I stood together, both still barefoot, he tattered with fish scales in his hair, me just tattered, and I held him while he cried and I tried to explain to him how a world that could take a pre-pubescent child and with a week of operations make an amphibious creature that can exist for a month on either side of the sea's foam-fraught surface could still be helpless before certain general endocrine cancers coupled with massive renal deterioration. Juao and I returned to the village alone, by bus, three days before our birthday—back when I was twenty-three and Juao was twenty-three and seven hours old.

"This morning," Juao said. (The shuttle danced in the web at the end of the orange line.) "I got a letter for you to read me. It's about the children. Come on, we go up and drink." The shuttle paused, back-tracked twice, and he yanked the knot tight. We walked along the port toward the square. "Do you think the letter says that the children are accepted?"

"It's from the Aquatic Corp. And they just send postcards when they reject someone. The question is, how do you feel about it?"

"You are a good man. If they grow up like you, then it will be fine."

"But you're still worried." I'd been prodding Juao to get the kids into the International Aquatic Corp nigh on since I became their godfather. The operations had to be performed near puberty. It would mean much time away from the village during their training period—and they might eventually be stationed in any ocean in the world. But two motherless children had not been easy on Juao or his sisters. The Corp would mean education, travel, interesting work, the things that make up one kind of good life. They wouldn't look twice their age when they were thirty-five; and not too many amphimen look like me.

"Worry is part of life. But the work is dangerous. Did you know there is an amphiman going to try and lay cable down in the Slash?"

I frowned. "Again?"

"Yes. And that is what you tried to do when the sea broke you to pieces and burned the parts, eh?"

"Must you be so damned picturesque?" I asked. "Who's going to beard the lion this time?"

"A young amphiman named Tork. They speak of him down at the docks as a brave man."

"Why the hell are they still trying to lay the cable there? They've gotten by this long without a line through the Slash."

"Because of the fish," Juao said. "You told me why twenty years ago. The fish are still there, and we fishermen who can not go below are still here. If the children go for the operations, then there will be less fishermen. But today . . ." He shrugged. "They must either lay the line across the fish paths or down in the Slash." Juao shook his head.

Funny things, the great power cables the Aquatic Corp has been strewing across the ocean floor to bring power to their undersea mines and farms, to run their oil wells—and how many flaming wells have I capped down there—for their herds of whale, and chemical distillation plants. They carry two

hundred sixty cycle current. Over certain sections of the ocean floor, or in sections of the water with certain mineral contents, this sets up inductance in the water itself which sometimes—and you will probably get a Nobel prize if you can detail exactly why it isn't always—drives the fish away over areas up to twenty-five and thirty miles, unless the lines are laid in the bottom of those canyons that delve into the ocean floor.

"This Tork thinks of the fishermen. He is a good man too."

I raised my eyebrows—the one that's left, anyway—and tried to remember what my little Undine had said about him that morning. And remembered not much.

"I wish him luck," I said.

"What do you feel about this young man going down into the coral rimmed jaws to the Slash?"

I thought for a moment. "I think I hate him."

Juao looked up.

"He is an image in a mirror where I look and am forced to regard what I was," I went on. "I envy him the chance to succeed where I failed, and I can come on just as quaint as you can. I hope he makes it."

Juao twisted his shoulders in a complicated shrug (once I could do that) which is coastal Brazilian for, "I didn't know things had progressed to that point, but seeing that they have, there is little to be done."

"The sea is that sort of mirror," I said.

"Yes," Juao nodded.

Behind us I heard the slapping of sandals on concrete. I turned in time to catch my goddaughter in my good arm. My godson had grabbed hold of the bad one and was swinging on it.

"Tio Cal—"

"Hey, Tio Cal, what did you bring us?"

"You will pull him over," Juao reprimanded them. "Let go." And, bless them, they ignored their father.

"What did you bring us?"

"What did you bring us, Tio Cal?"

"If you let me, I'll show you." So they stepped back,

green-eyed and quivering. I watched Juao watching: brown pupils on ivory balls, and in the left eye a vein had broken in a jagged smear. He was loving his children, who would soon be as alien to him as the fish he netted. He was also looking at the terrible thing that was me and wondering what would come to his own spawn. And he was watching the world turn and grow older, clocked by the waves, reflected in that mirror.

It's impossible for me to see what the population explosion and the budding colonies on Luna and Mars and the flowering beneath the ocean really look like from the disrupted cultural *mélange* of a coastal fishing town. But I come closer than many others, and I know what I don't understand.

I pushed around in my pocket and fetched out the milky fragment I had brought from the beach. "Here. Do you like this one?" And they bent above my webbed and alien fingers.

In the supermarket, which is the biggest building in the village, Juao bought a lot of cake mixes. "That moist, delicate texture," whispered the box when you lifted it from the shelf, "with that deep flavor, deeper than chocolate."

I'd just read an article about the new vocal packaging in a U.S. magazine that had gotten down last week, so I was prepared and stayed in the fresh vegetable section to avoid temptation. Then we went up to Juao's house. The letter proved to be what I'd expected. The kids had to take the bus into Brasilia tomorrow. My godchildren were on their way to becoming fish.

We sat on the front steps and drank and watched the donkeys and the motorbikes, the men in baggy trousers, the women in yellow scarfs and brighter skirts with wreaths of garlic and sacks of onions. As well, a few people glittered by in the green scales of amphimen uniforms.

Finally Juao got tired and went in to take a nap. Most of my life has been spent on the coast of countries accustomed to siestas, but those first formative ten were passed on a Danish collective farm and the idea never really took. So I stepped over

my goddaughter, who had fallen asleep on her fists on the bottom step, and walked back through the town toward the beach.

[III]

At midnight Ariel came out of the sea, climbed the rocks and clicked her nails against my glass wall so that droplets ran down, pearled by the gibbous moon.

Earlier I had stretched in front of the fireplace on the sheepskin throw to read, then dozed off. The conscientious timer had asked me if there was anything I wanted, and getting no answer had turned off the Dvorak Cello Concerto that was on its second time around, extinguished the reading lamp, and stopped dropping logs onto the flame so that now, as I woke, the grate was carpeted with coals.

She clicked on the glass again, and I raised my head from the cushion. The green uniform, her amber hair— all color was lost under the silver light outside. I lurched across the rug to the glass wall, touched the button, and the glass slid down into the floor. The breeze came to my face, as the barrier fell.

“What do you want?” I asked. “What time is it, anyway?”

“Tork is on the beach, waiting for you.”

The night was warm but windy. Below the rocks silver flakes chased each other in to shore. The tide lay full.

I rubbed my face. “The new boss man? Why didn’t you bring him up to the house? What does he want to see me about?”

She touched my arm. “Come. They are all down on the beach.”

“Who all?”

“Tork and the others.”

She led me across the patio and to the path that wound to the sand. The sea roared in the moonlight. Down the beach people stood around a driftwood fire that whipped into night. Ariel walked beside me.

Two of the fishermen from town were crowding each other

on the bottom of an overturned washtub, playing guitars. The singing, raucous and rhythmic, jarred across the paled sand. Shark's teeth shook on the necklace of an old woman dancing. Others were sitting on an overturned dinghy, eating.

Over one part of the fire on a skillet two feet across, oil frothed through pink islands of shrimp. One woman ladled them in, another ladled them out.

"Tio Cal!"

"Look, Tio Cal is here!"

"Hey, what are you two doing up?" I asked. "Shouldn't you be home in bed?"

"Poppa Juao said we could come. He'll be here, too, soon."

I turned to Ariel. "Why are they all gathering?"

"Because of the laying of the cable tomorrow at dawn."

Someone was running up the beach, waving a bottle in each hand.

"They didn't want to tell you about the party. They thought that it might hurt your pride."

"My what . . . ?"

"If you knew they were making so big a thing of the job you had failed at—"

"But—"

"—and that had hurt you so in failure. They did not want you to be sad. But Tork wants to see you. I said you would not be sad. So I went to bring you down from the rocks."

"Thanks, I guess."

"Tio Cal?"

But the voice was bigger and deeper than a child's.

He sat on a log back from the fire, eating a sweet potato. The flame flickered on his dark cheekbones, in his hair, wet and black. He stood, came to me, held up his hand. I held up mine and we slapped palms. "Good." He was smiling. "Ariel told me you would come. I will lay the power line down through the Slash tomorrow." His uniform scales glittered down his arms. He was very strong. But standing still, he still moved. The light on the cloth told me that. "I . . ." He paused.

I thought of a nervous, happy dancer. "I wanted to talk to you about the cable." I thought of an eagle, I thought of a shark. "And about the . . . accident. If you would."

"Sure," I said. "If there's anything I could tell you that would help."

"See, Tork," Ariel said. "I told you he would talk to you about it."

I could hear his breathing change. "It really doesn't bother you to talk about the accident?"

I shook my head and realized something about that voice. It was a boy's voice that could imitate a man's. Tork was not over nineteen.

"We're going fishing soon," Tork told me. "Will you come?"

"If I'm not in the way."

A bottle went from the woman at the shrimp crate to one of the guitarists, down to Ariel, to me, then to Tork. (The liquor, made in a cave seven miles inland, was almost rum. The too tight skin across the left side of my mouth makes the manful swig a little difficult to bring off. I got "rum" down my chin.)

He drank, wiped his mouth, passed the bottle on and put his hand on my shoulder. "Come down to the water."

We walked away from the fire. Some of the fishermen stared after us. A few of the amphimen glanced, and glanced away.

"Do all the young people of the village call you Tio Cal?"

"No. Only my godchildren. Their father and I have been friends since I was your age."

"Oh, I thought perhaps it was a nickname. That's why I called you that."

We reached wet sand where orange light cavorted at our feet. The broken shell of a lifeboat rocked in moonlight. Tork sat down on the shell's rim. I sat beside him. The water splashed to our knees.

"There's no other place to lay the power cable?" I asked. "There is no other way to take it except through the Slash?"

"I was going to ask you what you thought of the whole business. But I guess I don't really have to." He shrugged and

clapped his hands together a few times. "All the projects this side of the bay have grown huge and cry for power. The new operations tax the old lines unmercifully. There was a power failure last July in Cayine down the shelf below the twilight level. The whole village was without light for two days, and twelve amphimen died of overexposure to the cold currents coming up from the depths. If we laid the cables farther up, we chance disrupting our own fishing operations as well as those of the fishermen on shore."

I nodded.

"Cal, what happened to you in the Slash?"

Eager, scared Tork. I was remembering now, not the accident, but the midnight before, pacing the beach, guts clamped with fists of fear and anticipation. Some of the Indians back where they make the liquor still send messages by tying knots in palm fibers. One could have spread my entrails then, or Tork's tonight, to read our respective horoscopes.

Juao's mother knew the knot language, but he and his sisters never bothered to learn because they wanted to be modern, and, as children, still confused with modernity the new ignorances, lacking modern knowledge.

"When I was a boy," Tork said, "we would dare each other to walk the boards along the edge of the ferry slip. The sun would be hot and the boards would rock in the water, and if the boats were in and you fell down between the boats and the piling, you could get killed." He shook his head. "The crazy things kids will do. That was back when I was eight or nine, before I became a waterbaby."

"Where was it?"

Tork looked up. "Oh, Manila. I'm Filipino."

The sea licked our knees, and the gunwale sagged under us.

"What happened in the Slash?"

"There's a volcanic flaw near the base of the Slash."

"I know."

"And the sea is as sensitive down there as a fifty-year-old woman with a new hairdo. We had an avalanche. The cable

broke. And the sparks were so hot and bright they made gouts of foam fifty feet high on the surface, so they tell me.”

“What caused the avalanche?”

I shrugged. “It could have been just a goddamned coincidence. There are rock falls down there all the time. It could have been the noise from the machines—though we masked them pretty well. It could have been something to do with the inductance from the smaller cables for the machines. Or maybe somebody just kicked out the wrong stone that was holding everything up.”

One webbed hand became a fist, sank into the other, and hung. Calling, “Cal!”

I looked up. Juao, pants rolled to his knees, shirt sailing in the sea wind, stood in the wave of white water. The wind lifted Tork’s hair from his neck; and the fire roared on the beach.

Tork looked up too.

“They’re getting ready to catch a big fish!” Juao called.

Men were already pushing their boats out. Tork clapped my shoulder. “Come, Cal. We fish now.” We stood and went back to the shore.

Juao caught me as I reached dry sand. “You ride in my boat, Cal!”

Someone came with the acrid flares that hissed. The water slapped around the bottom of the boats as we wobbled into the swell.

Juao vaulted in and took up the oars. Around us green amphimen walked into the sea, struck forward, and were gone.

Juao pulled, leaned, pulled. The moonlight slid down his arms. The fire diminished on the beach.

Then among the boats, there was a splash, an explosion, and the red flare bloomed in the sky: the amphimen had sighted a big fish.

The flare hovered, pulsed once, twice, three times, four times (twenty, forty, sixty, eighty stone they estimated its weight to be), then fell.

Suddenly I shrugged out of my shirt, pulled at my belt buckle. “I’m going over the side, Juao!”

He leaned, he pulled, he leaned. "Take the rope."

"Yeah. Sure." It was tied to the back of the boat. I made a loop in the other end, slipped it around my shoulder. I swung my bad leg over the side, flung myself on the black water—

—mother of pearl shattered over me. That was the moon, blocked by the shadow of Juao's boat ten feet overhead. I turned below the rippling wounds Juao's oars made stroking the sea.

One hand and one foot with torn webs, I rolled over and looked down. The rope snaked to its end, and I felt Juao's strokes pulling me through the water.

They fanned below with underwater flares. Light undulated on their backs and heels. They circled, they closed, like those deep sea fish who carry their own illumination. I saw the prey, glistening as it neared a flare.

You chase a fish with one spear among you. And that spear would be Tork's tonight. The rest have ropes to bind him that go up to the fishermen's boats.

There was a sudden confusion of lights below. The spear had been shot!

The fish, long as a tall and a short man together, rose through the ropes. He turned out to sea, trailing his pursuers. But others waited there, tried to loop him. Once I had flung those ropes, treated with tar and lime to dissolve the slime of the fish's body and hold on the beast. The looped ropes caught, and by the movement of the flares, I saw them jerked from their paths. The fish turned, rose again, this time toward me.

He pulled around when one line ran out (and somewhere on the surface the prow of a boat doffed deep) and turned back and came on.

Of a sudden, amphimen were flicking about me as the fray's center drifted by. Tork, his spear dug deep, forward and left of the marlin's dorsal, had hauled himself astride the beast.

The fish tried to shake him, then dropped his tail and rose straight. Everybody started pulling toward the surface. I broke foam and grabbed Juao's gunwale.

Tork and the fish exploded up among the boats. They twisted

in the air, in moonlight, in froth. The fish danced across the water on its tail, fell.

Juao stood up in the boat and shouted. The other fishermen shouted too, and somebody perched on the prow of a boat flung a rope and someone in the water caught it.

Then fish and Tork and me and a dozen amphimen all went underwater at once.

They dropped in a corona of bubbles. The fish struck the end of another line, and shook himself. Tork was thrown free, but he doubled back.

Then the lines began to haul the beast up again, quivering, whipping, quivering again.

Six lines from six boats had him. For one moment he was still in the submarine moonlight. I could see his wound tossing scarfs of blood.

When he (and we) broke surface, he was thrashing again, near Juao's boat. I was holding onto the side when suddenly Tork, glistening, came out of the water beside me and went over into the dinghy.

"Here we go," he said, turning to kneel at the bobbing rim, and pulled me up while Juao leaned against the far side to keep balance.

Wet rope slopped on the prow. "Hey, Cal!" Tork laughed, grabbed it up, and began to haul.

The fish prized wave from white wave in the white water.

The boats came together. The amphimen had all climbed up. Ariel was across from us, holding a flare that drooled smoke down her arm. She peered by the hip of the fisherman who was standing in front of her.

Juao and Tork were hauling the rope. Behind them I was coiling it with one hand as it came back to me.

The fish came up and was flopped into Ariel's boat, tail out, head up, chewing air.

I had just finished pulling on my trousers when Tork fell down on the seat behind me and grabbed me around the shoulders with his wet arms. "Look at our fish, Tio Cal! Look!"

He gasped air, laughing, his dark face diamonded beside the flares. "Look at our fish there, Cal!"

Juao, grinning white and gold, pulled us back in to shore. The fire, the singing, hands beating hands—and my godson had put pebbles in the empty rum bottle and was shaking them to the music—the guitars spiraled around us as we carried the fish up the sand and the men brought the spit.

"Watch it!" Tork said, grasping the pointed end of the great stick that was thicker than his wrist.

We turned the fish over.

"Here, Cal?"

He prodded two fingers into the white flesh six inches back from the bony lip.

"Fine."

Tork jammed the spit in.

We worked it through the body. By the time we carried it to the fire, they had brought more rum.

"Hey, Tork. Are you going to get some sleep before you go down in the morning?" I asked.

He shook his head. "Slept all afternoon." He pointed toward the roasting fish with his elbow. "That's my breakfast."

But when the dancing grew violent a few hours later, just before the fish was to come off the fire, and the kids were pushing the last of the sweet potatoes from the ashes with sticks, I walked back to the lifeboat shell we had sat on earlier. It was three quarters flooded.

Curled below still water, Tork slept, fist loose before his mouth, the gills at the back of his neck pulsing rhythmically. Only his shoulder and hip made islands in the floated boat.

"Where's Tork?" Ariel asked me at the fire. They were swinging up the sizzling fish.

"Taking a nap."

"Oh, he wanted to cut the fish!"

"He's got a lot of work coming up. Sure you want to wake him up?"

“No, I’ll let him sleep.”

But Tork was coming up from the water, brushing his dripping hair back from his forehead.

He grinned at us, then went to carve. I remember him standing on the table, astraddle the meat, arm going up and down with the big knife (details, yes, those are the things you remember) stopping to hand down the portions, then hauling his arm back to cut again.

That night, with music and stomping on the sand and shouting back and forth over the fire, we made more noise than the sea.

[IV]

The eight-thirty bus was more or less on time.

“I don’t think they want to go,” Juao’s sister said. She was accompanying the children to the Aquatic Corp Headquarters in Brasilia.

“They are just tired,” Juao said. “They should not have stayed up so late last night. Get on the bus now. Say good-bye to Tio Cal.”

“Good-bye.”

“Good-bye.”

Kids are never their most creative in that sort of situation. And I suspect that my godchildren may just have been suffering their first (or one of their first) hangovers. They had been very quiet all morning.

I bent down and gave them a clumsy hug. “When you come back on your first weekend off, I’ll take you exploring down below at the point. You’ll be able to gather your own coral now.”

Juao’s sister got teary, cuddled the children, cuddled me, Juao, then got on the bus.

Someone was shouting out the window for someone else at the bus stop not to forget something. They trundled around the square and then toward the highway. We walked back across

the street where the café owners were putting out canvas chairs.

"I will miss them," he said, like a long-considered admission.

"You and me both." At the docks near the hydrofoil wharf where the submarine launches went out to the undersea cities, we saw a crowd. "I wonder if they had any trouble laying the—"

A woman screamed in the crowd. She pushed from the others, dropping eggs and onions. She began to pull her hair and shriek. (Remember the skillet of shrimp? She had been the woman ladling them out.) A few people moved to help her.

A clutch of men broke off and ran into the streets of the town. I grabbed a running amphiman, who whirled to face me.

"What in hell is going on?"

For a moment his mouth worked on his words for all the trite world like a beached fish.

"From the explosion . . ." he began. "They just brought them back from the explosion at the Slash!"

I grabbed his other shoulder. "What happened!"

"About two hours ago. They were just a quarter of the way through, when the whole fault gave way. They had a goddamn underwater volcano for half an hour. They're still getting seismic disturbances."

Juao was running toward the launch. I pushed the guy away and limped after him, struck the crowd and jostled through calico, canvas and green scales.

They were carrying the corpses out of the hatch of the submarine and laying them on a canvas spread across the dock. They still return bodies to the countries of birth for the family to decide the method of burial. When the fault had given, the hot slag that had belched into the steaming sea was mostly molten silicon.

Three of the bodies were only slightly burned here and there; from their bloated faces (one still bled from the ear) I guessed they had died from sonic concussion. But several of the bodies were almost totally encased in dull, black glass.

"Tork—" I kept asking. "Is one of them Tork?"

It took me forty-five minutes, asking first the guys who were carrying the bodies, then going into the launch and asking some guy with a clipboard, and then going back on the dock and into the office to find out that one of the more unrecognizable bodies, yes, was Tork.

* * *

Juao brought me a glass of buttermilk in a café on the square. He sat still a long time, then finally rubbed away his white mustache, released the chair rung with his toes, put his hands on his knees.

“What are you thinking about?”

“That it’s time to go fix the nets. Tomorrow morning I will fish.” He regarded me a moment. “Where should I fish tomorrow, Cal?”

“Are you wondering about . . . well, sending the kids off today?”

He shrugged. “Fishermen from this village have drowned. Still it is a village of fishermen. Where should I fish?”

I finished my buttermilk. “The mineral content over the Slash should be high as the devil. Lots of algae will gather tonight. Lots of small fish down deep. Big fish hovering over.”

He nodded. “Good. I will take the boat out there tomorrow.”

We got up.

“See you, Juao.”

I limped back to the beach.

[V]

The fog had unsheathed the sand by ten. I walked around, poking in clumps of weeds with a stick, banging the same stick on my numb leg. When I lurched up to the top of the rocks, I stopped in the still grass. “Ariel?”

She was kneeling in the water, head down, red hair breaking over sealed gills. Her shoulders shook, stopped, shook again.

“Ariel?” I came down over the blistered stones.

She turned away to look at the ocean.

The attachments of children are so important and so brittle. "How long have you been sitting here?"

She looked at me now, the varied waters of her face stilled on drawn cheeks. And her face was exhausted. She shook her head.

Sixteen? Who was the psychologist a hundred years back, in the seventies, who decided that "adolescents" were just physical and mental adults with no useful work? "You want to come up to the house?"

The head shaking got faster, then stopped.

After a while I said, "I guess they'll be sending Tork's body back to Manila."

"He didn't have a family," she explained. "He'll be buried here, at sea."

"Oh," I said.

And the rough volcanic glass, pulled across the ocean's sands, changing shape, dulling—

"You were—you liked Tork a lot, didn't you? You kids looked like you were pretty fond of each other."

"Yes. He was an awfully nice—" Then she caught my meaning and blinked. "No," she said. "Oh, no. I was—I was engaged to Jonni . . . the brown-haired boy from California? Did you meet him at the party last night? We're both from Los Angeles, but we only met down here. And now . . . they're sending his body back this evening." Her eyes got wide, then closed.

"I'm sorry."

That's it, you clumsy cripple, step all over everybody's emotions. You look in that mirror and you're too busy looking at what might have been to see what is.

"I'm sorry, Ariel."

She opened her eyes and began to look around her.

"Come on up to the house and have an avocado. I mean, they have avocados in now, not at the supermarket. But at the old town market on the other side. And they're better than any they grow in California."

She kept looking around.

“None of the amphimen get over there. It’s a shame, because soon the market will probably close, and some of their fresh foods are really great. Oil and vinegar is all you need on them.” I leaned back on the rocks. “Or a cup of tea?”

“OK.” She remembered to smile. I know the poor kid didn’t feel like it. “Thank you. I won’t be able to stay long, though.”

We walked back up the rocks toward the house, the sea on our left. Just as we reached the patio, she turned and looked back. “Cal?”

“Yes? What is it?”

“Those clouds over there, across the water. Those are the only ones in the sky. Are they from the eruption in the Slash?”

I squinted. “I think so. Come on inside.”

Four men, two by two, had gone into the howling maelstrom that was Jupiter and had not returned. They had walked into the keening gale—or rather, they had loped, bellies low against the ground, wet sides gleaming in the rain.

For they did not go in the shape of men.

Now the fifth man stood before the desk of Kent Fowler, head of Dome No. 3, Jovian Survey Commission.

Under Fowler's desk, old Towser scratched a flea, then settled down to sleep again.

Harold Allen, Fowler saw with a sudden pang, was young—too young. He had the easy confidence of youth, the face of one who never had known fear. And that was strange. For men in the domes of Jupiter did know fear—fear and humility. It was hard for Man to reconcile his puny self with the mighty forces of the monstrous planet.

"You understand," said Fowler, "that you need not do this. You understand that you need not go."

It was formula, of course. The other four had been told the same thing, but they had gone. This fifth one, Fowler knew, would go as well. But suddenly he felt a dull hope stir within him that Allen wouldn't go.

"When do I start?" asked Allen.

There had been a time when Fowler might have taken quiet pride in that answer, but not now. He frowned briefly.

"Within the hour," he said.

Allen stood waiting, quietly.

"Four other men have gone out and have not returned," said Fowler. "You know that, of course. We want you to return. We don't want you going off on any heroic rescue expedition. The main thing, the only thing, is that you come back, that you prove man can live in a Jovian form. Go to the

first survey stake, no farther, then come back. Don't take any chances. Don't investigate anything. Just come back."

Allen nodded. "I understand all that."

"Miss Stanley will operate the converter," Fowler went on. "You need have no fear on that particular score. The other men were converted without mishap. They left the converter in apparently perfect condition. You will be in thoroughly competent hands. Miss Stanley is the best qualified conversion operator in the solar system. She has had experience on most of the other planets. That is why she's here."

Allen grinned at the woman and Fowler saw something flicker across Miss Stanley's face—something that might have been pity, or rage—or just plain fear. But it was gone again and she was smiling back at the youth who stood before the desk. Smiling in that prim, schoolteacherish way she had of smiling, almost as if she hated herself for doing it.

"I shall be looking forward," said Allen, "to my conversion."

And the way he said it, he made it all a joke, a vast, ironic joke.

But it was no joke.

It was serious business, deadly serious. Upon these tests, Fowler knew, depended the fate of men on Jupiter. If the tests succeeded, the resources of the giant planet would be thrown open. Man would take over Jupiter as he already had taken over the other smaller planets. And if they failed—

If they failed, Man would continue to be chained and hampered by the terrific pressure, the greater force of gravity, the weird chemistry of the planet. He would continue to be shut within the domes, unable to set actual foot upon the planet, unable to see it with direct, unaided vision, forced to rely upon the awkward tractors and televisor, forced to work with clumsy tools and mechanisms or through the medium of robots that themselves were clumsy.

For Man, unprotected and in his natural form, would be blotted out by Jupiter's terrific pressure of fifteen thousand pounds per square inch, pressure that made terrestrial sea bottoms seem a vacuum by comparison.

Even the strongest metal Earthmen could devise couldn't exist under pressure such as that, under the pressure and the alkaline rains that forever swept the planet. It grew brittle and flaky, crumbling like clay, or it ran away in little streams and puddles of ammonia salts. Only by stepping up the toughness and strength of that metal, by increasing its electronic tension, could it be made to withstand the weight of thousands of miles of swirling, choking gases that made up the atmosphere. And even when that was done, everything had to be coated with tough quartz to keep away the rain—the liquid ammonia that fell as bitter rain.

Fowler sat listening to the engines in the sub-floor of the dome—engines that ran on endlessly, the dome never quiet of them. They had to run and keep on running, for if they stopped the power flowing into the metal walls of the dome would stop, the electronic tension would ease up and that would be the end of everything.

Towser roused himself under Fowler's desk and scratched another flea, his leg thumping hard against the floor.

"Is there anything else?" asked Allen.

Fowler shook his head. "Perhaps there's something you want to do," he said. "Perhaps you—"

He had meant to say write a letter and he was glad he caught himself quick enough so he didn't say it.

Allen looked at his watch. "I'll be there on time," he said. He swung around and headed for the door.

Fowler knew Miss Stanley was watching him and he didn't want to turn and meet her eyes. He fumbled with a sheaf of papers on the desk before him.

"How long are you going to keep this up?" asked Miss Stanley, and she bit off each word with a vicious snap.

He swung around in his chair and faced her then. Her lips were drawn into a straight, thin line, her hair seemed skinned back from her forehead tighter than ever, giving her face that queer, almost startling deathmask quality.

He tried to make his voice cool and level. "As long as there's any need of it," he said. "As long as there's any hope."

"You're going to keep on sentencing them to death," she said. "You're going to keep marching them out face to face with Jupiter. You're going to sit in here safe and comfortable and send them out to die."

"There is no room for sentimentality, Miss Stanley," Fowler said, trying to keep the note of anger from his voice. "You know as well as I do why we're doing this. You realize that Man in his own form simply cannot cope with Jupiter. The only answer is to turn men into the sort of things that can cope with it. We've done it on the other planets."

"If a few men die, but we finally succeed, the price is small. Through the ages men have thrown away their lives on foolish things, for foolish reasons. Why should we hesitate, then, at a little death in a thing as great as this?"

Miss Stanley sat stiff and straight, hands folded in her lap, the lights shining on her graying hair and Fowler, watching her, tried to imagine what she might feel, what she might be thinking. He wasn't exactly afraid of her, but he didn't feel quite comfortable when she was around. Those sharp blue eyes saw too much, her hands looked far too competent. She should be somebody's aunt sitting in a rocking chair with her knitting needles. But she wasn't. She was the top-notch conversion unit operator in the solar system and she didn't like the way he was doing things.

"There is something wrong, Mr. Fowler," she declared.

"Precisely," agreed Fowler. "That's why I'm sending young Allen out alone. He may find out what it is."

"And if he doesn't?"

"I'll send someone else."

She rose slowly from her chair, started toward the door, then stopped before his desk.

"Some day," she said, "you will be a great man. You never let a chance go by. This is your chance. You knew it was when this dome was picked for the tests. If you put it through, you'll

go up a notch or two. No matter how many men may die, you'll go up a notch or two."

"Miss Stanley," he said and his voice was curt, "young Allen is going out soon. Please be sure that your machine—"

"My machine," she told him icily, "is not to blame. It operates along the coordinates the biologists set up."

He sat hunched at his desk, listening to her footsteps go down the corridor.

What she said was true, of course. The biologists had set up the coordinates. But the biologists could be wrong. Just a hair's-breadth of difference, one iota of digression, and the converter would be sending out something that wasn't the thing they meant to send. A mutant that might crack up, go haywire, come unstuck under some condition or stress of circumstance wholly unsuspected.

For Man didn't know much about what was going on outside. Only what his instruments told him was going on. And the samplings of those happenings furnished by those instruments and mechanisms had been no more than samplings, for Jupiter was unbelievably large and the domes were very few.

Even the work of the biologists in getting the data on the Lopers, apparently the highest form of Jovian life, had involved more than three years of intensive study and after that two years of checking to make sure. Work that could have been done on Earth in a week or two. But work that, in this case, couldn't be done on Earth at all, for one couldn't take a Jovian life form to Earth. The pressure here on Jupiter couldn't be duplicated outside of Jupiter and at Earth pressure and temperature the Lopers would simply have disappeared in a puff of gas.

Yet it was work that had to be done if Man ever hoped to go about Jupiter in the life form of the Lopers. For before the converter could change a man to another life form, every detailed physical characteristic of that life form must be known—surely and positively, with no chance of mistake.

Allen did not come back.

The tractors, combing the nearby terrain, found no trace of him, unless the skulking thing reported by one of the drivers had been the missing Earthman in Loper form.

The biologists sneered their most accomplished academic sneers when Fowler suggested the coordinates might be wrong. Carefully they pointed out the coordinates worked. When a man was put into the converter and the switch was thrown, the man became a Loper. He left the machine and moved away, out of sight, into the soupy atmosphere.

Some quirk, Fowler had suggested; some tiny deviation from the thing a Loper should be, some minor defect. If there were, the biologists said, it would take years to find it.

And Fowler knew that they were right.

So there were five men now instead of four and Harold Allen had walked out into Jupiter for nothing at all. It was as if he'd never gone, so far as knowledge was concerned.

Fowler reached across his desk and picked up the personnel file, a thin sheaf of paper neatly clipped together. It was a thing he dreaded but a thing he had to do. Somehow the reason for these strange disappearances must be found. And there was no other way than to send out more men.

He sat for a moment listening to the howling of the wind above the dome, the everlasting thundering gale that swept across the planet in boiling, twisting wrath.

Was there some threat out there, he asked himself? Some danger they did not know about? Something that lay in wait and gobbled up the Lopers, making no distinction between Lopers that were bona fide and Lopers that were men? To the gobblers, of course, it would make no difference.

Or had there been a basic fault in selecting the Lopers as the type of life best fitted for existence on the surface of the planet? The evident intelligence of the Lopers, he knew, had been one factor in that determination. For if the thing Man became did not have capacity for intelligence, Man could not for long retain his own intelligence in such a guise.

Had the biologists let that one factor weigh too heavily,

using it to offset some other factor that might be unsatisfactory, even disastrous? It didn't seem likely. Stiffnecked as they might be, the biologists knew their business.

Or was the whole thing impossible, doomed from the very start? Conversion to other life forms had worked on other planets, but that did not necessarily mean it would work on Jupiter. Perhaps Man's intelligence could not function correctly through the sensory apparatus provided Jovian life. Perhaps the Lopers were so alien there was no common ground for human knowledge and the Jovian conception of existence to meet and work together.

Or the fault might lie with Man, be inherent with the race. Some mental aberration which, coupled with what they found outside, wouldn't let them come back. Although it might not be an aberration, not in the human sense. Perhaps just one ordinary human trait, accepted as commonplace on Earth, would be so violently at odds with Jovian existence that it would blast human sanity.

Claws rattled and clicked down the corridor. Listening to them, Fowler smiled wanly. It was Towser coming back from the kitchen, where he had gone to see his friend, the cook.

Towser came into the room, carrying a bone. He wagged his tail at Fowler and flopped down beside the desk, bone between his paws. For a long moment his rheumy old eyes regarded his master, and Fowler reached down a hand to ruffle a ragged ear.

"You still like me, Towser?" Fowler asked, and Towser thumped his tail.

"You're the only one," said Fowler.

He straightened and swung back to the desk. His hand reached out and picked up the file.

Bennett? Bennett had a girl waiting for him back on Earth.

Andrews? Andrews was planning on going back to Mars Tech just as soon as he earned enough to see him through a year.

Olson? Olson was nearing pension age. All the time telling the boys how he was going to settle down and grow roses.

Carefully, Fowler laid the file back on the desk.

Sentencing men to death. Miss Stanley had said that, her pale lips scarcely moving in her parchment face. Marching men out to die while he, Fowler, sat here safe and comfortable.

They were saying it all through the dome, no doubt, especially since Allen had failed to return. They wouldn't say it to his face, of course. Even the man or men he called before this desk and told they were the next to go wouldn't say it to him.

But he would see it in their eyes.

He picked up the file again. Bennett, Andrews, Olson. There were others, but there was no use in going on.

Kent Fowler knew that he couldn't do it, couldn't face them, couldn't send more men out to die.

He leaned forward and flipped up the toggle on the intercommunicator.

"Yes, Mr. Fowler."

"Miss Stanley, please."

He waited for Miss Stanley, listening to Towser chewing half-heartedly on the bone. Towser's teeth were getting bad.

"Miss Stanley," said Miss Stanley's voice.

"Just wanted to tell you, Miss Stanley, to get ready for two more."

"Aren't you afraid," asked Miss Stanley, "that you'll run out of them? Sending out one at a time, they'd last longer, give you twice the satisfaction."

"One of them," said Fowler, "will be a dog."

"A dog!"

"Yes, Towser."

He heard the quick, cold rage that iced her voice. "Your own dog! He's been with you all these years—"

"That's the point," said Fowler. "Towser would be unhappy if I left him behind."

It was not the Jupiter he had known through the televisior. He had expected it to be different, but not like this. He had expected a hell of ammonia rain and stinking fumes and the deafening, thundering tumult of the storm. He had expected

swirling clouds and fog and the snarling flicker of monstrous thunderbolts.

He had not expected that the lashing downpour would be reduced to drifting purple mist that moved like fleeing shadows over a red and purple sward. He had not even guessed the snaking bolts of lightning would be flares of pure ecstasy across a painted sky.

Waiting for Towser, Fowler flexed the muscles of his body, amazed at the smooth, sleek strength he found. Not a bad body, he decided, and grimaced at remembering how he had pitied the Lopers when he glimpsed them through a television screen.

For it had been hard to imagine a living organism based upon ammonia and hydrogen rather than upon water and oxygen, hard to believe that such a form of life could know the same quick thrill of life that humankind could know. Hard to conceive of life out in the soupy maelstrom that was Jupiter, not knowing, of course, that through Jovian eyes it was no soupy maelstrom at all.

The wind brushed against him with what seemed gentle fingers and he remembered with a start that by Earth standards the wind was a roaring gale, a two-hundred-mile-an-hour howler laden with deadly gases.

Pleasant scents seeped into his body. And yet scarcely scents, for it was not the sense of smell as he remembered it. It was as if his whole being was soaking up the sensation of lavender—and yet not lavender. It was something, he knew, for which he had no word, undoubtedly the first of many enigmas in terminology. For the words he knew, the thought symbols that served him as an Earthman, would not serve him as a Jovian.

The lock in the side of the dome opened and Towser came tumbling out—at least he thought it must be Towser.

He started to call to the dog, his mind shaping the words he meant to say. But he couldn't say them. There was no way to say them. He had nothing to say them with.

For a moment his mind swirled in muddy terror, a blind fear that eddied in little puffs of panic through his brain.

How did Jovians talk? How—

Suddenly he was aware of Towser, intensely aware of the bumbling, eager friendliness of the shaggy animal that had followed him from Earth to many planets. As if the thing that was Towser had reached out and for a moment sat within his brain.

And out of the bubbling welcome that he sensed, came words.
“Hiya, pal.”

Not words really, better than words. Thought symbols in his brain, communicated thought symbols that had shades of meaning words could never have.

“Hiya, Towser,” he said.

“I feel good,” said Towser. “Like I was a pup. Lately I’ve been feeling pretty punk. Legs stiffening up on me and teeth wearing down to almost nothing. Hard to mumble a bone with teeth like that. Besides, the fleas give me hell. Used to be I never paid much attention to them. A couple of fleas more or less never meant much in my early days.”

“But . . . but—” Fowler’s thoughts tumbled awkwardly.
“You’re talking to me!”

“Sure thing,” said Towser. “I always talked to you, but you couldn’t hear me. I tried to say things to you, but I couldn’t make the grade.”

“I understood you sometimes,” Fowler said.

“Not very well,” said Towser. “You knew when I wanted food and when I wanted a drink, and when I wanted out, but that’s about all you ever managed.”

“I’m sorry,” Fowler said.

“Forget it,” Towser told him. “I’ll race you to the cliff.”

For the first time, Fowler saw the cliff, apparently many miles away, but with a strange crystalline beauty that sparkled in the shadow of the many-colored clouds.

Fowler hesitated. “It’s a long way—”

“Ah, come on,” said Towser, and even as he said it he started for the cliff.

Fowler followed, testing his legs, testing the strength in that

new body of his, a bit doubtful at first, amazed a moment later, then running with a sheer joyousness that was one with the red and purple sward, with the drifting smoke of the rain across the land.

As he ran the consciousness of music came to him, a music that beat into his body, that surged throughout his being, that lifted him on wings of silver speed. Music like bells might make from some steeple on a sunny springtime hill.

As the cliff drew nearer the music deepened and filled the universe with a spray of magic sound. And he knew the music came from the tumbling waterfall that feathered down the face of the shining cliff.

Only, he knew, it was no waterfall, but an ammonia-fall, and the cliff was white because it was oxygen, solidified.

He skidded to a stop beside Towser where the waterfall broke into a glittering rainbow of many hundred colors. Literally many hundred, for here, he saw, was no shading of one primary to another such as human beings saw, but a clear-cut selectivity that broke the prism down to its last ultimate classification.

"The music," said Towser.

"Yes, what about it?"

"The music," said Towser, is vibrations. Vibrations of water falling."

"But, Towser, you don't know about vibrations."

"Yes, I do," contended Towser. "It just popped into my head."

Fowler gulped mentally. "Just popped!"

And suddenly, within his own head, he held a formula—the formula for a process that would make metal to withstand the pressure of Jupiter.

He stared, astounded, at the waterfall and swiftly his mind took the many colors and placed them in their exact sequence in the spectrum. Just like that. Just out of blue sky. Out of nothing, for he knew nothing either of metals or of colors.

"Towser," he cried. "Towser, something's happening to us!"

“Yeah, I know,” said Towser.

“It’s our brains,” said Fowler. “We’re using them, all of them, down to the last hidden corner. Using them to figure out things we should have known all the time. Maybe the brains of Earth-things naturally are slow and foggy. Maybe we are the morons of the universe. Maybe we are fixed so we have to do things the hard way.”

And, in the new sharp clarity of thought that seemed to grip him, he knew that it would not only be the matter of colors in a waterfall or metals that would resist the pressure of Jupiter. He sensed other things, things not yet quite clear. A vague whispering that hinted of greater things, of mysteries beyond the pale of human thought, beyond even the pale of human imagination. Mysteries, fact, logic built on reasoning. Things that any brain should know if it used all its reasoning power.

“We’re still mostly Earth,” he said. “We’re just beginning to learn a few of the things we are to know—a few of the things that were kept from us as human beings, perhaps because we were human beings. Because our human bodies were poor bodies. Poorly equipped for thinking, poorly equipped in certain senses that one has to have to know. Perhaps even lacking in certain senses that are necessary to true knowledge.”

He stared back at the dome, a tiny black thing dwarfed by the distance.

Back there were men who couldn’t see the beauty that was Jupiter. Men who thought that swirling clouds and lashing rain obscured the planet’s face. Unseeing human eyes. Poor eyes. Eyes that could not see the beauty in the clouds, that could not see through the storm. Bodies that could not feel the thrill of trilling music stemming from the rush of broken water.

Men who walked alone, in terrible loneliness, talking with their tongues like Boy Scouts wigwagging out their messages, unable to reach out and touch one another’s mind as he could reach out and touch Towser’s mind. Shut off forever from that personal, intimate contact with other living things.

He, Fowler, had expected terror inspired by alien things out

here on the surface, had expected to cower before the threat of unknown things, had steeled himself against disgust of a situation that was not of Earth.

But instead he had found something greater than Man had ever known. A swifter, surer body. A sense of exhilaration, a deeper sense of life. A sharper mind. A world of beauty that even the dreamers of the Earth had not yet imagined.

"Let's get going," Towser urged.

"Where do you want to go?"

"Anywhere," said Towser. "Just start going and see where we end up. I have a feeling . . . well, a feeling—"

"Yes, I know," said Fowler.

For he had the feeling, too. The feeling of high destiny. A certain sense of greatness. A knowledge that somewhere off beyond the horizons lay adventure and things greater than adventure.

Those other five had felt it, too. Had felt the urge to go and see, the compelling sense that here lay a life of fullness and of knowledge.

That, he knew, was why they had not returned.

"I won't go back," said Towser.

"We can't let them down," said Fowler.

Fowler took a step or two, back toward the dome, then stopped.

Back to the dome. Back to that aching, poison-laden body he had left. It hadn't seemed aching before, but now he knew it was.

Back to the fuzzy brain. Back to muddled thinking. Back to the flapping mouths that formed signals others understood. Back to eyes that now would be worse than no sight at all. Back to squalor, back to crawling, back to ignorance.

"Perhaps some day," he said, muttering to himself.

"We got a lot to do and a lot to see," said Towser. "We got a lot to learn. We'll find things—"

Yes, they could find things. Civilizations, perhaps. Civilizations that would make the civilization of Man seem puny by

comparison. Beauty and, more important, an understanding of that beauty. And a comradeship no one had ever known before—that no man, no dog had ever known before.

And life. The quickness of life after what seemed a drugged existence.

“I can’t go back,” said Towser.

“Nor I,” said Fowler.

“They would turn me back into a dog,” said Towser.

“And me,” said Fowler, “back into a man.”

[illegible]

direct contact among galactic civilizations*

**"There is no use trying," she said: "one can't believe impossible things."
"I daresay you haven't had much practice," said the Queen. "When I
was your age, I always did it for half-an-hour a day. Why, sometimes I've
believed as many as six impossible things before breakfast."**

Lewis Carroll, *Alice in Wonderland*

**"What matters it how far we go?" his scaly friend replied,
"There is another shore, you know, upon the other side.
The farther off from England, the nearer is to France;
Then turn not pale, beloved snail, but come and join the dance."**

Lewis Carroll, *The Lobster Quadrille*

■ Among the possible ways of effecting interstellar communication, we have considered automatic interstellar probe vehicles of rather limited range, and methods of electromagnetic communication over somewhat greater ranges. The difficulties in electromagnetic communication over interstellar distances are serious. A simple query and response to the nearest postulated technical civilization would require periods approaching 1000 years. An extended conversation—or even a one-way transmission to a particularly interesting community on the other side of the Galaxy—would occupy much greater time intervals, 10^4 to 10^5 years. Electromagnetic communication assumes that

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* "Direct Contact Among Galactic Civilizations" is an extract from Carl Sagan's annotated translation of a book by I. S. Shklovskii, *Vselen-naia, Zhizn, Razum* (in English: *Universe, Life, Mind*) which was published in Moscow in 1963. In order to avoid the possibility of attribution to Shklovskii of a view he does not hold, Sagan set off his annotations by means of symbols ■ and □, the first preceding and the second following his additions and discussions.

i.s. shklovskii and carl sagan

the choice of signal frequency will be obvious to all communities. [However,] there has been considerable disagreement about interstellar transmission frequency assignments even on our own planet. Among Galactic communities, we may expect even greater differences of opinion about what is obvious and what is not. □

If there were indeed a lack of coordination in the standard wavelength—even if the wavelength were an integral fraction or multiple of 21 cm—the extraterrestrial societies would find it very difficult to detect the signals. Furthermore, if radio contact were attempted between civilizations separated by more than 2000 or 3000 light years, and if the communication radiation would have to pass relatively close to the Galactic plane, the artificial signal would be absorbed by the interstellar medium. Such absorption could be significantly decreased if we depart slightly (1 to 2 megacycles per second) from the neutral hydrogen frequency ($1420 \text{ megacycles sec}^{-1}$); but this would again complicate the search.

■ No matter how ingenious the method, there are certain limitations on the character of the communication effected with an alien civilization by electromagnetic radiation. With billions of years of independent biological and social evolution, the thought processes and habit patterns of any two communities must differ greatly. While it seemed likely to us . . . that the transmission of pictorial representations and artificial languages such as Lincos would be easily understood by alien civilizations, this is really a conjecture. We do not know what hidden assumptions lie in our proposed communication channel, assumptions which we are unable to evaluate because they are so intimately woven into the fabric of our thinking.

■ There is a famous story in the anthropological community which illustrates this point:

■ A husband-and-wife team of anthropologists was studying adjacent villages in a remote Pacific island. Despite their proximity, different languages were spoken in the two villages. One day, the

woman anthropologist received an urgent message by bearer from her husband, asking her to come at once. She arrived in haste and found her husband in an ecstasy of anthropological exhilaration. "My dear," he said, "I have stumbled upon a marvelous philosophical insight of the inhabitants of this village." Approaching one of the villagers, he pointed to a palm tree and asked, "What is this?" The native promptly replied, let us say, "Unga munga." Next, the anthropologist pointed to a pig wallowing in the mud, and illuminated by the late afternoon sun. "What is this?"

"Unga munga," again replied the informant, with identical inflection.

Finally, in triumph, the anthropologist pointed to the village chieftain, and once again asked, "What is this?"

The respondent replied again—this time, somewhat dejectedly, it seemed—"Unga munga."

"You see—they do not make distinctions among different forms of life. Their language incorporates the unity of all living things," exclaimed the anthropologist. "Dear," suggested his wife gently, "ask him what the word for index finger is."

■ I can imagine such difficulties amplified by many orders of magnitude, were we to establish tomorrow interstellar radio contact.

■ As an example of the potential difficulties of a less subtle sort, we can consider the case of Egyptian hieroglyphics. This language was deciphered only after the discovery of the Rosetta Stone, in effect a selective dictionary in two other known languages, Demotic and Greek. But earlier, several generations of European linguists had attempted to decipher the large body of hieroglyphic writing available even then. What is noteworthy is not so much that their efforts were almost uniformly unsuccessful, but rather, that some thought they had succeeded. While the hieroglyphics are mainly syllabic, some of the early linguists thought that they were ideographic, and constructed marvelously fanciful translations in which birds of course played a leading part. The Egyptians did not write their inscriptions for the benefit of another civilization ignorant of their

language. In interstellar communication, there will be conscious attempts to make the contents clear. But our partners in the cosmic discourse will not be human beings, and it remains to be seen whether mathematics is the interstellar Rosetta Stone.

■ Electromagnetic communication does not permit three of the most exciting categories of interstellar contact:

■ (1) Contact between an advanced civilization and an intelligent but pre-technical society. □ Such contact would be particularly valuable, because the lifetime of the pre-technological era on many planets may be quite long, and the number of pre-technical civilizations in the Galaxy may greatly exceed the number of technically advanced societies.

■ (2) Direct exploration of alien nonintelligent biologies, of the interstellar medium, of exotic star systems, and of the wide range of physical phenomena unobservable from the solar neighborhood.

■ (3) The direct exchange of material objects, including biological specimens, among distant civilizations.

■ If effective interstellar electromagnetic communication is feasible, there is the possibility of a kind of surrogate exchange of material goods, despite the fact that only photons would be exchanged. We might receive, for example, detailed instructions for the construction of material objects, a scale model of the capitol of Delta Pavonis 3, a household appliance of Beta Hydri 4, or perhaps a novel scientific device developed on 82 Eridani 2. It is even possible, as Fred Hoyle has suggested, that we should receive detailed instructions for assembling the genetic material of an extraterrestrial organism, even an intelligent extraterrestrial organism. □ But even then, the demand for actual physical exchange would soon arise.

■ In electromagnetic interstellar communication, the communicants are far distant, the learning vicarious, and the duration of the discourse long. But if direct interstellar spaceflight were possible, it would sweep away these difficulties; it would reopen the arena of action for civilizations where local exploration has been completed; it would provide access beyond the planetary

frontiers. . . . We must now examine the prospect of interstellar spaceflight, manned—this will not be quite the appropriate word—by intelligent beings.

■ There are two basic methods of achieving interstellar spaceflight within characteristic human lifetimes. One involves the slowing down of human metabolic activities during very long flight times. Let us imagine that society has advanced to the stage where fast non-relativistic interstellar spaceflight is possible, with velocities of, say, $100,000 \text{ km sec}^{-1}$, one-third the speed of light. A one-way voyage to a destination planet 1000 light years distant would take some 3000 years, or slightly longer, allowing for acceleration and deceleration. A round-trip to the Galactic center would take about 60,000 years. If such voyages are to be feasible, the lifetime of our civilization should perhaps exceed the length of the voyage. Otherwise, there will be no one to come home to. Work on metabolic inhibitors is just beginning on our planet. . . . it is possible to preserve a variety of microorganisms for extended periods of time—perhaps indefinitely—by quick-freezing them to fairly low temperatures. Low-temperature preservation of human blood and sperm is now routine. But the preservation of a whole human being at low temperatures for extended periods of time has never been accomplished. The reason is essentially this: The density of ice is lower than the density of water. (This is why ice floats on ponds in winter.) Therefore, ice occupies a larger volume than the same mass of water. (For this reason, milk bottles placed outdoors on cold days undergo sometimes spectacular distortions.) Consequently, on freezing an animal such as a human being, composed largely of water, serious damage is done to his cells, both during freezing and during thawing. During freezing, the volumes of the cells increase; they encroach upon each other, and their internal structure is disrupted. During thawing, comparable contractions occur. Antifreezing chemicals are, of course, known, but it is difficult to saturate adequately a human being with such antifreezes without killing him first.

■ But there do exist possibilities which have not yet been

explored. As one example, we consider the following idea, developed jointly in conversation between myself and the Swedish biologist Carl-Gören Hedén, of the Karolinska Institute, Stockholm. While freezing preserves, it also kills, as we have just discussed, because of the difference in density between water and ice. But at high pressures, there are other kinds of ice, with different crystal structures and different densities from those of ordinary ice. At pressures of about 3000 atm and temperatures of -40°C (-40°F) or less, ordinary ice, called ice I, becomes ice II, a variety of frozen water which has very nearly the same density as the liquid. If a human being could be safely brought to and maintained at an ambient pressure of several thousand atmospheres, and then quickly and carefully frozen to very low temperatures, it might be possible to preserve him for long periods of time. This is only one of many possible alternatives. It seems possible that by the time interstellar space vehicles with velocities of $10^{10} \text{ cm sec}^{-1}$ are available, techniques for long-term preservation of a human crew will also be available. . . . [E]ven for very long journeys—say, approaching 10^5 years in duration—the background cosmic radiation will not prove a very serious hazard to the survival of the sleeping crew.

- There is another possible means of establishing manned interstellar spaceflight over long distances, which does not necessarily involve metabolic inhibitors. This is relativistic interstellar spaceflight.

- It has been known for some time that there is a remarkable effect, due to the theory of relativity, which would play a major role in spaceflights at velocities close to c , the velocity of light. The passage of time, as measured by the crew of the space vehicle, would be very slow when compared with the passage of time measured by their friends, relatives, and colleagues on their home planet. As the passengers would travel over immense distances of thousands of light years or more at relativistic velocities, they would become only slightly older. This phenomenon of relativistic time dilation is a specific consequence of the theory of special relativity formulated by Albert Einstein,

a theory whose other predictions have been repeatedly verified. Direct experimental confirmations of time dilation itself also exist. For example, the time for an elementary particle called a mu meson to decay at non-relativistic velocities is well known. If, as a result, for example, of the cosmic ray bombardment of the upper atmosphere, a mu meson were to enter the atmosphere of the Earth traveling at a velocity close to the speed of light, but with its ordinary lifetime, it would never reach the surface of the Earth, and would never be detected there. Instead, mu mesons are commonly detected at the surface of the Earth, because the time for them to decay when moving at relativistic velocities is much longer than the time for them to decay at slower velocities. There is no essential difference between biological time and physical time; both are subject to the same physical laws. Aboard a relativistic interstellar space ship, not only would the passengers' clocks move more slowly than their counterparts' on Earth, but they themselves would move more slowly, their hearts would beat more slowly, their awareness of the passage of time would be retarded. Relativistic interstellar spaceflight is in fact a kind of metabolic inhibitor, but one that works on the entire spacecraft.

■ Let us illustrate the time dilation phenomenon with a concrete example. Let us consider a spacecraft which moves with a constant acceleration as far as the midpoint of its journey, and then decelerates at the same rate to its destination. The acceleration chosen for the trip would very likely be the same as the acceleration due to gravity on the home planet. For example, on the planet Earth, the acceleration due to gravity, that is, the acceleration experienced by any falling body, is 980 cm sec^{-2} , or 32 feet sec^{-2} . If the spacecraft were to move with this same acceleration, called 1 g, the human passengers would feel quite at home, and would experience neither any sense of motion nor any untoward lightness or ponderousness. The inhabitants of a Jovian-type planet would choose accelerations of perhaps 2 g or 3 g. At an acceleration of 1 g it would take only about a year to be traveling close to the speed of light. However con-

tinued acceleration would not carry the spacecraft faster than the speed of light but only closer and closer to its value of 300,000 km/sec. This ultimate limit on velocity while unfortunate in the present context is inexorable. The impossibility of information or material objects traveling faster than light is one of the firmest foundations of contemporary physics.

■ With the above flight plan, it is then possible to compute the elapsed time in years, as measured on board the spacecraft, for a trip to a destination distant S light years from the Earth. These computations are displayed in Figure 1 for three choices of on-board acceleration—1 g , 2 g , and 3 g . We see that at an acceleration of 1 g , it takes only a few years, ship time, to reach the nearest stars; 21 years to reach the Galactic center; and 28 years to reach the nearest spiral galaxy beyond the Milky Way. With accelerations of 2 or 3 g , these distances can be negotiated in about half the time. Of course, there is no time dilation on the home planet. The elapsed time in years there approximately equals the distance of the destination in light years plus twice the time required to reach relativistic velocities. This time, at an acceleration of about 1 g , is close to one year. For distances beyond about 10 light years, the elapsed time on the home planet in years roughly equals the distance of the destination in light years. Thus, for a round-trip with a several-year stopover to the nearest stars, the elapsed time on Earth would be a few decades; to Deneb, a few centuries; to the Vela cloud complex, a few millennia; to the Galactic center, a few tens of thousands of years; to M 31, the great galaxy in Andromeda, a few million years; to the Virgo cluster of galaxies, a few tens of millions of years; and to the immensely distant Coma cluster of galaxies, a few hundreds of millions of years. Nevertheless, each of these enormous journeys could be performed within the lifetimes of a human crew, because of time dilation on board the spacecraft.

■ It is at these immense distances that another curious feature of relativistic interstellar spaceflight emerges. If for some reason we were to desire a two-way communication with the inhabitants of some nearby galaxy, we might try the transmis-

sion of electromagnetic signals, or perhaps even the launching of an automatic probe vehicle. With either method, the elapsed transmit time to the galaxy would be several millions of years at least. By that time in our future, there may be no civilization left on Earth to continue the dialogue. But if relativistic interstellar spaceflight were used for such a mission, the crew would

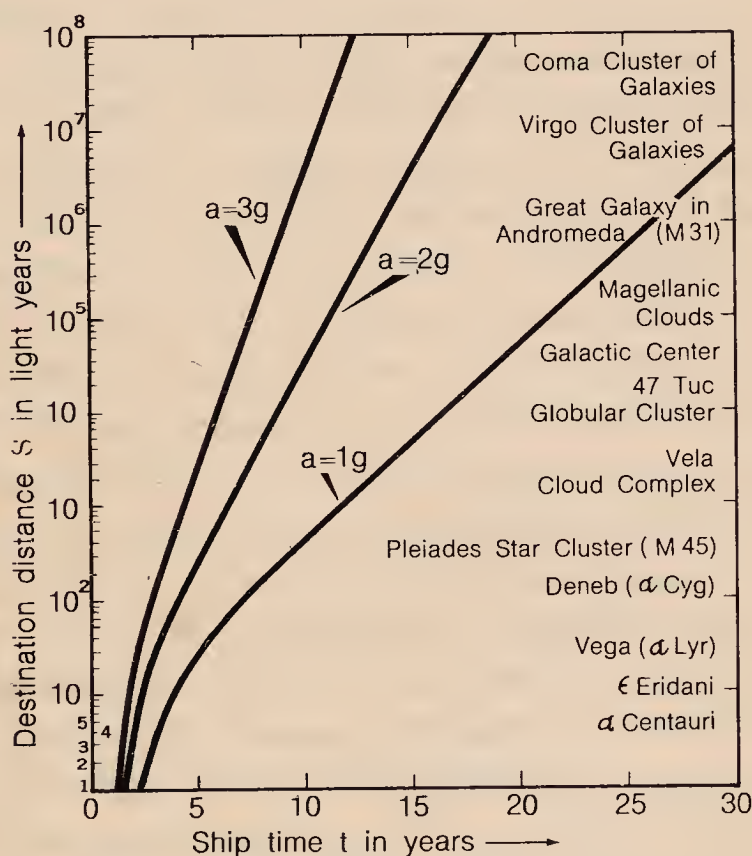


Figure 1. An illustration of the potentialities of time dilation in interstellar spaceflight. A space vehicle is imagined which has uniform acceleration of $1g$, $2g$, or $3g$ to the midpoint of its voyage and a uniform deceleration thereafter. It is seen that immense distances—millions of light years and more—could be reached by such vehicles during the lifetime of its crew. Yet the time passed on their home planet during the same voyage would amount to millions of years as measured by clocks there. (Courtesy of *Planetary and Space Science*, Pergamon Press, London)

arrive at the galaxy in question after perhaps 30 years in transit, able not only to sing the songs of distant Earth, but to provide an opportunity for cosmic discourse with inhabitants of a certainly unique and possibly vanished civilization. Despite the dangers of the passage and the length of the voyage, I have no

doubt that qualified crews for such missions could be mustered. Shorter, round-trip journeys to destinations within our Galaxy might prove even more attractive. Not only would the crews voyage to a distant world, but they would return in the distant future of their own world, an adventure and a challenge certainly difficult to duplicate.

■ It is clear that the ships and engines which we are now barely developing for the exploration of our provincial solar system are but pale shadows of the mighty starships required for relativistic interstellar spaceflight. The primary problem is the construction of a space ship capable of carrying a substantial payload at extremely high velocities over a long period of time. A propulsion system based on contemporary design with the fuel carried on board the spacecraft at launch would require a fantastic quantity of fuel, even if complete conversion of the mass of the fuel into energy were attainable and all the energy so released could be utilized for thrust. At relativistic velocities and with the above flight plan, the ratio of payload mass to the initial total mass of the spacecraft must be about $2/(1 - v/c)$, where v is the maximum velocity. To reach the great galaxy in Andromeda, M 31, during the lifetime of a human crew would require $v = 0.99999 c$. The initial mass of this ideal fuel would then have to be some 200,000 times greater than the mass of the remainder of the spacecraft. Complete conversion of mass into energy could be obtained only if half the rocket fuel were anti-matter—that is, a form of matter in which our familiar positively charged protons are replaced by negatively charged anti-protons and in which conventional negative electrons are replaced by positively charged positrons. Anti-matter is uncommon on the Earth for a reason: When it is brought into physical contact with ordinary matter, both become annihilated, in a violent, blinding conversion of mass into energy, often in the form of gamma rays. It is just such an annihilation which would be used to power a hypothetical anti-matter space drive.

■ The containment of the anti-matter—to say nothing of its production in the quantities required—is clearly a very serious

problem. We would not want it to accidentally come into contact with the walls of the spacecraft, themselves composed of ordinary matter. □ Surprisingly, a number of interesting ideas have been put forward which might lead to a successful circumvention of this difficulty. For example, perhaps a special type of non-material, magnetic bottle, employing an intense magnetic field, could be used. Such magnetic bottles are now being investigated in connection with experiments on controlled thermonuclear reactions. ■ But an interstellar space vehicle powered by anti-matter and requiring a mass ratio of 200,000 does not seem to be an elegant solution to this problem.

■ A way out of these difficulties which approaches elegance in its conception has been provided by the American physicist Robert W. Bussard, of the TRW Corporation, Los Angeles. Bussard describes an interstellar ramjet which uses the atoms of the interstellar medium both as a working fluid (to provide reaction mass) and as an energy source (through thermonuclear fusion). There is no complete conversion of matter into energy. Such a fusion reactor is certainly not available today, but it violates no physical principles. Its construction is currently being very actively pursued in research on controlled thermonuclear reactions, and there is no reason to expect it to be more than a century away from realization on this planet.

■ Such an interstellar ramjet would require a large surface area, in order to draw in sufficient interstellar gas to propel the craft. The calculations of Bussard indicate that if there were one atom of hydrogen per cm^3 in the interstellar medium, the surface density of the ramjet would have to be $10^{-8} \text{gm cm}^{-2}$. In general, the intake surface area of the ramjet is inversely proportional to the concentration n_H of the interstellar gas. If, for example, the mass of the rocket were 100 tons, and n_H equaled 1 atom cm^{-3} , the surface area of the ramjet intake would have to be 10^{15}cm^2 , corresponding to a radius of about 700 km. □ In metagalactic space, where $n_H \leq 10^{-5}$ atoms cm^{-3} , the intake radius would have to be 100 times greater.

■ These frontal loading areas seem, of course, enormously

large by contemporary standards, and perhaps remain absurdly large even when we project the progress of future technology. But we should emphasize that the collecting areas need not be material. Intense magnetic fields are now routinely generated in the laboratory, and even in commercial applications, through the use of what are called superconducting flux pumps. Magnetic fields guide charged particles along a specified trajectory, and if the magnetic lines of force are cleverly arranged, through the design of the flux pumps, the charged particles can be conveyed to any desired region within the magnetic field. Thus, it seems at least possible that the collection of atoms of the interstellar medium by ramjet starships will be accomplished by ionizing the medium ahead of the spacecraft, and guiding the ions into the intake area through the use of intense magnetic fields. □

Should the Bussard ramjet become a reality, our descendants will witness a return, in the interstellar context, of the flight principles used by their ancestors for jet aircraft. The surrounding medium would be necessary for flight.

■ There is still another very serious difficulty which must be overcome before relativistic interstellar spaceflight can be considered feasible. The ramjet is moving through the interstellar medium with a velocity just short of the velocity of light. This is equivalent to the spacecraft sitting motionless, and the dust grains and atoms of the interstellar medium rushing into it with a velocity almost equal to the velocity of light.

■ With our previously described flight plan, the maximum velocity of the ramjet would be

$$v = c[1 - (1 + aS/2c^2)^{-2}]^{1/2}$$

where S is the destination distance, and a is the constant acceleration and deceleration chosen. If S equaled 10,000 parsecs—the distance to the Galactic center— v would differ from c by only one millionth of a percent. At this velocity, each atom of the interstellar medium colliding with the ramjet would appear as a component of the cosmic rays having an energy of 10^{13} electron volts. For 1 atom

of hydrogen cm^3 in interstellar space, the spacecraft encounters 10^{13} electron volts cm^{-3} . Since the spacecraft is moving almost with the velocity of light, the flow of equivalent cosmic radiation striking the frontal loading area of the ramjet would be 10^{13} electron volts $\text{cm}^{-3} \times (3 \times 10^{10} \text{ cm sec}^{-1}) = 3 \times 10^{23}$ electron volts $\text{cm}^{-2} \text{ sec}^{-1}$, or $2 \times 10^{11} \text{ erg cm}^{-2} \text{ sec}^{-1}$. This is penetrating radiation, with an intensity 100,000 times greater than the intensity of sunlight at the surface of the Earth.

The crew would be fried, even on flights to the nearest stars, unless careful precautions were taken.

■ It is evident, from the large mass ratios already required for “boosted” interstellar flight (for example, using anti-matter), and from the very low frontal loading area surface densities required for an interstellar ramjet, that material shielding would probably never be a practical solution. But it is possible that the same magnetic deflection techniques used to guide interstellar particles to the ramjet’s thermonuclear reactor could also be used to deflect particles away from the living quarters and other sensitive areas of the spacecraft. □

These difficulties seem colossal today, but we must remember that a century ago, the prospect of flight in a heavier-than-air vehicle seemed remote ■ or impossible. □ Now, of course, we take the airplane for granted. Experience in the development of science and technology teaches us that if the basic requirements for an idea do not contradict known scientific principles, sooner or later the problem will be solved. The tempo of scientific and technological development seems to be increasing with each decade. Considering all the possibilities for establishing contact among Galactic civilizations, we cannot exclude direct contact by means of interstellar spaceflight. ■ Bussard’s own concluding remarks on the magnitude of the effort involved in relativistic interstellar spaceflight are worth quoting:

. . . On any account interstellar travel is inherently a rather grand undertaking, certainly many magnitudes broader in scope and likewise more difficult than interplanetary travel in the solar system

. . . The engineering effort required for the achievement of successful short-time interstellar flight will likely be as much greater than that involved in interplanetary flight as the latter is more difficult than travel on the surface of the Earth. However, the expansion of man's horizons will be proportionately greater, and nothing worthwhile is ever achieved easily. □

scanners live in vain

Martel was angry. He did not even adjust his blood away from anger. He stamped across the room by judgment, not by sight. When he saw the table hit the floor, and could tell by the expression on Luci's face that the table must have made a loud crash, he looked down to see if his leg were broken. It was not. Scanner to the core, he had to scan himself. The action was reflex and automatic. The inventory included his legs, abdomen, Chestbox of instruments, hands, arms, face and back with the Mirror. Only then did Martel go back to being angry. He talked with his voice, even though he knew that his wife hated its blare and preferred to have him write.

"I tell you, I must cranch. I have to cranch. It's my worry, isn't it?"

When Luci answered, he saw only a part of her words as he read her lips: "Darling . . . you're my husband . . . right to love you . . . dangerous . . . do it . . . dangerous . . . wait. . ."

He faced her, but put sound in his voice, letting the blare hurt her again: "I tell you, I'm going to cranch."

Catching her expression, he became rueful and a little tender: "Can't you understand what it means to me? To get out of this horrible prison in my own head? To be a man again—hearing your voice, smelling smoke? To *feel* again—to feel my feet on the ground, to feel the air move against my face? Don't you know what it means?"

Her wide-eyed worrisome concern thrust him back into pure annoyance. He read only a few words as her lips moved: ". . . love you . . . your own good . . . don't you think I want you to be human? . . . your own good . . . too much . . . he said . . . they said. . ."

When he roared at her, he realized that his voice must be particularly bad. He knew that the sound hurt her no less than did the words: "Do you think I wanted you to marry a

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cordwainer smith

Scanner? Didn't I tell you we're almost as low as the habermans? We're dead, I tell you. We've got to be dead to do our work. How can anybody go to the Up-and-Out? Can you dream what raw Space is? I warned you. But you married me. All right, you married a man. Please, darling, let me be a man. Let me hear your voice, let me feel the warmth of being alive, of being human. Let me!"

He saw by her look of stricken assent that he had won the argument. He did not use his voice again. Instead, he pulled his tablet up from where it hung against his chest. He wrote on it, using the pointed fingernail of his right forefinger—the Talking Nail of a Scanner—in quick cleancut script: "Pls, drlng, whrs Crnching Wire?"

She pulled the long gold-sheathed wire out of the pocket of her apron. She let its field sphere fall to the carpeted floor. Swiftly, dutifully, with the deft obedience of a Scanner's wife, she wound the Cranching Wire around his head, spirally around his neck and chest. She avoided the instruments set in his chest. She even avoided the radiating scars around the instruments, the stigmata of men who had gone Up and into the Out. Mechanically he lifted a foot as she slipped the wire between his feet. She drew the wire taut. She snapped the small plug into the High Burden Control next to his Heart Reader. She helped him to sit down, arranging his hands for him, pushing his head back into the cup at the top of the chair. She turned then, full-face toward him, so that he could read her lips easily. Her expression was composed.

She knelt, scooped up the sphere at the other end of the wire, stood erect calmly, her back to him. He scanned her, and saw nothing in her posture but grief which would have escaped the eye of anyone but a Scanner. She spoke: he could see her chest-muscles moving. She realized that she was not facing him, and turned so that he could see her lips.

"Ready at last?"

He smiled a yes.

She turned her back to him again. (Luci could never bear to watch him under-the-wire.) She tossed the sphere into the air.

It caught in the force-field, and hung there. Suddenly it glowed. That was all. All—except for the sudden red stinking roar of coming back to his senses. Coming back, across the wild threshold of pain.

[1]

When he awakened under-the-wire, he did not feel as though he had just crunched. Even though it was the second crunching within the week, he felt fit. He lay in the chair. His ears drank in the sound of air touching things in the room. He heard Luci breathing in the next room, where she was hanging up the wire to cool. He smelt the thousand-and-one smells that are in anybody's room: the crisp freshness of the germ-burner, the sour-sweet tang of the humidifier, the odor of the dinner they had just eaten, the smells of clothes, furniture, of people themselves. All these were pure delight. He sang a phrase or two of his favorite song:

“Here's to the haberman, Up and Out!

“Up—oh!—and Out—oh!—Up and Out! . . .”

He heard Luci chuckle in the next room. He gloated over the sounds of her dress as she swished to the doorway.

She gave him her crooked little smile. “You sound all right. Are you all right, really?”

Even with this luxury of senses, he scanned. He took the flash-quick inventory which constituted his professional skill. His eyes swept in the news of the instruments. Nothing showed off scale, beyond the Nerve Compression hanging in the edge of *Danger*. But he could not worry about the Nervebox. That always came through crunching. You couldn't get under the wire without having it show on the Nervebox. Some day the box would go to *Overload* and drop back down to *Dead*. That was the way a haberman ended. But you couldn't have everything. People who went to the Up-and-Out had to pay the price for Space.

Anyhow, he should worry! He was a Scanner. A good one, and he knew it. If he couldn't scan himself, who could? This

cranching wasn't too dangerous. Dangerous, but not too dangerous.

Luci put out her hand and ruffled his hair as if she had been reading his thoughts, instead of just following them: "But you know you shouldn't have! You shouldn't!"

"But I did!" He grinned at her.

Her gaiety still forced, she said: "Come on, darling, let's have a good time. I have almost everything there is in the icebox—all your favorite tastes. And I have two new records just full of smells. I tried them out myself, and even I liked them. And you know me—"

"Which?"

"Which what, you old darling?"

He slipped his hand over her shoulders as he limped out of the room. (He could never go back to feeling the floor beneath his feet, feeling the air against his face, without being bewildered and clumsy. As if cranching was real, and being a haberman was a bad dream. But he *was* a haberman, and a Scanner.) "You know what I meant, Luci . . . the smells, which you have. Which one did you like, on the record?"

"Well-l-l," said she, judiciously, "there were some lamb chops that were the strangest things—"

He interrupted: "What are lambtchots?"

"Wait till you smell them. Then guess. I'll tell you this much. It's a smell hundreds and hundreds of years old. They found out about it in the old books."

"Is a lambtchot a Beast?"

"I won't tell you. You've got to wait," she laughed, and she helped him sit down and spread his tasting dishes before him. He wanted to go back over the dinner first, sampling all the pretty things he had eaten, and savoring them this time with his now-living lips and tongue.

When Luci had found the Music Wire and had thrown its sphere up into the force-field, he reminded her of the new smells. She took out the long glass records and set the first one into a transmitter.

“Now sniff!”

A queer frightening, exciting smell came over the room. It seemed like nothing in this world, nor like anything from the Up-and-Out. Yet it was familiar. His mouth watered. His pulse beat a little faster; he scanned his Heartbox. (Faster, sure enough.) But that smell, what was it? In mock perplexity, he grabbed her hands, looked into her eyes, and growled:

“Tell me, darling! Tell me, or I’ll eat you up!”

“That’s just right!”

“What?”

“You’re right. It should make you want to eat me. It’s meat.”

“Meat. Who?”

“Not a person,” said she, knowledgeably, “a Beast. A Beast which people used to eat. A lamb was a small sheep—you’ve seen sheep out in the Wild, haven’t you?—and a chop is part of its middle—here!” She pointed at her chest.

Martel did not hear her. All his boxes had sung over toward *Alarm*, some to *Danger*. He fought against the roar of his own mind, forcing his body into excess excitement. How easy it was to be a Scanner when you really stood outside your own body, haberman-fashion, and looked back into it with your eyes alone. Then you could manage the body, rule it coldly even in the enduring agony of Space. But to realize that you *were* a body, that this thing was ruling you, that the mind could kick the flesh and send it roaring off into panic! That was bad.

He tried to remember the days before he had gone into the Haberman Device, before he had been cut apart for the Up-and-Out. Had he always been subject to the rush of his emotions from his mind to his body, from his body back to his mind, confounding him so that he couldn’t Scan? But he hadn’t been a Scanner then.

He knew what had hit him. Amid the roar of his own pulse, he knew. In the nightmare of the Up-and-Out, that smell had forced its way through to him, while their ship burned off Venus and the habermans fought the collapsing metal with their bare hands. He had scanned then: all were in *Danger*. Chestboxes

went up to *Overload* and dropped to *Dead* all around him as he had moved from man to man, shoving the drifting corpses out of his way as he fought to scan each man in turn, to clamp vises on unnoticed broken legs, to snap the Sleeping Valve on men whose instruments showed they were hopelessly near *Overload*. With men trying to work and cursing him for a Scanner while he, professional zeal aroused, fought to do his job and keep them alive in the Great Pain of Space, he had smelled that smell. It had fought its way along his rebuilt nerves, past the Haberman cuts, past all the safeguards of physical and mental discipline. In the wildest hour of tragedy, he had smelled aloud. He remembered it was like a bad cranching, connected with the fury and nightmare all around him. He had even stopped his work to scan himself, fearful that the First Effect might come, breaking past all Haberman cuts and ruining him with the Pain of Space. But he had come through. His own instruments stayed and stayed at *Danger*, without nearing *Overload*. He had done his job, and won a commendation for it. He had even forgotten the burning ship.

All except the smell.

And here the smell was all over again—the smell of meat-with-fire. . . .

Luci looked at him with wifely concern. She obviously thought he had crunched too much, and was about to haberman back. She tried to be cheerful: “You’d better rest, honey.”

He whispered to her: “Cut—off—that—smell.”

She did not question his word. She cut the transmitter. She even crossed the room and stepped up the room controls until a small breeze flitted across the floor and drove the smells up to the ceiling.

He rose, tired and stiff. (His instruments were normal, except that Heart was fast and Nerves still hanging on the edge of *Danger*.) He spoke sadly:

“Forgive me, Luci. I suppose I shouldn’t have crunched. Not so soon again. But darling, I have to get out from being a haberman. How can I ever be near you? How can I be a man—not hearing my own voice, not even feeling my own life as

it goes through my veins? I love you, darling. Can't I ever be near you?"

Her pride was disciplined and automatic: "But you're a Scanner!"

"I know I'm a Scanner. But so what?"

She went over the words, like a tale told a thousand times to reassure herself: "You are the bravest of the brave, the most skillful of the skilled. All Mankind owes most honor to the Scanner, who unites the Earths of Mankind. Scanners are the protectors of the habermans. They are the judges in the Up-and-Out. They make men live in the place where men need desperately to die. They are the most honored of Mankind, and even the Chiefs of the Instrumentality are delighted to pay them homage!"

With obstinate sorrow he demurred: "Luci, we've heard that all before. But does it pay us back—"

" 'Scanners work for more than pay. They are the strong guards of Mankind.' Don't you remember that?"

"But our lives, Luci. What can you get out of being the wife of a Scanner? Why did you marry me? I'm human only when I cranch. The rest of the time—you know what I am. A machine. A man turned into a machine. A man who has been killed and kept alive for duty. Don't you realize what I miss?"

"Of course, darling, of course—"

He went on: "Don't you think I remember my childhood? Don't you think I remember what it is to be a man and not a haberman? To walk and feel my feet on the ground? To feel a decent clean pain instead of watching my body every minute to see if I'm alive? How will I know if I'm dead? Did you ever think of that, Luci? How will I know if I'm dead?"

She ignored the unreasonableness of his outburst. Pacifyingly, she said: "Sit down, darling. Let me make you some kind of a drink. You're overwrought."

Automatically, he scanned: "No I'm not! Listen to me. How do you think it feels to be in the Up-and-Out with the crew tied-for-space all around you? How do you think it feels to watch them sleep? How do you think I like scanning, scanning,

scanning month after month, when I can feel the Pain-of-Space beating against every part of my body, trying to get past my Haberman blocks? How do you think I like to wake the men when I have to, and have them hate me for it? Have you ever seen habermans fight—strong men fighting, and neither knowing pain, fighting until one touches *Overload*? Do you think about that, Luci?” Triumphantly he added: “Can you blame me if I cranch, and come back to being a man, just two days a month?”

“I’m not blaming you, darling. Let’s enjoy your cranch. Sit down now, and have a drink.”

He was sitting down, resting his face in his hands, while she fixed the drink, using natural fruits out of bottles in addition to the secure alkaloids. He watched her restlessly and pitied her for marrying a Scanner; and then, though it was unjust, resented having to pity her.

Just as she turned to hand him the drink, they both jumped a little as the phone rang. It should not have rung. They had turned it off. It rang again, obviously on the emergency circuit. Stepping ahead of Luci, Martel strode over to the phone and looked into it. Vomact was looking at him.

The custom of Scanners entitled him to be brusque, even with a Senior Scanner, on certain given occasions. This was one.

Before Vomact could speak, Martel spoke two words into the plate, not caring whether the old man could read lips or not:

“Cranching. Busy.”

He cut the switch and went back to Luci.

The phone rang again.

Luci said, gently, “I can find out what it is, darling. Here, take your drink and sit down.”

“Leave it alone,” said her husband. “No one has a right to call when I’m cranching. He knows that. He ought to know that.”

The phone rang again. In a fury, Martel rose and went to the plate. He cut it back on. Vomact was on the screen. Before Martel could speak, Vomact held up his Talking Nail in line with his Heartbox. Martel reverted to discipline:

"Scanner Martel present and waiting, sir."

The lips moved solemnly: "Top emergency."

"Sir, I am under the wire."

"Top emergency."

"Sir, don't you understand?" Martel mouthed his words, so he could be sure that Vomact followed. "I am under the wire. Unfit . . for . . Space!"

Vomact repeated: "Top emergency. Report to your central Tie-in."

"But, sir, no emergency like this—"

"Right, Martel. No emergency like this, ever before. Report to Tie-in." With a faint glint of kindness, Vomact added: "No need to de-cranch. Report as you are."

This time it was Martel whose phone was cut out. The screen went gray.

He turned to Luci. The temper had gone out of his voice. She came to him. She kissed him, and rumbled his hair. All she could say was, "I'm sorry."

She kissed him again, knowing his disappointment. "Take good care of yourself, darling. I'll wait."

He scanned, and slipped into his transparent aircoat. At the window he paused, and waved. She called, "Good luck!" As the air flowed past him he said to himself,

"This is the first time I've felt flight in—eleven years. Lord, but it's easy to fly if you can feel yourself live!"

Central Tie-in glowed white and austere far ahead. Martel peered. He saw no glare of incoming ships from the Up-and-Out, no shuddering flare of Space-fire out of control. Everything was quiet, as it should be on an off-duty night.

And yet Vomact had called. He had called an emergency higher than Space. There was no such thing. But Vomact had called it.

[2]

When Martel got there, he found about half the Scanners present, two dozen or so of them. He lifted the Talking Finger.

Most of the Scanners were standing face to face, talking in pairs as they read lips. A few of the old, impatient ones were scribbling on their tablets and then thrusting the tablets into other people's faces. All the faces wore the dull dead relaxed look of a haberman. When Martel entered the room, he knew that most of the others laughed in the deep isolated privacy of their own minds, each thinking things it would be useless to express in formal words. It had been a long time since a Scanner showed up at a meeting crunched.

Vomact was not there: probably, thought Martel, he was still on the phone calling others. The light of the phone flashed on and off; the bell rang. Martel felt odd when he realized that of all those present, he was the only one to hear that loud bell. It made him realize why ordinary people did not like to be around groups of habermans or Scanners. Martel looked around for company.

His friend Chang was there, busy explaining to some old and testy Scanner that he did not know why Vomact had called. Martel looked further and saw Parizianski. He walked over, threading his way past the others with a dexterity that showed he could feel his feet from the inside, and did not have to watch them. Several of the others stared at him with their dead faces, and tried to smile. But they lacked full muscular control and their faces twisted into horrid masks. (Scanners knew better than to show expression on faces which they could no longer govern. Martel added to himself, I swear *I'll* never smile again unless I'm crunched.)

Parizianski gave him the sign of the Talking Finger. Looking face to face, he spoke:

"You come here crunched?"

Parizianski could not hear his own voice, so the words roared like the words on a broken and screeching phone; Martel was startled, but knew that the inquiry was well meant. No one could be better-natured than the burly Pole.

"Vomact called. Top emergency."

"You told him you were crunched?"

“Yes.”

“He still made you come?”

“Yes.”

“Then all this—it is not for Space? You could not go up-and-out? You are like ordinary men?”

“That’s right.”

“Then why did he call us?” Some pre-Haberman habit made Parizianski wave his arms in inquiry. The hand struck the back of the old man behind them. The slap could be heard throughout the room, but only Martel heard it. Instinctively, he scanned Parizianski and the old Scanner: they scanned him back, and then asked why. Only then did the old man ask why Martel had scanned him. When Martel explained that he was under-the-wire, the old man moved swiftly away to pass on the news that there was a crunched Scanner present at the Tie-in.

Even this minor sensation could not keep the attention of most of the Scanners from the worry about the Top Emergency. One young man, who had Scanned his first transit just the year before, dramatically interposed himself between Parizianski and Martel. He dramatically flashed his tablet at them:

Is Vmct mad?

The older men shook their heads. Martel, remembering that it had not been too long that the young man had been a haberman, mitigated the dead solemnity of the denial with a friendly smile. He spoke in a normal voice, saying:

“Vomact is the Senior of Scanners. I am sure that he could not go mad. Would he not see it on his boxes first?”

Martel had to repeat the question, speaking slowly and mouthing his words before the young Scanner could understand the comment. The young man tried to make his face smile, and twisted it into a comic mask. But he took up his tablet and scribbled:

Yr rght.

Chang broke away from his friend and came over, his half-Chinese face gleaming in the warm evening. (It’s strange, thought Martel, that more Chinese don’t become Scanners. Or

not so strange perhaps, if you think that they never fill their quota of habermans. Chinese love good living too much. The ones who do scan are all good ones.) Chang saw that Martel was crunched, and spoke with voice:

"You break precedents. Luci must be angry to lose you?"

"She took it well. Chang, that's strange."

"What?"

"I'm crunched, and I can hear. Your voice sounds all right. How did you learn to talk like—like an ordinary person?"

"I practiced with soundtracks. Funny you noticed it. I think I am the only Scanner in or between the Earths who can pass for an Ordinary Man. Mirrors and soundtracks. I found out how to act."

"But you don't . . . ?"

"No. I don't feel, or taste, or hear, or smell things, any more than you do. Talking doesn't do me much good. But I notice that it cheers up the people around me."

"It would make a difference in the life of Luci."

Chang nodded sagely. "My father insisted on it. He said, 'You may be proud of being a Scanner. I am sorry you are not a Man. Conceal your defects.' So I tried. I wanted to tell the old boy about the Up-and-Out, and what we did there, but it did not matter. He said, 'Airplanes were good enough for Confucius, and they are for me too.' The old humbug! He tries so hard to be a Chinese when he can't even read Old Chinese. But he's got wonderful good sense, and for somebody going on two hundred he certainly gets around."

Martel smiled at the thought: "In his airplane?"

Chang smiled back. This discipline of his facial muscles was amazing; a bystander would not think that Chang was a haberman, controlling his eyes, cheeks, and lips by cold intellectual control. The expression had the spontaneity of life. Martel felt a flash of envy for Chang when he looked at the dead cold faces of Parizianski and the others. He knew that he himself looked fine: but why shouldn't he? he was crunched. Turning to Parizianski he said, "Did you see what Chang said about his father? The old boy uses an airplane."

Parizianski made motions with his mouth, but the sounds meant nothing. He took up his tablet and showed it to Martel and Chang.

Bzz bzz. Ha ha. Gd ol' boy.

At that moment, Martel heard steps out in the corridor. He could not help looking toward the door. Other eyes followed the direction of his glance.

Vomact came in.

The group shuffled to attention in four parallel lines. They scanned one another. Numerous hands reached across to adjust the electrochemical controls on Chestboxes which had begun to load up. One Scanner held out a broken finger which his counter-Scanner had discovered, and submitted it for treatment and splinting.

Vomact had taken out his Staff of Office. The cube at the top flashed red light through the room, the lines reformed, and all Scanners gave the sign meaning

Present and ready!

Vomact countered with the stance signifying, *I am the Senior and take Command.*

Talking fingers rose in the counter-gesture, *We concur and commit ourselves.*

Vomact raised his right arm, dropped the wrist as though it were broken, in a queer searching gesture, meaning: *Any men around? Any habermans not tied? All clear for the Scanners?*

Alone of all those present, the crunched Martel heard the queer rustle of feet as they all turned completely around without leaving position, looking sharply at one another and flashing their beltlights into the dark corners of the great room. When again they faced Vomact, he made a further sign:

All clear. Follow my words.

Martel noticed that he alone relaxed. The others could not know the meaning of relaxation with the minds blocked off up there in their skulls, connected only with the eyes, and the rest of the body connected with the mind only by controlling non-sensory nerves and the instrument boxes on their chests. Martel realized that, crunched as he was, he expected to hear Vomact's

voice: the Senior had been talking for some time. No sound escaped his lips. (Vomact never bothered with sound.)

“. . . and when the first men to go up-and-out went to the Moon, what did they find?”

“Nothing,” responded the silent chorus of lips.

“Therefore they went farther, to Mars and to Venus. The ships went out year by year, but they did not come back until the Year One of Space. Then did a ship come back with the First Effect. Scanners, I ask you, what is the First Effect?”

“No one knows. No one knows.”

“No one will ever know. Too many are the variables. By what do we know the First Effect?”

“By the Great Pain of Space,” came the chorus.

“And by what further sign?”

“By the need, oh the need for death.”

Vomact again: “And who stopped the need for death?”

“Henry Haberman conquered the First Effect in the Year Three of Space.”

“And, Scanners, I ask you, what did he do?”

“He made the habermans.”

“How, O Scanners, are habermans made?”

“They are made with the cuts. The brain is cut from the heart, the lungs. The brain is cut from the ears, the nose. The brain is cut from the mouth, the belly. The brain is cut from desire, and pain. The brain is cut from the world. Save for the eyes. Save for the control of the living flesh.”

“And how, O Scanners, is flesh controlled?”

“By the boxes set in the flesh, the controls set in the chest, the signs made to rule the living body, the signs by which the body lives.”

“How does a haberman live and live?”

“The haberman lives by control of the boxes.”

“Whence come the habermans?”

Martel felt in the coming response a great roar of broken voices echoing through the room as the Scanners, habermans themselves, put sound behind their mouthings:

"Habermans are the scum of Mankind. Habermans are the weak, the cruel, the credulous, and the unfit. Habermans are the sentenced-to-more-than-death. Habermans live in the mind alone. They are killed for Space but they live for Space. They master the ships that connect the Earths. They live in the Great Pain while ordinary men sleep in the cold cold sleep of the transit."

"Brothers and Scanners, I ask you now: are we habermans or are we not?"

"We are habermans in the flesh. We are cut apart, brain and flesh. We are ready to go to the Up-and-Out. All of us have gone through the Haberman Device."

"We are habermans then?" Vomact's eyes flashed and glittered as he asked the ritual question.

Again the chorused answer was accompanied by a roar of voices heard only by Martel: "Habermans we are, and more, and more. We are the Chosen who are habermans by our own free will. We are the Agents of the Instrumentality of Mankind."

"What must the others say to us?"

"They must say to us, 'You are the bravest of the brave, the most skillful of the skilled. All Mankind owes most honor to the Scanner, who unites the Earths of Mankind. Scanners are the protectors of the habermans. They are the judges in the Up-and-Out. They make men live in the place where men need desperately to die. They are the most honored of Mankind, and even the Chiefs of the Instrumentality are delighted to pay them homage!'"

Vomact stood more erect: "What is the secret duty of the Scanner?"

"To keep secret our law, and to destroy the acquirers thereof."

"How to destroy?"

"Twice to the *Overload*, back and *Dead*."

"If habermans die, what the duty then?"

The Scanners all compressed their lips for answer. (Silence

was the code.) Martel, who—long familiar with the code—was a little bored with the proceedings, noticed that Chang was breathing too heavily; he reached over and adjusted Chang's Lung control and received the thanks of Chang's eyes. Vomact observed the interruption and glared at them both. Martel relaxed, trying to imitate the dead cold stillness of the others. It was so hard to do, when you were crunched.

"If others die, what the duty then?" asked Vomact.

"Scanners together inform the Instrumentality. Scanners together accept the punishment. Scanners together settle the case."

"And if the punishment be severe?"

"Then no ships go."

"And if Scanners not be honored?"

"Then no ships go."

"And if a Scanner goes unpaid?"

"Then no ships go."

"And if the Others and the Instrumentality are not in all ways at all times mindful of their proper obligation to the Scanners?"

"Then no ships go."

"And what, O Scanners, if no ships go?"

"The Earths fall apart. The Wild comes back in. The Old Machines and the Beasts return."

"What is the unknown duty of a Scanner?"

"Not to sleep in the Up-and-Out."

"What is the second duty of a Scanner?"

"To keep forgotten the name of fear."

"What is the third duty of a Scanner?"

"To use the wire of Eustace Cranch only with care, only with moderation." Several pair of eyes looked quickly at Martel before the mouthed chorus went on. "To cranch only at home, only among friends, only for the purpose of remembering, of relaxing, or of begetting."

"What is the word of the Scanner?"

"Faithful though surrounded by death."

"What is the motto of the Scanner?"

"Awake though surrounded by silence."

"What is the work of the Scanner?"

"Labor even in the heights of the Up-and-Out, loyalty even in the depths of Earths."

"How do you know a Scanner?"

"We know ourselves. We are dead though we live. And we talk with the Tablet and the Nail."

"What is this Code?"

"This Code is the friendly ancient wisdom of Scanners, briefly put that we may be mindful and be cheered by our loyalty to one another."

At this point the formula should have run: "We complete the Code. Is there work or word for the Scanners?" But Vomact said, and he repeated:

"Top emergency. Top emergency."

They gave him the sign, *Present and ready!*

He said, with every eye straining to follow his lips:

"Some of you know the work of Adam Stone?"

Martel saw lips move, saying: "The Red Asteroid. The Other who lives at the edge of Space."

"Adam Stone has gone to the Instrumentality, claiming success for his work. He says that he has found how to Screen Out the Pain-of-Space. He says that the Up-and-Out can be made safe for ordinary men to work in, to stay awake in. He says that there need be no more Scanners."

Beltlights flashed on all over the room as Scanners sought the right to speak. Vomact nodded to one of the older men. "Scanner Smith will speak."

Smith stepped slowly up into the light, watching his own feet. He turned so that they could see his face. He spoke: "I say that this is a lie. I say that Stone is a liar. I say that the Instrumentality must not be deceived."

He paused. Then, in answer to some question from the audience which most of the others did not see, he said:

"I invoke the secret duty of the Scanners."

Smith raised his right hand for Emergency Attention:

"I say that Stone must die."

[3]

Martel, still crunched, shuddered as he heard the boos, groans, shouts, squeaks, grunts and moans which came from the Scanners who forgot noise in their excitement and strove to make their dead bodies talk to one another's deaf ears. Beltlights flashed wildly all over the room. There was a rush for the rostrum and Scanners milled around at the top, vying for attention until Parizianski—by sheer bulk—shoved the others aside and down, and turned to mouth at the group.

"Brother Scanners, I want your eyes."

The people on the floor kept moving, with their numb bodies jostling one another. Finally Vomact stepped up in front of Parizianski, faced the others, and said:

"Scanners, be Scanners! Give him your eyes."

Parizianski was not good at public speaking. His lips moved too fast. He waved his hands, which took the eyes of the others away from his lips. Nevertheless, Martel was able to follow most of the message:

". . . can't do this. Stone may have succeeded. If he has succeeded, it means the end of the Scanners. It means the end of the habermans, too. None of us will have to fight in the Up-and-Out. We won't have anybody else going under-the-wire for a few hours or days of being human. Everybody will be Other. Nobody will have to cranch, never again. Men can be men. The habermans can be killed decently and properly, the way men were killed in the Old Days, without anybody keeping them alive. They won't have to work in the Up-and-Out! There will be no more Great Pain—think of it! No . . . more . . . Great . . . Pain! How do we know that Stone is a liar—" Lights began flashing directly into his eyes. (The rudest insult of Scanner to Scanner was this.)

Vomact again exercised authority. He stepped in front of

Parizianski and said something which the others could not see. Parizianski stepped down from the rostrum. Vomact again spoke:

“I think that some of the Scanners disagree with our Brother Parizianski. I say that the use of the rostrum be suspended till we have had a chance for private discussion. In fifteen minutes I will call the meeting back to order.”

Martel looked around for Vomact when the Senior had rejoined the group on the floor. Finding the Senior, Martel wrote swift script on his tablet, waiting for a chance to thrust the tablet before the Senior's eyes. He had written,

Am crnchd. Rspctfly request prmissn lv now, stnd by fr orders.

Being crunched did strange things to Martel. Most meetings that he attended seemed formal, heartening, ceremonial, lighting up the dark inward eternities of habermanhood. When he was not crunched, he noticed his body no more than a marble bust notices its marble pedestal. He had stood with them before. He had stood with them effortless hours, while the long-winded ritual broke through the terrible loneliness behind his eyes, and made him feel that the Scanners, though a confraternity of the damned, were nonetheless forever honored by the professional requirements of their mutilation.

This time, it was different. Coming crunched, and in full possession of smell-sound-taste-feeling, he reacted more or less as a normal man would. He saw his friends and colleagues as a lot of cruelly driven ghosts, posturing out the meaningless ritual of their indefeasible damnation. What difference did anything make, once you were a haberman? Why all this talk about habermans and Scanners? Habermans were criminals or heretics, and Scanners were gentlemen-volunteers, but they were all in the same fix—except that Scanners were deemed worthy of the short-time return of the Cranching Wire, while habermans were simply disconnected while the ships lay in port and were left suspended until they should be awakened, in some hour of emergency or trouble, to work out another spell of their damnation. It was a rare haberman that you saw

on the street—someone of special merit or bravery, allowed to look at mankind from the terrible prison of his own mechanified body. And yet, what Scanner ever pitied a haberman? What Scanner ever honored a haberman except perfunctorily in the line of duty? What had the Scanners, as a guild and a class, ever done for the habermans, except to murder them with a twist of the wrist whenever a haberman, too long beside a Scanner, picked up the tricks of the Scanning trade and learned how to live at his own will, not the will the Scanners imposed? What could the Others, the ordinary men, know of what went on inside the ships? The Others slept in their cylinders, mercifully unconscious until they woke up on whatever other Earth they had consigned themselves to. What could the Others know of the men who had to stay alive within the ship?

What could any Other know of the Up-and-Out? What Other could look at the biting acid beauty of the stars in open space? What could they tell of the Great Pain, which started quietly in the marrow, like an ache, and proceeded by the fatigue and nausea of each separate nerve cell, brain cell, touchpoint in the body, until life itself became a terrible aching hunger for silence and for death?

He was a Scanner. All right, he *was* a Scanner. He had been a Scanner from the moment when, wholly normal, he had stood in the sunlight before a Subchief of Instrumentality, and had sworn:

"I pledge my honor and my life to Mankind. I sacrifice myself willingly for the welfare of Mankind. In accepting the perilous austere Honor, I yield all my rights without exception to the Honorable Chiefs of the Instrumentality and to the Honored Confraternity of Scanners."

He had pledged.

He had gone into the Haberman Device.

He remembered his hell. He had not had such a bad one, even though it had seemed to last a hundred million years, all of them without sleep. He had learned to feel with his eyes. He had learned to see despite the heavy eyeplates set back of

his eyeballs, to insulate his eyes from the rest of him. He had learned to watch his skin: He still remembered the time he had noticed dampness on his shirt, and had pulled out his Scanning Mirror only to discover that he had worn a hole in his side by leaning against a vibrating machine. (A thing like that could not happen to him now; he was too adept at reading his own instruments.) He remembered the way that he had gone up-and-out, and the way that the Great Pain beat into him, despite the fact that his touch, smell, feeling, and hearing were gone for all ordinary purposes. He remembered killing habermans, and keeping others alive, and standing for months beside the Honorable Scanner-Pilot while neither of them slept. He remembered going ashore on Earth Four, and remembered that he had not enjoyed it, and had realized on that day that there was no reward.

Martel stood among the other Scanners. He hated their awkwardness when they moved, their immobility when they stood still. He hated the queer assortment of smells which their bodies yielded unnoticed. He hated the grunts and groans and squawks which they emitted from their deafness. He hated them, and himself.

How could Luci stand him? He had kept his Chestbox reading *Danger* for weeks while he courted her, carrying the Cranching Wire about with him most illegally, and going direct from one cranch to the other without worrying about the fact that his indicators all crept up to the edge of *Overload*. He had wooed her without thinking of what would happen if she did say, "Yes." She had.

"And they lived happily ever after." In Old Books they did, but how could they, in life? He had had eighteen days under-the-wire in the whole of the past year! Yet she had loved him. She still loved him. He knew it. She fretted about him through the long months that he was in the Up-and-Out. She tried to make home mean something to him even when he was haberman, make food pretty when it could not be tasted, make herself lovable when she could not be kissed—or might as well

not, since a haberman body meant no more than furniture. Luci was patient.

And now, Adam Stone! (He let his tablet fade: how could he leave, now?)

God bless Adam Stone?

Martel could not help feeling a little sorry for himself. No longer would the high keen call of duty carry him through two hundred or so years of the Other's time, two million private eternities of his own. He could slouch and relax. He could forget High Space, and let the Up-and-Out be tended by Others. He could cranch as much as he dared. He could be almost normal—almost—for one year or five or no years. But at least he could stay with Luci. He could go with her into the Wild, where there were Beasts and Old Machines still roving the dark places. Perhaps he would die in the excitement of the hunt, throwing spears at an ancient Manshonjagger as it leapt from its lair, or tossing hot spheres at the tribesmen of the Unforgiven who still roamed the Wild. There was still life to live, still a good normal death to die, not the moving of a needle out in silence and Pain-of-Space!

He had been walking about restlessly. His ears were attuned to the sounds of normal speech, so that he did not feel like watching the mouthings of his brethren. Now they seemed to have come to a decision. Vomact was moving to the rostrum. Martel looked about for Chang, and went to stand beside him. Chang whispered:

“You're as restless as water in mid-air! What's the matter? De-cranching?”

They both scanned Martel, but the instruments held steady and showed no sign of the cranch giving out.

The great light flared in its call to attention. Again they formed ranks. Vomact thrust his lean old face into the glare, and spoke:

“Scanners and Brothers, I call for a vote.” He held himself in the stance which meant: *I am the Senior and take Command.*

A beltlight flashed in protest.

It was old Henderson. He moved to the rostrum, spoke to Vomact, and—with Vomact's nod of approval—turned full-face to repeat his question:

“Who speaks for the Scanners Out in Space?”

No beltlight or hand answered.

Henderson and Vomact, face to face, conferred for a few moments. Then Henderson faced them again:

“I yield to the Senior in Command. But I do not yield to a Meeting of the Confraternity. There are sixty-eight Scanners, and only forty-seven present, of whom one is crunched and U. D. I have therefore proposed that the Senior in Command assume authority only over an Emergency Committee of the Confraternity, not over a Meeting. Is that agreed and understood by the Honorable Scanners?”

Hands rose in assent.

Chang murmured in Martel's ear, “Lot of difference that makes! Who can tell the difference between a meeting and a committee?” Martel agreed with the words, but was even more impressed with the way that Chang, while haberman, could control his own voice.

Vomact resumed chairmanship: “We now vote on the question of Adam Stone.

“First, we can assume that he has not succeeded, and that his claims are lies. We know that from our practical experience as Scanners. The Pain-of-Space is only part of Scanning” (*But the essential part, the basis of it all*, thought Martel.) “and we can rest assured that Stone cannot solve the problem of Space Discipline.”

“That tripe again,” whispered Chang, unheard save by Martel.

“The Space Discipline of our Confraternity has kept High Space clean of war and dispute. Sixty-eight disciplined men control all High Space. We are removed by our oath and our haberman status from all Earthly passions.

“Therefore, if Adam Stone has conquered the Pain-of-Space, so that Others can wreck our Confraternity and bring to Space

the trouble and ruin which afflicts Earths, I say that Adam Stone is wrong. If Adam Stone succeeds, Scanners live in Vain!

"Secondly, if Adam Stone has conquered the Pain-of-Space, he will cause great trouble in all the Earths. The Instrumentality and the Subchiefs may not give us as many habermans as we need to operate the ships of Mankind. There will be wild stories, and fewer recruits and, worst of all, the Discipline of the Confraternity may relax if this kind of nonsensical heresy is spread around.

"Therefore, if Adam Stone has succeeded, he threatens the ruin of the Confraternity and should die.

"I move the death of Adam Stone."

And Vomact made the sign, *The Honorable Scanners are pleased to vote.*

[4]

Martel grabbed wildly for his beltlight. Chang, guessing ahead, had his light out and ready; its bright beam, voting *No*, shone straight up at the ceiling. Martel got his light out and threw its beam upward in dissent. Then he looked around. Out of the forty-seven present, he could see only five or six glittering.

Two more lights went on. Vomact stood as erect as a frozen corpse. Vomact's eyes flashed as he stared back and forth over the group, looking for lights. Several more went on. Finally Vomact took the closing stance:

May it please the Scanners to count the vote.

Three of the older men went up on the rostrum with Vomact. They looked over the room. (Martel thought: *These damned ghosts are voting on the life of a real man, a live man! They have no right to do it. I'll tell the Instrumentality!* But he knew that he would not. He thought of Luci and what she might gain by the triumph of Adam Stone: the heartbreaking folly of the vote was then almost too much for Martel to bear.)

All three of the tellers held up their hands in unanimous agreement on the sign of the number: *Fifteen against.*

Vomact dismissed them with a bow of courtesy. He turned and again took the stance, *I am the Senior and take Command*.

Marveling at his own daring, Martel flashed his beltlight on. He knew that any one of the bystanders might reach over and twist his Heartbox to *Overload* for such an act. He felt Chang's hand reaching to catch him by the aircoat. But he eluded Chang's grasp and ran, faster than a Scanner should, to the platform. As he ran, he wondered what appeal to make. It was no use talking commonsense. Not now. It had to be law.

He jumped up on the rostrum beside Vomact, and took the stance: *Scanners, an Illegality!*

He violated good custom while speaking, still in the stance: "A Committee has no right to vote death by a majority vote. It takes two-thirds of a full Meeting."

He felt Vomact's body lunge behind him, felt himself falling from the rostrum, hitting the floor, hurting his knees and his touch-aware hands. He was helped to his feet. He was scanned. Some Scanner he scarcely knew took his instruments and toned him down.

Immediately Martel felt more calm, more detached, and hated himself for feeling so.

He looked up at the rostrum. Vomact maintained the stance signifying: *Order!*

The Scanners adjusted their ranks. The two Scanners next to Martel took his arms. He shouted at them, but they looked away, and cut themselves off from communication altogether.

Vomact spoke again when he saw the room was quiet: "A Scanner came here crunched. Honorable Scanners, I apologize for this. It is not the fault of our great and worthy Scanner and friend, Martel. He came here under orders. I told him not to de-crunch. I hoped to spare him an unnecessary haberman. We all know how happily Martel is married, and we wish his brave experiment well. I like Martel. I respect his judgment. I wanted him here. I knew you wanted him here. But he is crunched. He is in no mood to share in the lofty business of the Scanners. I

therefore propose a solution which will meet all the requirements of fairness. I propose that we rule Scanner Martel out of order for his violation of rules. This violation would be inexcusable if Martel were not crunched.

"But at the same time, in all fairness to Martel, I further propose that we deal with the points raised so improperly by our worthy but disqualified brother."

Vomact gave the sign, *The Honorable Scanners are pleased to vote*. Martel tried to reach his own beltlight; the dead strong hands held him tightly and he struggled in vain. One lone light shone high: Chang's, no doubt.

Vomact thrust his face into the light again: "Having the approval of our worthy Scanners and present company for the general proposal, I now move that this Committee declare itself to have the full authority of a Meeting, and that this Committee further make me responsible for all misdeeds which this Committee may enact, to be held answerable before the next full Meeting, but not before any other authority beyond the closed and secret ranks of Scanners."

Flamboyantly this time, his triumph evident, Vomact assumed the *vote* stance.

Only a few lights shone: far less, patently, than a minority of one-fourth.

Vomact spoke again. The light shone on his high calm forehead, on his dead relaxed cheekbones. His lean cheeks and chin were half-shadowed, save where the lower light picked up and spotlighted his mouth, cruel even in repose. (Vomact was said to be a descendant of some Ancient Lady who had traversed, in an illegitimate and inexplicable fashion, some hundreds of years of time in a single night. Her name, the Lady Vomact, had passed into legend; but her blood and her archaic lust for mastery lived on in the mute masterful body of her descendant. Martel could believe the old tales as he stared at the rostrum, wondering what untraceable mutation had left the Vomact kith as predators among mankind.) Calling loudly with the movement of his lips, but still without sound, Vomact appealed:

"The Honorable Committee is now pleased to reaffirm the sentence of death issued against the heretic and enemy, Adam Stone." Again the *vote* stance.

Again Chang's light shone lonely in its isolated protest.

Vomact then made his final move:

"I call for the designation of the Senior Scanner present as the manager of the sentence. I call for authorization to him to appoint executioners, one or many, who shall make evident the will and majesty of Scanners. I ask that I be accountable for the deed, and not for the means. The deed is a noble deed, for the protection of Mankind and for the honor of the Scanners; but of the means it must be said that they are to be the best at hand, and no more. Who knows the true way to kill an Other, here on a crowded and watchful Earth? This is no mere matter of discharging a cylindered sleeper, no mere question of upgrading the needle of a haberman. When people die down here, it is not like the Up-and-Out. They die reluctantly. Killing within the Earth is not our usual business, O brothers and Scanners, as you know well. You must choose me to choose my agent as I see fit. Otherwise the common knowledge will become the common betrayal whereas if I alone know the responsibility, I alone could betray us, and you will not have far to look in case the Instrumentality comes searching." (*What about the killer you choose?* thought Martel. *He too will know unless—unless you silence him forever.*)

Vomact went into the stance, *The Honorable Scanners are pleased to vote.*

One light of protest shone; Chang's, again.

Martel imagined that he could see a cruel joyful smile on Vomact's dead face—the smile of a man who knew himself righteous and who found his righteousness upheld and affirmed by militant authority.

Martel tried one last time to come free.

The dead hands held. They were locked like vises until their owners' eyes unlocked them: how else could they hold the piloting month by month?

Martel then shouted: "Honorable Scanners, this is judicial murder."

No ear heard him. He was crunched, and alone.

None the less, he shouted again: "You endanger the Confraternity."

Nothing happened.

The echo of his voice sounded from one end of the room to the other. No head turned. No eyes met his.

Martel realized that as they paired for talk, the eyes of the Scanners averted him. He saw that no one desired to watch his speech. He knew that behind the cold faces of his friends there lay compassion or amusement. He knew that they knew him to be crunched—absurd, normal, man-like, temporarily no Scanner. But he knew that in this matter the wisdom of Scanners was nothing. He knew that only a crunched Scanner could feel with his very blood the outrage and anger which deliberate murder would provoke among the Others. He knew that the Confraternity endangered itself, and knew that the most ancient prerogative of law was the monopoly of death. Even the Ancient Nations, in the times of the Wars, before the Beasts, before men went into the Up-and-Out—even the Ancients had known this. How did they say it? *Only the State shall kill*. The States were gone but the Instrumentality remained, and the Instrumentality could not pardon things which occurred within the Earths but beyond its authority. Death in Space was the business, the right of the Scanners: how could the Instrumentality enforce its laws in a place where all men who wakened, wakened only to die in the Great Pain? Wisely did the Instrumentality leave Space to the Scanners, wisely had the Confraternity not meddled inside the Earths. And now the Confraternity itself was going to step forth as an outlaw band, as a gang of rogues as stupid and reckless as the tribes of the Unforgiven!

Martel knew this because he was crunched. Had he been haberman, he would have thought only with his mind, not with his heart and guts and blood. How could the other Scanners know?

Vomact returned for the last time to the rostrum: *The Committee has met and its will shall be done*. Verbally he added: "Senior among you, I ask your loyalty and your silence."

At that point, the two Scanners let his arms go. Martel rubbed his numb hands, shaking his fingers to get the circulation back into the cold fingertips. With real freedom, he began to think of what he might still do. He scanned himself: the cranching held. He might have a day. Well, he could go on even if haberman, but it would be inconvenient, having to talk with finger and tablet. He looked about for Chang. He saw his friend standing patient and immobile in a quiet corner. Martel moved slowly, so as not to attract any more attention to himself than could be helped. He faced Chang, moved until his face was in the light, and then articulated:

"What are we going to do? You're not going to let them kill Adam Stone, are you? Don't you realize what Stone's work will mean to us, if it succeeds? No more Scanners. No more habermans. No more Pain in the Up-and-Out. I tell you, if the others were all crunched, as I am, they would see it in a human way, not with the narrow crazy logic which they used in the meeting. We've got to stop them. How can we do it? What are we going to do? What does Parizianski think? Who has been chosen?"

"Which question do you want me to answer?"

Martel laughed. (It felt good to laugh, even then; it felt like being a man.) "Will you help me?"

Chang's eyes flashed across Martel's face as Chang answered: "No. No. No."

"You won't help?"

"No."

"Why not, Chang? Why not?"

"I am a Scanner. The vote has been taken. You would do the same if you were not in this unusual condition."

"I'm not in an unusual condition. I'm crunched. That merely means that I see things the way that the Others would. I see the stupidity. The recklessness. The selfishness. It is murder."

"What is murder? Have you not killed? You are not one of

the Others. You are a Scanner. You will be sorry for what you are about to do, if you do not watch out."

"But why did you vote against Vomact then? Didn't you too see what Adam Stone means to all of us? Scanners will live in vain. Thank God for that! Can't you see it?"

"No."

"But you talk to me, Chang. You are my friend?"

"I talk to you. I am your friend. Why not?"

"But what are you going to do?"

"Nothing, Martel. Nothing."

"Will you help me?"

"No."

"Not even to save Stone?"

"No."

"Then I will go to Parizianski for help."

"It will do you no good."

"Why not? He's more human than you, right now."

"He will not help you, because he has the job. Vomact designated him to kill Adam Stone."

Martel stopped speaking in mid-movement. He suddenly took the stance, *I thank you, brother, and I depart*.

At the window he turned and faced the room. He saw that Vomact's eyes were upon him. He gave the stance, *I thank you, brother, and I depart*, and added the flourish of respect which is shown when Seniors are present. Vomact caught the sign, and Martel could see the cruel lips move. He thought he saw the words ". . . take good care of yourself. . . ." but did not wait to inquire. He stepped backward and dropped out the window.

Once below the window and out of sight, he adjusted his aircoat to maximum speed. He swam lazily in the air, scanning himself thoroughly, and adjusting his adrenal intake down. He then made the movement of release, and felt the cold air rush past his face like running water.

Adam Stone had to be at Chief Downport.

Adam Stone had to be there.

Wouldn't Adam Stone be surprised in the night? Surprised to meet the strangest of beings, the first renegade among Scanners. (Martel suddenly appreciated that it was of himself he was thinking. Martel the Traitor to Scanners! That sounded strange and bad. But what of Martel, the Loyal to Mankind? Was that not compensation? And if he won, he won Luci. If he lost, he lost nothing—an unconsidered and expendable haberman. It happened to be himself. But in contrast to the immense reward, to Mankind, to the Confraternity, to Luci, what did that matter?)

Martel thought to himself: "Adam Stone will have two visitors tonight. Two Scanners, who are the friends of one another." He hoped that Parizianski was still his friend.

"And the world," he added, "depends on which of us gets there first."

Multifaceted in their brightness, the lights of Chief Downport began to shine through the mist ahead. Martel could see the outer towers of the city and glimpsed the phosphorescent Periphery which kept back the Wild, whether Beasts, Machines, or the Unforgiven.

Once more Martel invoked the lords of his chance: "Help me to pass for an Other!"

[5]

Within the Downport, Martel had less trouble than he thought. He draped his aircoat over his shoulder so that it concealed the instruments. He took up his Scanning Mirror, and made up his face from the inside, by adding tone and animation to his blood and nerves until the muscles of his face glowed and the skin gave out a healthy sweat. That way he looked like an ordinary man who had just completed a long night flight.

After straightening out his clothing, and hiding his tablet within his jacket, he faced the problem of what to do about the Talking Finger. If he kept the nail, it would show him to be a

Scanner. He would be respected, but he would be identified. He might be stopped by the guards whom the Instrumentality had undoubtedly set around the person of Adam Stone. If he broke the nail—But he couldn't! No Scanner in the history of the Confraternity had ever willingly broken his nail. That would be Resignation, and there was no such thing. The only way *out*, was in the Up-and-Out! Martel put his finger to his mouth and bit off the nail. He looked at the now-queer finger, and sighed to himself.

He stepped toward the city gate, slipping his hand into his jacket and running up his muscular strength to four times normal. He started to scan, and then realized that his instruments were masked. *Might as well take all the chances at once*, he thought.

The watcher stopped him with a Searching Wire. The sphere thumped suddenly against Martel's chest.

"Are you a Man?" said the unseen voice. (Martel would have known that as a Scanner in haberman condition, his own field-charge would have illuminated the sphere.)

"I am a Man." Martel knew that the timber of his voice had been good; he hoped that it would not be taken for that of a Manshonjagger or a Beast or an Unforgiven one, who with mimicry sought to enter the cities and ports of Mankind.

"Name, number, rank, purpose, function, time departed."

"Martel." He had to remember his old number, not Scanner 34. "Sunward 4234, 182nd Year of Space. Rank, rising Sub-chief." That was no lie, but his substantive rank. "Purpose, personal and lawful within the limits of this city. No function of the Instrumentality. Departed Chief Outport 2019 hours." Everything now depended on whether he was believed, or would be checked against Chief Outport.

The voice was flat and routine: "Time desired within the city."

Martel used the standard phrase: "Your Honorable sufferance is requested."

He stood in the cool night air, waiting. Far above him, through a gap in the mist, he could see the poisonous glittering

in the sky of Scanners. *The stars are my enemies*, he thought: *I have mastered the stars but they hate me. Ho, that sounds Ancient! Like a Book. Too much cranching.*

The voice returned: "Sunward 4234 dash 182 rising Subchief Martel, enter the lawful gates of the city. Welcome. Do you desire food, raiment, money, or companionship?" The voice had no hospitality in it, just business. This was certainly different from entering a city in a Scanner's role! Then the petty officers came out, and threw their beltlights in their fretful faces, and mouthed their words with preposterous deference, shouting against the stone deafness of a Scanner's ears. So that was the way that a Subchief was treated: matter of fact, but not bad. Not bad.

Martel replied: "I have that which I need, but beg of the city a favor. My friend Adam Stone is here. I desired to see him, on urgent and personal lawful affairs."

The voice replied: "Did you have an appointment with Adam Stone?"

"No."

"The city will find him. What is his number?"

"I have forgotten it."

"You have forgotten it? Is not Adam Stone a Magnate of the Instrumentality? Are you truly his friend?"

"Truly." Martel let a little annoyance creep into his voice. "Watcher, doubt me and call your Subchief."

"No doubt implied. Why do you not know the number? This must go into the record," added the voice.

"We were friends in childhood. He has crossed the—" Martel started to say "the Up-and-Out" and remembered that the phrase was current only among Scanners. "He has leapt from Earth to Earth, and has just now returned. I knew him well and I seek him out. I have word of his kith. May the Instrumentality protect us!"

"Heard and believed. Adam Stone will be searched."

At a risk, though a slight one, of having the sphere sound an alarm for *non-human*, Martel cut in on his Scanner speaker within his jacket. He saw the trembling needle of light await

his words and he started to write on it with his blunt finger. *That won't work*, he thought, and had a moment's panic until he found his comb, which had a sharp enough tooth to write. He wrote: "Emergency none. Martel Scanner calling Parizianski Scanner."

The needle quivered and the reply glowed and faded out: "Parizianski Scanner on duty and D. C. Calls taken by Scanner Relay."

Martel cut off his speaker.

Parizianski was somewhere around. Could he have crossed the direct way, right over the city wall, setting off the alert, and invoking official business when the petty officers overtook him in mid-air? Scarcely. That meant that a number of other Scanners must have come in with Parizianski, all of them pretending to be in search of a few of the tenuous pleasures which could be enjoyed by a haberman, such as the sight of the newspictures or the viewing of beautiful women in the Pleasure Gallery. Parizianski was around, but he could not have moved privately, because Scanner Central registered him on duty and recorded his movements city by city.

The voice returned. Puzzlement was expressed in it. "Adam Stone is found and awakened. He has asked pardon of the Honorable, and says he knows no Martel. Will you see Adam Stone in the morning? The city will bid you welcome."

Martel ran out of resources. It was hard enough mimicking a man without having to tell lies in the guise of one. Martel could only repeat: "Tell him I am Martel. The husband of Luci."

"It will be done."

Again the silence, and the hostile stars, and the sense that Parizianski was somewhere near and getting nearer; Martel felt his heart beating faster. He stole a glimpse at his Chestbox and set his heart down a point. He felt calmer, even though he had not been able to scan with care.

The voice this time was cheerful, as though an annoyance had been settled: "Adam Stone consents to see you. Enter Chief Downport, and welcome."

The little sphere dropped noiselessly to the ground and the wire whispered away into the darkness. A bright arc of narrow light rose from the ground in front of Martel and swept through the city to one of the higher towers—apparently a hostel, which Martel had never entered. Martel plucked his aircoat to his chest for ballast, stepped heel-and-toe on the beam, and felt himself whistle through the air to an entrance window which sprang up before him as suddenly as a devouring mouth.

A tower guard stood in the doorway. "You are awaited, sir. Do you bear weapons, sir?"

"None," said Martel, grateful that he was relying on his own strength.

The guard let him past the check-screen. Martel noticed the quick flight of a warning across the screen as his instruments registered and identified him as a Scanner. But the guard had not noticed it.

The guard stopped at a door. "Adam Stone is armed. He is lawfully armed by authority of the Instrumentality and by the liberty of this city. All those who enter are given warning."

Martel nodded in understanding at the man and went in.

Adam Stone was a short man, stout and benign. His gray hair rose stiffly from a low forehead. His whole face was red and merry looking. He looked like a jolly guide from the Pleasure Gallery, not like a man who had been at the edge of the Up-and-Out, fighting the Great Pain without haberman protection.

He stared at Martel. His look was puzzled, perhaps a little annoyed, but not hostile.

Martel came to the point. "You do not know me. I lied. My name is Martel, and I mean you no harm. But I lied. I beg the Honorable gift of your hospitality. Remain armed. Direct your weapon against me—"

Stone smiled: "I am doing so," and Martel noticed the small Wirepoint in Stone's capable plump hand.

"Good. Keep on guard against me. It will give you confidence in what I shall say. But do, I beg you, give us a screen of

privacy. I want no casual lookers. This is a matter of life and death."

"First: whose life and death?" Stone's face remained calm, his voice even.

"Yours, and mine, and the worlds'."

"You are cryptic but I agree." Stone called through the doorway: "Privacy please." There was a sudden hum, and all the little noises of the night quickly vanished from the air of the room.

Said Adam Stone: "Sir, who are you? What brings you here?"

"I am Scanner Thirty-four."

"You a Scanner. I don't believe it."

For answer, Martel pulled his jacket open, showing his Chestbox. Stone looked up at him, amazed. Martel explained:

"I am crunched. Have you never seen it before?"

"*Not with men.* On animals. Amazing! But—what do you want?"

"The truth. Do you fear me?"

"Not with this," said Stone, grasping the Wirepoint. "But I shall tell you the truth."

"Is it true that you have conquered the Great Pain?"

Stone hesitated, seeking words for an answer.

"Quick, can you tell me how you have done it, so that I may believe you?"

"I have loaded the ships with life."

"Life."

"Life. I don't know what the Great Pain is, but I did find that in the experiments, when I sent out masses of animals or plants, the life in the center of the mass lived longest. I built ships—small ones, of course—and sent them out with rabbits, with monkeys—"

"Those are Beasts?"

"Yes. With small Beasts. And the Beasts came back unhurt. They came back because the walls of the ships were filled with life. I tried many kinds, and finally found a sort of life which

lives in the waters. Oysters. Oysterbeds. The outermost oysters died in the Great Pain. The inner ones lived. The passengers were unhurt."

"But they were Beasts?"

"Not only Beasts. Myself."

"You!"

"I came through Space alone. Through what you call the Up-and-Out, alone. Awake and sleeping. I am unhurt. If you do not believe me, ask your brother Scanners. Come and see my ship in the morning. I will be glad to see you then, along with your brother Scanners. I am going to demonstrate before the Chiefs of the Instrumentality."

Martel repeated his question: "You came here alone?"

Adam Stone grew testy: "Yes, alone. Go back and check your Scanner's register if you do not believe me. You never put me in a bottle to cross space."

Martel's face was radiant. "I believe you now. It is true. No more Scanners. No more habermans. No more cranching."

Stone looked significantly toward the door.

Martel did not take the hint. "I must tell you that—"

"Sir, tell me in the morning. Go enjoy your cranch. Isn't it supposed to be pleasure? Medically I know it well. But not in practice."

"It is pleasure. It's normality—for a while. But listen. The Scanners have sworn to destroy you, and your work."

"What!"

"They have met and have voted and sworn. You will make Scanners unnecessary, they say. You will bring the Ancient Wars back to the world, if Scanning is lost and the Scanners live in vain!"

Adam Stone was nervous but kept his wits about him: "You're a Scanner. Are you going to kill me—or try?"

"No, you fool. I have betrayed the Confraternity. Call guards the moment I escape. Keep guards around you. I will try to intercept the killer."

Martel saw a blur in the window. Before Stone could turn,

the Wirepoint was whipped out of his hand. The blur solidified and took form as Parizianski.

Martel recognized what Parizianski was doing: *High speed*.

Without thinking of his cranch, he thrust his hand to his chest, set himself up to *High speed* too. Waves of fire, like the Great Pain, but hotter, flooded over him. He fought to keep his face readable as he stepped in front of Parizianski and gave the sign,

Top Emergency.

Parizianski spoke, while the normally-moving body of Stone stepped away from them as slowly as a drifting cloud: "Get out of my way. I am on a mission."

"I know it. I stop you here and now. Stop. Stop. Stop. Stone is right."

Parizianski's lips were barely readable in the haze of pain which flooded Martel. (He thought: *God, God, God of the Ancients! Let me hold on! Let me live under Overload just long enough!*) Parizianski was saying: "Get out of my way. By order of the Confraternity, get out of my way!" And Parizianski gave the sign, *Help I demand in the name of my duty!*

Martel choked for breath in the syrup-like air. He tried one last time: "Parizianski, friend, friend, my friend. Stop. Stop." (No Scanner had ever murdered Scanner before.)

Parizianski made the sign: *You are unfit for duty, and I will take over.*

Martel thought, "For first time in the world!" as he reached over and twisted Parizianski's Brainbox up to *Overload*. Parizianski's eyes glittered in terror and understanding. His body began to drift down toward the floor.

Martel had just strength enough to reach his own Chestbox. As he faded into haberman or death, he knew not which, he felt his fingers turning on the control of speed, turning down. He tried to speak, to say, "Get a Scanner, I need help, get a Scanner. . . ."

But the darkness rose about him, and the numb silence clasped him.

Martel awakened to see the face of Luci near his own.

He opened his eyes wider, and found that he was hearing—hearing the sound of her happy weeping, the sound of her chest as she caught the air back into her throat.

He spoke weakly: “Still crunched? Alive?”

Another face swam into the blur beside Luci’s. It was Adam Stone. His deep voice rang across immensities of space before coming to Martel’s hearing. Martel tried to read Stone’s lips, but could not make them out. He went back to listening to the voice:

“... not crunched. Do you understand me? Not crunched!”

Martel tried to say: “But I can hear! I can feel!” The others got his sense if not his words.

Adam Stone spoke again:

“You have gone back through the Haberman. I put you back first. I didn’t know how it would work in practice, but I had the theory all worked out. You don’t think the Instrumentality would waste the Scanners, do you? You go back to normality. We are letting the habermans die as fast as the ships come in. They don’t need to live any more. But we are restoring the Scanners. You are the first. Do you understand? You are the first. Take it easy, now.”

Adam Stone smiled. Dimly behind Stone, Martel thought that he saw the face of one of the Chiefs of the Instrumentality. That face, too, smiled at him, and then both faces disappeared upward and away.

Martel tried to lift his head, to scan himself. He could not. Luci stared at him, calming herself, but with an expression of loving perplexity. She said,

“My darling husband! You’re back again, to stay!”

Still, Martel tried to see his box. Finally he swept his hand across his chest with a clumsy motion. There was nothing there. The instruments were gone. He was back to normality but still alive.

In the deep weak peacefulness of his mind, another troubling thought took shape. He tried to write with his finger, the way

that Luci wanted him to, but he had neither pointed fingernail nor Scanner's tablet. He had to use his voice. He summoned up his strength and whispered:

"Scanners?"

"Yes, darling? What is it?"

"Scanners?"

"Scanners. Oh, yes, darling, they're all right. They had to arrest some of them for going into *High Speed* and running away. But the Instrumentality caught them all—all those on the ground—and they're happy now. Do you know, darling," she laughed, "some of them didn't want to be restored to normality. But Stone and his Chiefs persuaded them."

"Vomact?"

"He's fine, too. He's staying crunched until he can be restored. Do you know, he has arranged for Scanners to take new jobs. You're all to be Deputy Chiefs for Space. Isn't that nice? But he got himself made Chief for Space. You're all going to be pilots, so that your fraternity and guild can go on. And Chang's getting changed right now. You'll see him soon."

Her face turned sad. She looked at him earnestly and said: "I might as well tell you now. You'll worry otherwise. There has been one accident. Only one. When you and your friend called on Adam Stone, your friend was so happy that he forgot to scan, and he let himself die of *Overload*."

"Called on Stone?"

"Yes. Don't you remember? Your friend."

He still looked surprised, so she said:

"Parizianski."

"all you zombies --"

2217 Time Zone V (EST) 7 Nov. 1970—NYC—"Pop's Place":

I was polishing a brandy snifter when the Unmarried Mother came in. I noted the time—10:17 P.M., zone five, or eastern time, November 7th, 1970. Temporal agents always notice time and date; we must.

The Unmarried Mother was a man twenty-five years old, no taller than I am, childish features and a touchy temper. I didn't like his looks—I never had—but he was a lad I was here to recruit, he was my boy. I gave him my best barkeep's smile.

Maybe I'm too critical. He wasn't swish; his nickname came from what he always said when some nosy type asked him his line: "I'm an unmarried mother." If he felt less than murderous he would add: "at four cents a word. I write confession stories."

If he felt nasty, he would wait for somebody to make something of it. He had a lethal style of infighting, like a female cop—one reason I wanted him. Not the only one.

He had a load on and his face showed that he despised people more than usual. Silently I poured a double shot of Old Underwear and left the bottle. He drank it, poured another.

I wiped the bar top. "How's the 'Unmarried Mother' racket?"

His fingers tightened on the glass and he seemed about to throw it at me; I felt for the sap under the bar. In temporal manipulation you try to figure everything, but there are so many factors that you never take needless risks.

I saw him relax that tiny amount they teach you to watch for in the Bureau's training school. "Sorry," I said. "Just asking, 'How's business?' Make it 'How's the weather?'"

He looked sour. "Business is okay. I write 'em, they print 'em, I eat."

I poured myself one, leaned toward him. "Matter of fact," I said, "you write a nice stick—I've sampled a few. You have an amazingly sure touch with the woman's angle."

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robert a. heinlein

It was a slip I had to risk; he never admitted what pen-names he used. But he was boiled enough to pick up only the last: “‘Woman’s angle!’” he repeated with a snort. “Yeah, I know the woman’s angle. I should.”

“So?” I said doubtfully. “Sisters?”

“No. You wouldn’t believe me if I told you.”

“Now, now,” I answered mildly, “bartenders and psychiatrists learn that nothing is stronger than truth. Why, son, if you heard the stories I do—well, you’d make yourself rich. Incredible.”

“You don’t know what ‘incredible’ means!”

“So? Nothing astonishes me. I’ve always heard worse.”

He snorted again. “Want to bet the rest of the bottle?”

“I’ll bet a full bottle.” I placed one on the bar.

“Well—” I signaled my other bartender to handle the trade. We were at the far end, a single-stool space that I kept private by loading the bar top by it with jars of pickled eggs and other clutter. A few were at the other end watching the fights and somebody was playing the juke box—private as a bed where we were.

“Okay,” he began, “to start with, I’m a bastard.”

“No distinction around here,” I said.

“I mean it,” he snapped. “My parents weren’t married.”

“Still no distinction,” I insisted. “Neither were mine.”

“When—” He stopped, gave me the first warm look I ever saw on him. “You mean that?”

“I do. A one-hundred-percent bastard. In fact,” I added, “no one in my family ever marries. All bastards.

“Oh, that.” I showed it to him. “It just looks like a wedding ring; I wear it to keep women off.” It is an antique I bought in 1985 from a fellow operative—he had fetched it from pre-Christian Crete. “The Worm Ouroboros . . . the World Snake that eats its own tail, forever without end. A symbol of the Great Paradox.”

He barely glanced at it. “If you’re really a bastard, you know how it feels. When I was a little girl—”

“Wups!” I said. “Did I hear you correctly?”

"Who's telling this story? When I was a little girl—Look, ever hear of Christine Jorgensen? Or Roberta Cowell?"

"Uh, sex-change cases? You're trying to tell me—"

"Don't interrupt or swelp me, I won't talk. I was a foundling, left at an orphanage in Cleveland in 1945 when I was a month old. When I was a little girl, I envied kids with parents. Then, when I learned about sex—and, believe me, Pop, you learn fast in an orphanage—"

"I know."

"—I made a solemn vow that any kid of mine would have both a pop and a mom. It kept me 'pure,' quite a feat in that vicinity—I had to learn to fight to manage it. Then I got older and realized I stood darn little chance of getting married—for the same reason I hadn't been adopted." He scowled. "I was horse-faced and buck-toothed, flat-chested and straight-haired."

"You don't look any worse than I do."

"Who cares how a barkeep looks? Or a writer? But people wanting to adopt pick little blue-eyed golden-haired morons. Later on, the boys want bulging breasts, a cute face, and an Oh-you-wonderful-male manner." He shrugged. "I couldn't compete. So I decided to join the W.E.N.C.H.E.S."

"Eh?"

"Women's Emergency National Corps, Hospitality & Entertainment Section, what they now call 'Space Angels'—Auxiliary Nursing Group, Extraterrestrial Legions."

I knew both terms, once I had them chronized. We use still a third name, it's that elite military service corps: Women's Hospitality Order Refortifying & Encouraging Spacemen. Vocabulary shift is the worst hurdle in time-jumps—did you know that "service station" once meant a dispensary for petroleum fractions? Once on an assignment in the Churchill Era, a woman said to me, "Meet me at the service station next door"—which is not what it sounds; a "service station" (then) wouldn't have a bed in it.

He went on: "It was when they first admitted you can't send men into space for months and years and not relieve the tension.

You remember how the wowzers screamed?—that improved my chance, since volunteers were scarce. A gal had to be respectable, preferably virgin (they liked to train them from scratch), above average mentally, and stable emotionally. But most volunteers were old hookers, or neurotics who would crack up ten days off Earth. So I didn't need looks; if they accepted me, they would fix my buck teeth, put a wave in my hair, teach me to walk and dance and how to listen to a man pleasingly, and everything else—plus training for the prime duties. They would even use plastic surgery if it would help—nothing too good for Our Boys.

“Best yet, they made sure you didn't get pregnant during your enlistment—and you were almost certain to marry at the end of your hitch. Same way today, A.N.G.E.L.S. marry spacers—they talk the language.

“When I was eighteen I was placed as a ‘mother's helper.’ This family simply wanted a cheap servant but I didn't mind as I couldn't enlist till I was twenty-one. I did housework and went to night school—pretending to continue my high school typing and shorthand but going to a charm class instead to better my chances for enlistment.

“Then I met this city slicker with his hundred-dollar bills.” He scowled. “The no-good actually did have a wad of hundred-dollar bills. He showed me one night, told me to help myself.

“But I didn't. I liked him. He was the first man I ever met who was nice to me without trying games with me. I quit night school to see him oftener. It was the happiest time of my life.

“Then one night in the park the games began.”

He stopped. I said, “And then?”

“And then *nothing*! I never saw him again. He walked me home and told me he loved me—and kissed me good-night and never came back.” He looked grim. “If I could find him, I'd kill him!”

“Well,” I sympathized, “I know how you feel. But killing him—just for doing what comes naturally—hmm . . . Did you struggle?”

"Huh? What's that got to do with it?"

"Quite a bit. Maybe he deserves a couple of broken arms for running out on you, but—"

"He deserves worse than that! Wait till you hear. Somehow I kept anyone from suspecting and decided it was all for the best. I hadn't really loved him and probably would never love anybody—and I was more eager to join the W.E.N.C.H.E.S. than ever. I wasn't disqualified, they didn't insist on virgins. I cheered up.

"It wasn't until my skirts got tight that I realized."

"Pregnant?"

"He had me higher 'n a kite! Those skinflints I lived with ignored it as long as I could work—then kicked me out and the orphanage wouldn't take me back. I landed in a charity ward surrounded by other big bellies and trotted bedpans until my time came.

"One night I found myself on an operating table, with a nurse saying, 'Relax. Now breathe deeply.'

"I woke up in bed, numb from the chest down. My surgeon came in. 'How do you feel?' he says cheerfully.

" 'Like a mummy.'

" 'Naturally. You're wrapped like one and full of dope to keep you numb. You'll get well—but a Caesarean isn't a hang-nail.'

" 'Caesarean,' I said. 'Doc—*did I lose the baby?*'"

" 'Oh, no. Your baby's fine.'

" 'Oh, Boy or girl?'"

" 'A healthy little girl. Five pounds, three ounces.'

"I relaxed. It's something, to have made a baby. I told myself I would go somewhere and tack 'Mrs.' on my name and let the kid think her papa was dead—no orphanage for *my* kid!

"But the surgeon was talking. 'Tell me, uh—' He avoided my name. '—did you ever think your glandular setup was odd?'"

"I said, 'Huh? Of course not. What are you driving at?'"

"He hesitated. 'I'll give you this in one dose, then a hypo to let you sleep off your jitters. You'll have 'em.'

“ ‘Why?’ I demanded.

“ ‘Ever hear of that Scottish physician who was female until she was thirty-five?—then had surgery and became legally and medically a man? Got married. All okay.’

“ ‘What’s that got to do with me?’

“ ‘That’s what I’m saying. You’re a man.’

“ ‘I tried to sit up. *What?*’

“ ‘Take it easy. When I opened you, I found a mess. I sent for the Chief of Surgery while I got the baby out, then we held a consultation with you on the table—and worked for hours to salvage what we could. You had two full sets of organs, both immature, but with the female set well enough developed for you to have a baby. They could never be any use to you again, so we took them out and rearranged things so that you can develop properly as a man.’ He put a hand on me. ‘Don’t worry. You’re young, your bones will readjust, we’ll watch your glandular balance—and make a fine young man out of you.’

“ ‘I started to cry. ‘What about my *baby?*’

“ ‘Well, you can’t nurse her, you haven’t milk enough for a kitten. If I were you, I wouldn’t see her—put her up for adoption.’

“ ‘No!’

“ ‘He shrugged. ‘The choice is yours; you’re her mother—well, her parent. But don’t worry now; we’ll get you well first.’

“ ‘Next day they let me see the kid and I saw her daily—trying to get used to her. I had never seen a brand-new baby and had no idea how awful they look—my daughter looked like an orange monkey. My feelings changed to cold determination to do right by her. But four weeks later that didn’t mean anything.’

“ ‘Eh?’

“ ‘She was snatched.’

“ ‘Snatched?’ ”

The Unmarried Mother almost knocked over the bottle we had bet. “Kidnapped—stolen from the hospital nursery!” He breathed hard. “How’s that for taking the last a man’s got to live for?”

“A bad deal,” I agreed. “Let’s pour you another. No clues?”

“Nothing the police could trace. Somebody came to see her, claimed to be her uncle. While the nurse had her back turned, he walked out with her.”

“Description?”

“Just a man, with a face-shaped face, like yours or mine.” He frowned. “I think it was the baby’s father. The nurse swore it was an older man but he probably used makeup. Who else would swipe my baby? Childless women pull such stunts—but whoever heard of a man doing it?”

“What happened to you then?”

“Eleven more months of that grim place and three operations. In four months I started to grow a beard; before I was out I was shaving regularly . . . and no longer doubted that I was male.” He grinned wryly. “I was staring down nurses’ necklines.”

“Well,” I said, “seems to me you came through okay. Here you are, a normal man, making good money, no real troubles. And the life of a female is not an easy one.”

He glared at me. “A lot you know about it!”

“So?”

“Ever hear the expression ‘a ruined woman’?”

“Mmm, years ago. Doesn’t mean much today.”

“I was as ruined as a woman can be; that bum *really* ruined me—I was no longer a woman . . . and I didn’t know *how* to be a man.”

“Takes getting used to, I suppose.”

“You have no idea. I don’t mean learning how to dress, or not walking into the wrong rest room; I learned those in the hospital. But how could I *live*? What job could I get? Hell, I couldn’t even drive a car, I didn’t know a trade; I couldn’t do manual labor—too much scar tissue, too tender.

“I hated him for having ruined me for the W.E.N.C.H.E.S., too, but I didn’t know how much until I tried to join the Space Corps instead. One look at my belly and I was marked unfit for military service. The medical officer spent time on me just from curiosity; he had read about my case.

“So I changed my name and came to New York. I got by as a

fry cook, then rented a typewriter and set myself up as a public stenographer—what a laugh! In four months I typed four letters and one manuscript. The manuscript was for *Real Life Tales* and a waste of paper, but the goof who wrote it sold it. Which gave me an idea; I bought a stack of confession magazines and studied them.” He looked cynical. “Now you know how I get the authentic woman’s angle on an unmarried-mother story . . . through the only version I haven’t sold—the true one. Do I win the bottle?”

I pushed it toward him. I was upset myself, but there was work to do. I said, “Son, you still want to lay hands on that so-and-so?”

His eyes lighted up—a feral gleam.

“Hold it!” I said. “You wouldn’t kill him?”

He chuckled nastily. “Try me.”

“Take it easy. I know more about it than you think I do. I can help you. I know where he is.”

He reached across the bar. “*Where is he?*”

I said softly, “Let go my shirt, sonny—or you’ll land in the alley and we’ll tell the cops you fainted.” I showed him the sap.

He let go. “Sorry. But where is he?” He looked at me. “And how do you know so much?”

“All in good time. There are records—hospital records, orphanage records, medical records. The matron of your orphanage was Mrs. Fetherage—right? She was followed by Mrs. Gruenstein—right? Your name, as a girl, was ‘Jane’—right? And you didn’t tell me any of this—right?”

I had him baffled and a bit scared. “What’s this? You trying to make trouble for me?”

“No indeed. I’ve your welfare at heart. I can put this character in your lap. You do to him as you see fit—and I guarantee that you’ll get away with it. But I don’t think you’ll kill him. You’d be nuts to—and you aren’t nuts. Not quite.”

He brushed it aside. “Cut the noise. *Where is he?*”

I poured him a short one; he was drunk but anger was offsetting it. “Not so fast. I do something for you—you do something for me.”

"Uh . . . what?"

"You don't like your work. What would you say to high pay, steady work, unlimited expense account, your own boss on the job, and lots of variety and adventure?"

He stared. "I'd say, 'Get those goddam reindeer off my roof!' Shove it, Pop—there's no such job."

"Okay, put it this way: I hand him to you, you settle with him, then try my job. If it's not all I claim—well, I can't hold you."

He was wavering; the last drink did it. "When d'yuh d'liver 'im?" he said thickly.

He shoved out his hand. "It's a deal!"

"If it's a deal—*right now!*"

I nodded to my assistant to watch both ends, noted the time—2300—started to duck through the gate under the bar—when the juke box blared out: "I'm My Own Grandpaw!" The service man had orders to load it with Americana and classics because I couldn't stomach the "music" of 1970, but I hadn't known that tape was in it. I called out, "Shut that off! Give the customer his money back." I added, "Storeroom, back in a moment," and headed there with my Unmarried Mother following.

It was down the passage across from the johns, a steel door to which no one but my day manager and myself had a key; inside was a door to an inner room to which only I had a key. We went there.

He looked blearily around at windowless walls. "Where is 'e?"

"Right away." I opened a case, the only thing in the room; it was a U.S.F.F. Co-ordinates Transformer Field Kit, series 1992, Mod. II—a beauty, no moving parts, weight twenty-three kilos fully charged, and shaped to pass as a suitcase. I had adjusted it precisely earlier that day; all I had to do was to shake out the metal net which limits the transformation field.

Which I did. "What's that?" he demanded.

"Time machine," I said and tossed the net over us.

"Hey!" he yelled and stepped back. There is a technique to

this; the net has to be thrown so that the subject will instinctively step back *onto* the metal mesh, then you close the net with both of you inside completely—else you might leave shoe soles behind or a piece of foot, or scoop up a slice of floor. But that's all the skill it takes. Some agents con a subject into the net; I tell the truth and use that instant of utter astonishment to flip the switch. Which I did.

1030-VI-3 April 1963—Cleveland, Ohio-Apex Bldg.: “Hey!” he repeated. “Take this damn thing off!”

“Sorry,” I apologized and did so, stuffed the net into the case, closed it. “You said you wanted to find him.”

“But—you said that was a time machine!”

I pointed out a window. “Does that look like November? Or New York?” While he was gawking at new buds and spring weather, I reopened the case, took out a packet of hundred-dollar bills, checked that the numbers and signatures were compatible with 1963. The Temporal Bureau doesn't care how much you spend (it costs nothing) but they don't like unnecessary anachronisms. Too many mistakes, and a general court-martial will exile you for a year in a nasty period, say 1974 with its strict rationing and forced labor. I never make such mistakes, the money was okay.

He turned around and said, “What happened?”

“He's here. Go outside and take him. Here's expense money.” I shoved it at him and added, “Settle him, then I'll pick you up.”

Hundred-dollar bills have a hypnotic effect on a person not used to them. He was thumbing them unbelievably as I eased him into the hall, locked him out. The next jump was easy, a small shift in era.

7100-VI-10 March 1964—Cleveland-Apex Bldg.: There was a notice under the door saying that my lease expired next week; otherwise the room looked as it had a moment before. Outside, trees were bare and snow threatened; I hurried, stopping only for contemporary money and a coat, hat, and topcoat I had

left there when I leased the room. I hired a car, went to the hospital. It took twenty minutes to bore the nursery attendant to the point where I could swipe the baby without being noticed. We went back to the Apex Building. This dial setting was more involved, as the building did not yet exist in 1945. But I had precalculated it.

0100-VI-20 Sept. 1945—Cleveland-Skyview Motel. Field kit, baby, and I arrived in a motel outside town. Earlier I had registered as “Gregory Johnson, Warren, Ohio,” so we arrived in a room with curtains closed, windows locked, and doors bolted, and the floor cleared to allow for waver as the machine hunts. You can get a nasty bruise from a chair where it shouldn’t be—not the chair, of course, but backlash from the field.

No trouble. Jane was sleeping soundly; I carried her out, put her in a grocery box on the seat of a car I had provided earlier, drove to the orphanage, put her on the steps, drove two blocks to a “service station” (the petroleum-products sort) and phoned the orphanage, drove back in time to see them taking the box inside, kept going and abandoned the car near the motel—walked to it and jumped forward to the Apex Building in 1963.

2200-VI-24 April 1963—Cleveland-Apex Bldg.: I had cut the time rather fine—temporal accuracy depends on span, except on return to zero. If I had it right, Jane was discovering, out in the park this balmy spring night, that she wasn’t quite as “nice” a girl as she had thought. I grabbed a taxi to the home of those skinflints, had the hackie wait around a corner while I lurked in shadows.

Presently I spotted them down the street, arms around each other. He took her up on the porch and made a long job of kissing her good-night—longer than I thought. Then she went in and he came down the walk, turned away. I slid into step and hooked an arm in his. “That’s all, son,” I announced quietly. “I’m back to pick you up.”

"*You!*" He gasped and caught his breath.

"Me. Now you know who *he* is—and after you think it over you'll know who you are . . . and if you think hard enough, you'll figure out who the baby is . . . and who *I* am."

He didn't answer, he was badly shaken. It's a shock to have it proved to you that you can't resist seducing yourself. I took him to the Apex Building and we jumped again.

2300-VIII-1 Aug. 1985—Sub Rockies Base: I woke the duty sergeant, showed my I.D., told the sergeant to bed my companion down with a happy pill and recruit him in the morning. The sergeant looked sour, but rank is rank, regardless of era; he did what I said—thinking, no doubt, that the next time we met he might be the colonel and I the sergeant. Which can happen in our corps. "What name?" he asked.

I wrote it out. He raised his eyebrows. "Like so, eh? *Hmm—*"

"You just do your job, Sergeant." I turned to my companion.

"Son, your troubles are over. You're about to start the best job a man ever held—and you'll do well. *I know.*"

"That you will!" agreed the sergeant. "Look at me—born in 1917—still around, still young, still enjoying life." I went back to the jump room, set everything on preselected zero.

2301-V-7 Nov. 1970—NYC—"Pop's Place": I came out of the storeroom carrying a fifth of Drambuie to account for the minute I had been gone. My assistant was arguing with the customer who had been playing "I'm My Own Grandpaw!" I said, "Oh, let him play it, then unplug it." I was very tired.

It's rough, but somebody must do it and it's very hard to recruit anyone in the later years, since the Mistake of '72. Can you think of a better source than to pick people all fouled up where they are and give them well-paid, interesting (even though dangerous) work in a necessary cause? Everybody knows now why the Fizzle War of 1963 fizzled. The bomb with New York's number on it didn't go off, a hundred other things didn't go as planned—all arranged by the likes of me.

But not the Mistake of '72; that one is not our fault—and can't be undone; there's no paradox to resolve. A thing either is, or it isn't, now and forever amen. But there won't be another like it; an order dated “1992” takes precedence any year.

I closed five minutes early, leaving a letter in the cash register telling my day manager that I was accepting his offer to buy me out, so see my lawyer as I was leaving on a long vacation. The Bureau might or might not pick up his payments, but they want things left tidy. I went to the room back of the storeroom and forward to 1993.

2200-VII-12 Jan. 1993—Sub Rockies Annex-HQ Temporal

DOL: I checked in with the duty officer and went to my quarters, intending to sleep for a week. I had fetched the bottle we bet (after all, I won it) and took a drink before I wrote my report. It tasted foul and I wondered why I had ever liked Old Underwear. But it was better than nothing; I don't like to be cold sober, I think too much. But I don't really hit the bottle either; other people have snakes—I have people.

I dictated my report; forty recruitments all okayed by the Psych Bureau—counting my own, which I knew would be okayed. I was here, wasn't I? Then I taped a request for assignment to operations; I was sick of recruiting. I dropped both in the slot and headed for bed.

My eye fell on “The By-Laws of Time,” over my bed:

Never Do Yesterday What Should Be Done Tomorrow.

If at Last You Do Succeed, Never Try Again.

A Stitch in Time Saves Nine Billion.

A Paradox May be Paradoctored.

It Is Earlier When You Think.

Ancestors Are Just People.

Even Jove Nods.

They didn't inspire me the way they had when I was a recruit; thirty subjective-years of time-jumping wears you down. I undressed and when I got down to the hide I looked at my belly.

A Caesarean leaves a big scar but I'm so hairy now that I don't notice it unless I look for it.

Then I glanced at the ring on my finger.

The Snake That Eats Its Own Tail, Forever and Ever . . . I *know* where *I* came from—but *where did all you zombies come from?*

I felt a headache coming on, but a headache powder is one thing I do not take. I did once—and you all went away.

So I crawled into bed and whistled out the light.

You aren't really there at all. There isn't anybody but me—Jane—here alone in the dark.

I miss you dreadfully!

... the days went slowly round and round, endless and uneventful as cycles in space. Time, and time-pieces! How many centuries did my hammock tell, as pendulum-like it swung to the ship's dull roll, and ticked the hours and ages.

Herman Melville, in *Mardi*

Don't move.

It was the first thought that came into Garrard's mind when he awoke, and perhaps it saved his life. He lay where he was, strapped against the padding, listening to the round hum of the engines. That in itself was wrong; he should be unable to hear the overdrive at all.

He thought to himself: *Has it begun already?*

Otherwise everything seemed normal. The DFC-3 had crossed over into interstellar velocity, and he was still alive, and the ship was still functioning. The ship should at this moment be traveling at 22.4 times the speed of light—a neat 4,157,000 miles per second.

Somehow Garrard did not doubt that it was. On both previous tries, the ships had whiffed away toward Alpha Centauri at the proper moment when the overdrive should have cut in; and the split second of residual image after they had vanished, subjected to spectroscopy, showed a Doppler shift which tallied with the acceleration predicted for that moment by Haertel.

The trouble was not that Brown and Cellini hadn't gotten away in good order. It was simply that neither of them had ever been heard from again.

Very slowly, he opened his eyes. His eyelids felt terrifically heavy. As far as he could judge from the pressure of the couch against his skin, the gravity was normal; nevertheless, moving his eyelids seemed almost an impossible job.

After long concentration, he got them fully open. The instrument chassis was directly before him, extended over his diaphragm on its elbow joint. Still without moving anything but

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his eyes—and those only with the utmost patience—he checked each of the meters. Velocity: 22.4 c. Operating temperature: normal. Ship temperature: 37° C. Air pressure: 778 mm. Fuel: No. 1 tank full, No. 2 tank full, No. 3 tank full, No. 4 tank nine-tenths full. Gravity: 1 g. Calendar: stopped.

He looked at it closely, though his eyes seemed to focus very slowly, too. It was, of course, something more than a calendar—it was an all-purpose clock, designed to show him the passage of seconds, as well as of the ten months his trip was supposed to take to the double star. But there was no doubt about it: the second-hand was motionless.

That was the second abnormality. Garrard felt an impulse to get up and see if he could start the clock again. Perhaps the trouble had been temporary and safely in the past. Immediately there sounded in his head the injunction he had drilled into himself for a full month before the trip had begun—

Don't move!

Don't move until you know the situation as far as it can be known without moving. Whatever it was that had snatched Brown and Cellini irretrievably beyond human ken was potent, and totally beyond anticipation. They had both been excellent men, intelligent, resourceful, trained to the point of diminishing returns and not a micron beyond that point—the best men in the Project. Preparations for every knowable kind of trouble had been built into their ships, as they had been built into the DFC-3. Therefore, if there was something wrong nevertheless, it would be something that might strike from some commonplace quarter—and strike only once.

He listened to the humming. It was even and placid, and not very loud, but it disturbed him deeply. The overdrive was supposed to be inaudible, and the tapes from the first unmanned test vehicles had recorded no such hum. The noise did not appear to interfere with the overdrive's operation, or to indicate any failure in it. It was just an irrelevancy for which he could find no reason.

But the reason existed. Garrard did not intend to do so much as draw another breath until he found out what it was.

Incredibly, he realized for the first time that he had not in fact drawn one single breath since he had first come to. Though he felt not the slightest discomfort, the discovery called up so overwhelming a flash of panic that he very nearly sat bolt upright on the couch. Luckily—or so it seemed, after the panic had begun to ebb—the curious lethargy which had affected his eyelids appeared to involve his whole body, for the impulse was gone before he could summon the energy to answer it. And the panic, poignant though it had been for an instant, turned out to be wholly intellectual. In a moment, he was observing that his failure to breathe in no way discommoded him as far as he could tell—it was just there, waiting to be explained. . . .

Or to kill him. But it hadn't yet.

Engines humming; eyelids heavy; breathing absent; calendar stopped. The four facts added up to nothing. The temptation to move something—even if it were only a big toe—was strong, but Garrard fought it back. He had been awake only a short while—half an hour at most—and already had noticed four abnormalities. There were bound to be more, anomalies more subtle than these four; but available to close examination before he had to move. Nor was there anything in particular that he had to do, aside from caring for his own wants; the Project, on the chance that Brown's and Cellini's failure to return had resulted from some tampering with the overdrive, had made everything in the DFC-3 subject only to the computer. In a very real sense, Garrard was just along for the ride. Only when the overdrive was off could he adjust—

Pock.

It was a soft, low-pitched noise, rather like a cork coming out of a wine bottle. It seemed to have come just from the right of the control chassis. He halted a sudden jerk of his head on the cushions toward it with a flat fiat of will. Slowly, he moved his eyes in that direction.

He could see nothing that might have caused the sound. The ship's temperature dial showed no change, which ruled out a

heat noise from differential contraction or expansion—the only possible explanation he could bring to mind.

He closed his eyes—a process which turned out to be just as difficult as opening them had been—and tried to visualize what the calendar had looked like when he had first come out of anesthesia. After he got a clear and—he was almost sure—accurate picture, Garrard opened his eyes again.

The sound had been the calendar, advancing one second. It was now motionless again, apparently stopped.

He did not know how long it took the second-hand to make that jump, normally; the question had never come up. Certainly the jump, when it came at the end of each second, had been too fast for the eye to follow.

Belatedly, he realized what all this cogitation was costing him in terms of essential information. The calendar had moved. Above all and before anything else, he *must* know exactly how long it took it to move again. . . .

He began to count, allowing an arbitrary five seconds lost. *One-and-a-six, one-and-a-seven, one-and-an-eight—*

Garrard had gotten only that far when he found himself plunged into hell.

First, and utterly without reason, a sickening fear flooded swiftly through his veins, becoming more and more intense. His bowels began to knot, with infinite slowness. His whole body became a field of small, slow pulses—not so much shaking him as putting his limbs into contrary joggling motions, and making his skin ripple gently under his clothing. Against the hum another sound became audible, a nearly subsonic thunder which seemed to be inside his head. Still the fear mounted, and with it came the pain, and the tenesmus—a boardlike stiffening of his muscles, particularly across his abdomen and his shoulders, but affecting his forearms almost as grievously. He felt himself beginning, very gradually, to double at the middle, a motion about which he could do precisely nothing—a terrifying kind of dynamic paralysis. . . .

It lasted for hours. At the height of it, Garrard's mind, even

his very personality, was washed out utterly; he was only a vessel of horror. When some few trickles of reason began to return over that burning desert of reasonless emotion, he found that he was sitting up on the cushions, and that with one arm he had thrust the control chassis back on its elbow so that it no longer jutted over his body. His clothing was wet with perspiration, which stubbornly refused to evaporate or to cool him. And his lungs ached a little, although he could still detect no breathing.

What under God had happened? Was it this that had killed Brown and Cellini? For it would kill Garrard, too—of that he was sure—if it happened often. It would kill him even if it happened only twice more, if the next two such things followed the first one closely. At the very best it would make a slobbering idiot of him, and though the computer might bring Garrard and the ship back to Earth, it would not be able to tell the Project about this tornado of senseless fear.

The calendar said that the eternity in hell had taken three seconds. As he looked at it in academic indignation, it said *pock* and condescended to make the total seizure four seconds long. With grim determination, Garrard began to count again.

He took care to establish the counting as an absolutely even, automatic process which would not stop at the back of his mind no matter what other problem he tackled along with it, or what emotional typhoons should interrupt him. Really compulsive counting cannot be stopped by anything—not the transports of love nor the agonies of empires. Garrard knew the dangers in deliberately setting up such a mechanism in his mind, but he also knew how desperately he needed to time that clock tick. He was beginning to understand what had happened to him—but he needed exact measurement before he could put that understanding to use.

Of course there had been plenty of speculation on the possible effect of the overdrive on the subjective time of the pilot, but none of it had come to much. At any speed below the velocity of light, subjective and objective time were exactly the

same as far as the pilot was concerned. For an observer on Earth, time aboard the ship would appear to be vastly slowed at near-light speeds; but for the pilot himself there would be no apparent change.

Since flight beyond the speed of light was impossible—although for slightly differing reasons—by both the current theories of relativity, neither theory had offered any clue as to what would happen on board a translight ship. They would not allow that any such ship could ever exist. The Haertel transformation, on which, in effect, the DFC-3 flew, was nonrelativistic: it showed that the apparent elapsed time of a translight journey should be identical in ship-time, and in the time of observers at both ends of the trip.

But since ship and pilot were part of the same system, both covered by the same expression in Haertel's equation, it had never occurred to anyone that the pilot and the ship might keep different times. The notion was ridiculous.

One-and-a-sevenhundredone, one-and-a-sevenhundredtwo, one-and-a-sevenhundredthree, one-and-a-sevenhundredfour . . .

The ship was keeping ship-time, which was identical with observer-time. It would arrive at the Alpha Centauri system in ten months. But the pilot was keeping Garrard time, and it was beginning to look as though he wasn't going to arrive at all.

It was impossible, but there it was. Something—almost certainly an unsuspected physiological side effect of the overdrive field on human metabolism, an effect which naturally could not have been detected in the preliminary, robot-piloted tests of the overdrive—had speeded up Garrard's subjective apprehension of time, and had done a thorough job of it.

The second-hand began a slow, preliminary quivering as the calendar's innards began to apply power to it. *Seventy-hundred-forty-one, seventy-hundred-forty-two, seventy-hundred-forty-three . . .*

At the count of 7,058 the second-hand began the jump to the next graduation. It took it several apparent minutes to get across the tiny distance, and several more to come completely to rest. Later still, the sound came to him:

Pock.

In a fever of thought, but without any real physical agitation, his mind began to manipulate the figures. Since it took him longer to count an individual number as the number became larger, the interval between the two calendar ticks probably was closer to 7,200 seconds than to 7,058. Figuring backward brought him quickly to the equivalence he wanted:

One second in ship-time was two hours in Garrard-time.

Had he really been counting for what was, for him, two whole hours? There seemed to be no doubt about it. It looked like a long trip ahead.

Just how long it was going to be struck him with stunning force. Time had been slowed for him by a factor of 7,200. He would get to Alpha Centauri in just 72,000 months.

Which was—

Six thousand years!

[2]

Garrard sat motionless for a long time after that, the Nessus-shirt of warm sweat swathing him persistently, refusing even to cool. There was, after all, no hurry.

Six thousand years. There would be food and water and air for all that time, or for sixty or six hundred thousand years; the ship would synthesize his needs, as a matter of course, for as long as the fuel lasted, and the fuel bred itself. Even if Garrard ate a meal every three seconds of objective, or ship, time (which, he realized suddenly, he wouldn't be able to do, for it took the ship several seconds of objective time to prepare and serve up a meal once it was ordered; he'd be lucky if he ate once a day, Garrard-time), there would be no reason to fear any shortage of supplies. That had been one of the earliest of the possibilities for disaster that the Project engineers had ruled out in the design of the DFC-3.

But nobody had thought to provide a mechanism which would indefinitely refurbish Garrard. After six thousand years, there would be nothing left of him but a faint film of dust on the

DFC-3's dully gleaming horizontal surfaces. His corpse might outlast him a while, since the ship itself was sterile—but eventually he would be consumed by the bacteria which he carried in his own digestive tract. He needed those bacteria to synthesize part of his B-vitamin needs while he lived, but they would consume him without compunction once he had ceased to be as complicated and delicately balanced a thing as a pilot—or as any other kind of life.

Garrard was, in short, to die before the DFC-3 had gotten fairly away from Sol; and when, after 12,000 apparent years, the DFC-3 returned to Earth, not even his mummy would be still aboard.

The chill that went through him at that seemed almost unrelated to the way he thought he felt about the discovery; it lasted an enormously long time, and insofar as he could characterize it at all, it seemed to be a chill of urgency and excitement—not at all the kind of chill he should be feeling at a virtual death sentence. Luckily it was not as intolerably violent as the last such emotional convulsion; and when it was over, two clock ticks later, it left behind a residuum of doubt.

Suppose that this effect of time-stretching was only mental? The rest of his bodily processes might still be keeping ship-time; Garrard had no immediate reason to believe otherwise. If so, he would be able to move about only on ship-time, too; it would take many apparent months to complete the simplest task.

But he would live, if that were the case. His mind would arrive at Alpha Centauri six thousand years older, and perhaps madder, than his body, but he would live.

If, on the other hand, his bodily movements were going to be as fast as his mental processes, he would have to be enormously careful. He would have to move slowly and exert as little force as possible. The normal human hand movement, in such a task as lifting a pencil, took the pencil from a state of rest to another state of rest by imparting to it an acceleration of about two feet per second per second—and, of course, decelerated it by the same amount. If Garrard were to attempt

to impart to a two-pound weight, which was keeping ship-time, an acceleration of $14,440 \text{ ft/sec}^2$ in his time, he'd have to exert a force of 900 pounds on it.

The point was not that it couldn't be done—but that it would take as much effort as pushing a stalled jeep. He'd never be able to lift that pencil with his forearm muscles alone; he'd have to put his back into the task.

And the human body wasn't engineered to maintain stresses of that magnitude indefinitely. Not even the most powerful professional weight-lifter is forced to show his prowess throughout every minute of every day.

Pock.

That was the calendar again; another second had gone by. Or another two hours. It had certainly seemed longer than a second, but less than two hours, too. Evidently subjective time was an intensively recomplicated measure. Even in this world of micro-time—in which Garrard's mind, at least, seemed to be operating—he could make the lapses between calendar ticks seem a little shorter by becoming actively interested in some problem or other. That would help, during the waking hours, but it would help only if the rest of his body were *not* keeping the same time as his mind. If it were not, then he would lead an incredibly active, but perhaps not intolerable, mental life during the many centuries of his awake-time, and would be mercifully asleep for nearly as long.

Both problems—that of how much force he could exert with his body, and how long he could hope to be asleep in his mind—emerged simultaneously into the forefront of his consciousness while he still sat inertly on the hammock, their terms still much muddled together. After the single tick of the calendar, the ship—or the part of it that Garrard could see from here, settled back into complete rigidity. The sound of the engines, too, did not seem to vary in frequency or amplitude, at least as far as his ears could tell. He was still not breathing. Nothing moved, nothing changed.

It was the fact that he could still detect no motion of his diaphragm or his rib cage that decided him at last. His body had to be keeping ship-time, otherwise he would have blacked out from oxygen starvation long before now. That assumption explained, too, those two incredibly prolonged, seemingly sourceless saturnalias of emotion through which he had suffered: they had been nothing more nor less than the response of his endocrine glands to the purely intellectual reactions he had experienced earlier. He had discovered that he was not breathing, had felt a flash of panic and had tried to sit up. Long after his mind had forgotten those two impulses, they had inched their way from his brain down his nerves to the glands and muscles involved, and actual, *physical* panic had supervened. When that was over, he actually *was* sitting up, though the flood of adrenalin had prevented his noticing the notion as he had made it. The later chill—less violent, and apparently associated with the discovery that he might die long before the trip was completed—actually had been his body's response to a much earlier mental command; the abstract fever of interest he had felt while computing the time differential had been responsible for it.

Obviously, he was going to have to be very careful with apparently cold and intellectual impulses of any kind—or he would pay for them later with a prolonged and agonizing glandular reaction. Nevertheless, the discovery gave him considerable satisfaction, and Garrard allowed it free play; it certainly could not hurt him to feel pleased for a few hours, and the glandular pleasure might even prove helpful if it caught him at a moment of mental depression. Six thousand years, after all, provided a considerable number of opportunities for feeling down-in-the-mouth; so it would be best to encourage all pleasure moments, and let the after-reaction last as long as it might. It would be the instants of panic, of fear, of gloom, which he would have to regulate sternly the moment they came into his mind; it would be those which would otherwise plunge him into four, five, six, perhaps even ten, Garrard-hours of emotional inferno.

Pock.

There now, that was very good: there had been two Garrard-hours which he had passed with virtually no difficulty of any kind, and without being especially conscious of their passage. If he could really settle down and become used to this kind of scheduling, the trip might not be as bad as he had at first feared. Sleep would take immense bites out of it; and during the waking periods he could put in one hell of a lot of creative thinking. During a single day of ship-time, Garrard could get in more thinking than any philosopher of Earth could have managed during an entire lifetime. Garrard could, if he disciplined himself sufficiently, devote his mind for a century to running down the consequences of a single thought, down to the last detail, and still have millennia left to go on to the next thought. What panoplies of pure reason could he not have assembled by the time 6,000 years had gone by? With sufficient concentration, he might come up with the solution to the Problem of Evil between breakfast and dinner of a single ship's day, and in a ship's month might put his finger on the First Cause!

Pock.

Not that. Garrard was sanguine enough to expect that he would remain logical or even sane throughout the trip. The vista was still grim, in much of its detail. But the opportunities, too, were there. He felt a momentary regret that it hadn't been Haertel, rather than himself, who had been given such an opportunity—

Pock.

—for the old man could certainly have made better use of it than Garrard could. The situation demanded someone trained in the highest rigors of mathematics to be put to the best conceivable use. Still and all Garrard began to feel—

Pock.

—that he would give a good account of himself, and it tickled him to realize that (as long as he held on to his essential sanity) he would return—

Pock.

—to Earth after ten Earth months with knowledge centuries advanced beyond anything—

Pock.

—that Haertel knew, or that anyone could know—

Pock.

—who had to work within a normal lifetime. *Pck.* The whole prospect tickled him. *Pck.* Even the clock tick seemed more cheerful. *Pck.* He felt fairly safe now *Pck* in disregarding his drilled-in command *Pck* against moving *Pck*, since in any *Pck* event the *Pck* had already *Pck* moved *Pck* without *Pck* being *Pck* harmed *Pck Pck Pck Pck Pck Pck pckpckpckpckpckpckpckpck. . . .*

He yawned, stretched, and got up. It wouldn't do to be too pleased, after all. There were certainly many problems that still needed coping with, such as how to keep the impulse toward getting a ship-time task performed going, while his higher centers were following the ramifications of some purely philosophical point. And besides . . .

And besides, he had just moved.

More than that, he had just performed a complicated maneuver with his body *in normal time!*

Before Garrard looked at the calendar itself, the message it had been ticking away at him had penetrated. While he had been enjoying the protracted, glandular backwash of his earlier feeling of satisfaction, he had failed to notice, at least consciously, that the calendar was accelerating.

Good-bye, vast ethical systems which would dwarf the Greeks. Good-bye, calculuses aeons advanced beyond the spinor calculus of Dirac. Good-bye, cosmologies by Garrard which would allot the Almighty a job as third-assistant-waterboy in an *n*-dimensional backfield.

Good-bye, also, to a project he had once tried to undertake in college—to describe and count the positions of love, of which, according to under-the-counter myth, there were supposed to be at least forty-eight. Garrard had never been able to carry his tally beyond twenty, and he had just lost what was probably his last opportunity to try again.

The micro-time in which he had been living had worn off, only a few objective minutes after the ship had gone into overdrive and he had come out of the anesthetic. The long intellectual agony, with its glandular counterpoint, had come to nothing. Garrard was now keeping ship-time.

Garrard sat back down on the hammock, uncertain whether to be bitter or relieved. Neither emotion satisfied him in the end; he simply felt unsatisfied. Micro-time had been bad enough while it lasted; but now it was gone, and everything seemed normal. How could so transient a thing have killed Brown and Cellini? They were stable men, more stable, by his own private estimation, than Garrard himself. Yet he had come through it. Was there more to it than this?

And if there was—what, conceivably, could it be?

There was no answer. At his elbow, on the control chassis which he had thrust aside during that first moment of infinitely protracted panic, the calendar continued to tick. The engine noise was gone. His breath came and went in natural rhythm. He felt light and strong. The ship was quiet, calm, unchanging.

The calendar ticked, faster and faster. It reached and passed the first hour, ship-time, of flight in overdrive.

Pock.

Garrard looked up in surprise. The familiar noise, this time, had been the hour-hand jumping one unit. The minute-hand was already sweeping past the past half-hour. The second-hand was whirling like a propeller—and while he watched it, it speeded up to complete invisibility—

Pock.

Another hour. The half-hour already passed. *Pock.* Another hour. *Pock.* Another. *Pock. Pock. Pock, Pock, Pock, Pock, pck-pck-pck-pck-pck-pckpckpckpck. . . .*

The hands of the calendar swirled toward invisibility as time ran away with Garrard. Yet the ship did not change. It stayed there rigid, inviolate, invulnerable. When the date tumblers reached a speed at which Garrard could no longer read them,

he discovered that once more he could not move—and that, although his whole body seemed to be aflutter like that of a hummingbird, nothing coherent was coming to him through his senses. The room was dimming, becoming redder; or no, it was . . .

But he never saw the end of the process, never was allowed to look from the pinnacle of macro-time toward which the Haertel overdrive was taking him.

Pseudo-death took him first.

[3]

That Garrard did not die completely, and within a comparatively short time after the DFC-3 had gone into overdrive, was due to the purest of accidents; but Garrard did not know that. In fact, he knew nothing at all for an indefinite period, sitting rigid and staring, his metabolism slowed down to next to nothing, his mind almost utterly inactive. From time to time, a single wave of low-level metabolic activity passed through him—what an electrician might have termed a “maintenance turnover”—in response to the urgings of some occult survival urge; but these were of so basic a nature as to reach his consciousness not at all. This was the pseudo-death.

When the observer actually arrived, however, Garrard woke. He could make very little sense out of what he saw or felt even now; but one fact was clear: the overdrive was off—and with it the crazy alterations in time rates—and there was strong light coming through one of the ports. The first leg of the trip was over. It had been these two changes in his environment which had restored him to life.

The thing (or things) which had restored him to consciousness, however, was—it was what? It made no sense. It was a construction, a rather fragile one, which completely surrounded his hammock. No, it wasn't a construction, but evidently something alive—a living being, organized horizontally, that had arranged itself in a circle about him. No, it was a number of beings. Or a combination of all of these things.

How it had gotten into the ship was a mystery, but there it was. Or there they were.

"How do you hear?" the creature said abruptly. Its voice, or their voices, came at equal volume from every point in the circle, but not from any particular point in it. Garrard could think of no reason why that should be unusual.

"I—" he said. "Or we—we hear with our ears. Here."

His answer, with its unintentionally long chain of open vowel sounds, rang ridiculously. He wondered why he was speaking such an odd language.

"We-they wooed to pitch you-yours thiswise," the creature said. With a thump, a book from the DFC-3's ample library fell to the deck beside the hammock. "We wooed there and there and there for a many. You are the being-Garrard. We-they are the clinesterton beademung, with all of love."

"With all of love." Garrard echoed. The beademung's use of the language they both were speaking was odd; but again Garrard could find no logical reason why the beademung's usage should be considered wrong.

"Are—are you-they from Alpha Centauri?" he said hesitantly.

"Yes, we hear the twin radioteles, that show there beyond the gift-orifices. We-they pitched that the being-Garrard with most adoration these twins and had mind to them, soft and loud alike. How do you hear?"

This time the being-Garrard understood the question. "I hear Earth," he said. "But that is very soft, and does not show."

"Yes," said the beademung. "It is a harmony, not a first, as ours. The All-Devouring listens to lovers there, not on the radioteles. Let me-mine pitch you-yours so to have mind on the rodalent beademung and other brothers and lovers, along the channel which is fragrant to the being-Garrard."

Garrard found that he understood the speech without difficulty. The thought occurred to him that to understand a language on its own terms—without having to put it back into English in one's own mind—is an ability that is won only with difficulty and long practice. Yet, instantly his mind said, "But it

is English," which of course it was. The offer the clinesterton beademung had just made was enormously hearted, and he in turn was much minded and of love, to his own delighting as well as to the beademungen; that almost went without saying.

There were many matings of ships after that, and the being-Garrard pitched the harmonies of the beademungen, leaving his ship with the many gift-orifices in harmonic for the All-Devouring to love, while the beademungen made show of they-theirs.

He tried, also, to tell how he was out of love with the overdrive, which wooed only spaces and times, and made featurelings. The rodalent beademung wooed the overdrive, but it did not pitch he-them.

Then the being-Garrard knew that all the time was devoured, and he must hear Earth again.

"I pitch you-them to fullest love," he told the beademungen, "I shall adore the radioteles of Alpha and Proxima Centauri, 'on Earth as it is in Heaven.' Now the overdrive my-other must woo and win me, and make me adore a featureling much like silence."

"But you will be pitched again," the clinesterton beademung said. "After you have adored Earth. You are much loved by Time, the All-Devouring. We-they shall wait for this othering."

Privately Garrard did not faith as much, but he said, "Yes, we-they will make a new wooing of the beademungen at some other radiant. With all of love."

On this the beademungen made and pitched adorations, and in the midst the overdrive cut in. The ship with the many gift-orifices and the being-Garrard him-other saw the twin radioteles sundered away.

Then, once more, came the pseudo-death.

[4]

When the small candle lit in the endless cavern of Garrard's pseudo-dead mind, the DFC-3 was well inside the orbit of

Uranus. Since the Sun was still very small and distant, it made no spectacular display through the nearby port, and nothing called him from the post-death sleep for nearly two days.

The computers waited patiently for him. They were no longer immune to his control; he could now tool the ship back to Earth himself if he so desired. But the computers were also designed to take into account the fact that he might be truly dead by the time the DFC-3 got back. After giving him a solid week, during which time he did nothing but sleep, they took over again. Radio signals began to go out, tuned to a special channel.

An hour later, a very weak signal came back. It was only a directional signal, and it made no sound inside the DFC-3—but it was sufficient to put the big ship in motion again.

It was that which woke Garrard. His conscious mind was still glazed over with the icy spume of the pseudo-death, and as far as he could see the interior of the cabin had not changed one whit, except for the book on the desk—

The book. The clinesterton beademung had dropped it there. But what under God was a clinesterton beademung? And what was he, Garrard, crying about? It didn't make sense. He remembered dimly some kind of experience out there by the Centauri twins—

—*the twin radiocetes*—

There was another one of those words. It seemed to have Greek roots, but he knew no Greek—and besides, why would Centaurians speak Greek?

He leaned forward and actuated the switch which would roll the shutter off the front port, actually a telescope with a translucent viewing screen. It showed a few stars, and a faint nimbus off on one edge which might be the Sun. At about one o'clock on the screen was a planet about the size of a pea which had tiny projections, like teacup handles, on each side. The DFC-3 hadn't passed Saturn on its way out; at that time it had been on the other side of the Sun from the route the starship had had to follow. But the planet was certainly difficult to mistake.

Garrard was on his way home—and he was still alive and sane. Or was he still sane? These fantasies about Centaurians—which still seemed to have such a profound emotional effect upon him—did not argue very well for the stability of his mind.

But they were fading rapidly. When he discovered, clutching at the handiest fragments of the “memories,” that the plural of *beademung* was *beademungen*, he stopped taking the problem seriously. Obviously a race of Centaurians who spoke Greek wouldn’t also be forming weak German plurals. The whole business had obviously been thrown up by his unconscious.

But what *had* he found by the Centaurus stars?

There was no answer to that question but that incomprehensible garble about love, the All-Devouring, and beademungen. Possibly, he had never seen the Centaurus stars at all, but had been lying here, cold as a mackerel, for the entire twenty months.

Or had it been 12,000 years? After the tricks the overdrive had played with time, there was no way to tell what the objective date actually was. Frantically Garrard put the telescope into action. Where was the Earth? After 12,000 years—

The Earth was there. Which, he realized swiftly, proved nothing. The Earth had lasted for many millions of years; 12,000 years was nothing to a planet. The Moon was there, too; both were plainly visible, on the far side of the Sun—but not too far to pick them out clearly, with the telescope at highest power. Garrard could even see a clear sun-highlight on the Atlantic Ocean, not far east of Greenland; evidently the computers were bringing the DFC-3 in on the Earth from about 23° north of the plane of the ecliptic.

The Moon, too, had not changed. He could even see on its face the huge splash of white, mimicking the sun-highlight on Earth’s ocean, which was the magnesium hydroxide landing beacon, which had been dusted over the Mare Vaporum in the earliest days of space flight, with a dark spot on its southern edge which could only be the crater Monilius.

But that again proved nothing. The Moon never changed. A film of dust laid down by modern man on its face would last

for millennia—what, after all, existed on the Moon to blow it away? The Mare Vaporum beacon covered more than 4,000 square miles; age would not dim it, nor could man himself undo it—either accidentally, or on purpose—in anything under a century. When you dust an area that large on a world without atmosphere, it stays dusted.

He checked the stars against his charts. They hadn't moved; why should they have, in only 12,000 years? The pointer stars in the Dipper still pointed to Polaris. Draco, like a fantastic bit of tape, wound between the two Bears, and Cepheus and Cassiopeia, as it always had done. These constellations told him only that it was spring in the northern hemisphere of Earth.

But spring of what year?

Then, suddenly, it occurred to Garrard that he had a method of finding the answer. The Moon causes tides in the Earth, and action and reaction are always equal and opposite. The Moon cannot move things on Earth without itself being affected—and that effect shows up in the Moon's angular momentum. The Moon's distance from the Earth increases steadily by 0.6 inches every year. At the end of 12,000 years, it should be 600 feet farther away from the Earth.

Was it possible to measure? Garrard doubted it, but he got out his ephemeris and his dividers anyhow, and took pictures. While he worked, the Earth grew nearer. By the time he had finished his first calculation—which was indecisive, because it allowed a margin for error greater than the distances he was trying to check—Earth and Moon were close enough in the telescope to permit much more accurate measurements.

Which were, he realized wryly, quite unnecessary. The computer had brought the DFC-3 back, not to an observed sun or planet, but simply to a calculated point. That Earth and Moon would not be near that point when the DFC-3 returned was not an assumption that the computer could make. That the Earth was visible from here was already good and sufficient proof that no more time had elapsed than had been calculated for from the beginning.

This was hardly new to Garrard; it had simply been retired to the back of his mind. Actually he had been doing all this figuring for one reason, and one reason only: because deep in his brain, set to work by himself, there was a mechanism that demanded counting. Long ago, while he was still trying to time the ship's calendar, he had initiated compulsive counting—and it appeared that he had been counting ever since. That had been one of the known dangers of deliberately starting such a mental mechanism; and now it was bearing fruit in these perfectly useless astronomical exercises.

The insight was healing. He finished the figures roughly, and that unheard moron deep inside his brain stopped counting at last. It had been pawing its abacus for twenty months now, and Garrard imagined that it was as glad to be retired as he was to feel it go.

His radio squawked, and said anxiously, "DFC-3, DFC-3. Garrard, do you hear me? Are you still alive? Everybody's going wild down here. Garrard, if you hear me, call us!"

It was Haertel's voice. Garrard closed the dividers so convulsively that one of the points nipped into the heel of his hand. "Haertel, I'm here. DFC-3 to the Project. This is Garrard." And then, without knowing quite why, he added: "With all of love."

Haertel, after all the hoopla was over, was more than interested in the time effects. "It certainly enlarges the manifold in which I was working," he said. "But I think we can account for it in the transformation. Perhaps even factor it out, which would eliminate it as far as the pilot is concerned. We'll see, anyhow."

Garrard swirled his highball reflectively. In Haertel's cramped old office, in the Project's administration shack, he felt both strange and as old, as compressed, constricted. He said, "I don't think I'd do that, Adolph. I think it saved my life."

"How?"

"I told you that I seemed to die after a while. Since I got home, I've been reading; and I've discovered that the psychologists take far less stock in the individuality of the human

psyche than you and I do. You and I are physical scientists, so we think about the world as being all outside our skins—something which is to be observed, but which doesn't alter the essential *I*. But evidently, that old solipsistic position isn't quite true. Our very personalities, really, depend in large part upon *all* the things in our environment, large and small, that exist outside our skins. If by some means you could cut a human being off from every sense impression that comes to him from outside, he would cease to exist as a personality within two or three minutes. Probably he would die."

"Unquote: Harry Stack Sullivan," Haertel said, dryly. "So?"

"So," Garrard said, "think of what a monotonous environment the inside of a spaceship is. It's perfectly rigid, still, unchanging, lifeless. In ordinary interplanetary flight, in such an environment, even the most hardened spaceman may go off his rocker now and then. You know the typical spaceman's psychosis as well as I do, I suppose. The man's personality goes rigid, just like his surroundings. Usually he recovers as soon as he makes port, and makes contact with a more-or-less normal world again.

"But in the DFC-3, I was cut off from the world around me much more severely. I couldn't look outside the ports—I was in overdrive, and there was nothing to see. I couldn't communicate with home, because I was going faster than light. And then I found I couldn't move either, for an enormous long while; and that even the instruments that are in constant change for the usual spaceman wouldn't be in motion for me. Even those were fixed.

"After the time rate began to pick up, I found myself in an even more impossible box. The instruments moved, all right, but then they moved too *fast* for me to read them. The whole situation was now utterly rigid—and, in effect, I died. I froze as solid as the ship around me, and stayed that way as long as the overdrive was on."

"By that showing," Haertel said dryly, "the time effects were hardly your friends."

"But they were, Adolph. Look. Your engines act on subjective

time; they keep it varying along continuous curves—from far-too-slow to far-too-fast—and, I suppose, back down again. Now, this is a *situation of continuous change*. It wasn't marked enough, in the long run, to keep me out of pseudo-death; but it was sufficient to protect me from being obliterated altogether, which I think is what happened to Brown and Cellini. Those men knew that they could shut down the overdrive if they could just get to it, and they killed themselves trying. But I knew that I just had to sit and take it—and, by my great good luck, your sine-curve time variation made it possible for me to survive."

"Ah, hah," Haertel said. "A point worth considering—though I doubt that it will make interstellar travel very popular!"

He dropped back into silence, his thin mouth pursed. Garrard took a grateful pull at his drink.

At last Haertel said: "Why are you in trouble over these Centaurians? I seems to me that you have done a good job. It was nothing that you were a hero—any fool can be brave—but I see also that you *thought*, where Brown and Cellini evidently only reacted. Is there some secret about what you found when you reached those two stars?"

Garrard said, "Yes, there is. But I've already told you what it is. When I came out of the pseudo-death, I was just a sort of plastic palimpsest upon which anybody could have made a mark. My own environment, my ordinary Earth environment, was a hell of a long way off. My present surroundings were nearly as rigid as they had ever been. When I met the Centaurians—if I did, and I'm not at all sure of that—they became the most important thing in my world, and my personality changed to accommodate and understand them. That was a change about which I couldn't do a thing.

"Possibly I did understand them. But the man who understood them wasn't the same man you're talking to now, Adolph. Now that I'm back on Earth, I don't understand that man. He even spoke English in a way that's gibberish to me. If I can't understand myself during that period—and I can't; I don't even believe that that man was the Garrard I know—what hope have

I of telling you or the Project about the Centaurians? They found me in a controlled environment, and they altered me by entering it. Now that they're gone, nothing comes through; I don't even understand why I think they spoke English!"

"Did they have a name for themselves?"

"Sure," Garrard said. "They were the beademungen."

"What did they look like?"

"I never saw them."

Haertel leaned forward. "Then . . ."

"I heard them. I think." Garrard shrugged, and tasted his Scotch again. He was home, and on the whole he was pleased.

But in his malleable mind he heard someone say, *On Earth, as it is in Heaven*; and then, in another voice, which might also have been his own (why had he thought "him-other"?), *It is later than you think*.

"Adolph," he said, "is this all there is to it? Or are we going to go on with it from here? How long will it take to make a better starship, a DFC-4?"

"Many years," Haertel said, smiling kindly. "Don't be anxious, Garrard. You've come back, which is more than the others managed to do, and nobody will ask you to go out again. I really think that it's hardly likely that we'll get another ship built during your lifetime; and even if we do, we'll be slow to launch it. We really have very little information about what kind of playground you found out there."

"I'll go," Garrard said. "I'm not afraid to go back—I'd like to go. Now that I know how the DFC-3 behaves, I could take it out again, bring you back proper maps, tapes, photos."

"Do you really think," Haertel said, his face suddenly serious, "that we could let the DFC-3 go out again? Garrard, we're going to take that ship apart practically molecule by molecule; that's preliminary to the building of any DFC-4. And no more can we let you go. I don't mean to be cruel, but has it occurred to you that this desire to go back may be the result of some kind of post-hypnotic suggestion? If so, the more badly you want to go back, the more dangerous to us all you may be. We are going

to have to examine you just as thoroughly as we do the ship. If these beademungen wanted you to come back, they must have had a reason—and we have to know that reason.”

Garrard nodded, but he knew that Haertel could see the slight movement of his eyebrows and the wrinkles forming in his forehead, the contractions of the small muscles which stop the flow of tears only to make grief patent on the rest of the face.

“In short,” he said, “*don’t move.*”

Haertel looked politely puzzled. Garrard, however, could say nothing more. He had returned to humanity’s common time, and would never leave it again.

Not even, for all his dimly remembered promise, with all there was left in him of love.

the editors

TOTAL EFFECT is an educational organization aimed at developing and sharing new ways of teaching. In the past three years it has worked with college teachers across the country and in New York City workshops. It has also presented its approaches to learning at national and regional conferences of teachers and is currently at work on a Training Laboratory for Teachers of Teachers designed to be a national model for future-oriented learning. In 1972-73 Total Effect is offering a course at the New School for Social Research on the invention of individualized models for learning and communication. *Leonard Allison* is a Professor of English at Manhattan Community College and holds degrees in English and Education from Yeshiva University and NYU. He has worked with the Office of Academic Development of the City University in special seminars and in the development of the College Preparatory Television Project. *Leonard Jenkin* is a Professor of English at Manhattan Community College. He holds degrees from Columbia University and for two years has worked with the Teachers' and Writers' Collaborative. He is also a consultant on curriculum development to the American Association of Junior Colleges. *Robert Perrault* teaches courses on writing and teaching in the departments of English and Education at Rutgers College. He holds degrees from Reed College and Cornell University. He has been a consultant to the Federal Triple-T project in New York City and is currently at work on an anthology of Dr. Caleb Gattegno's writings.

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