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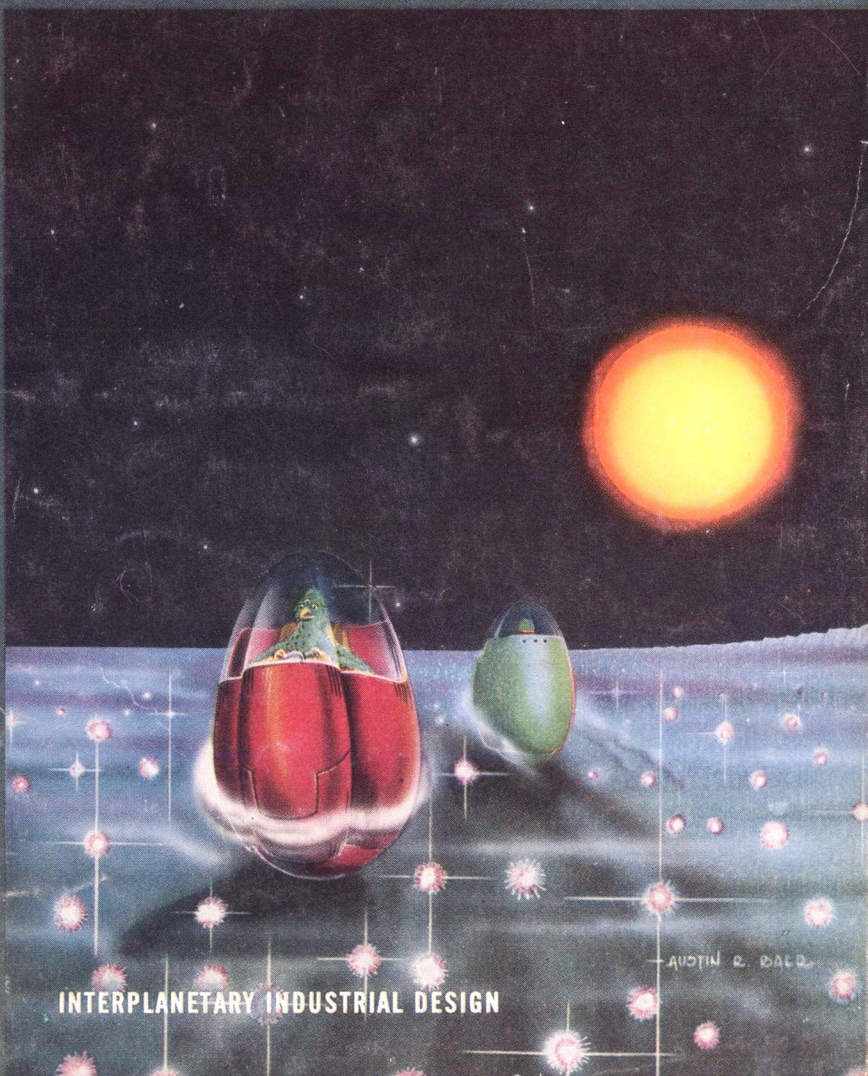
Space, Time and Education BY JOHN E. ARNOLD



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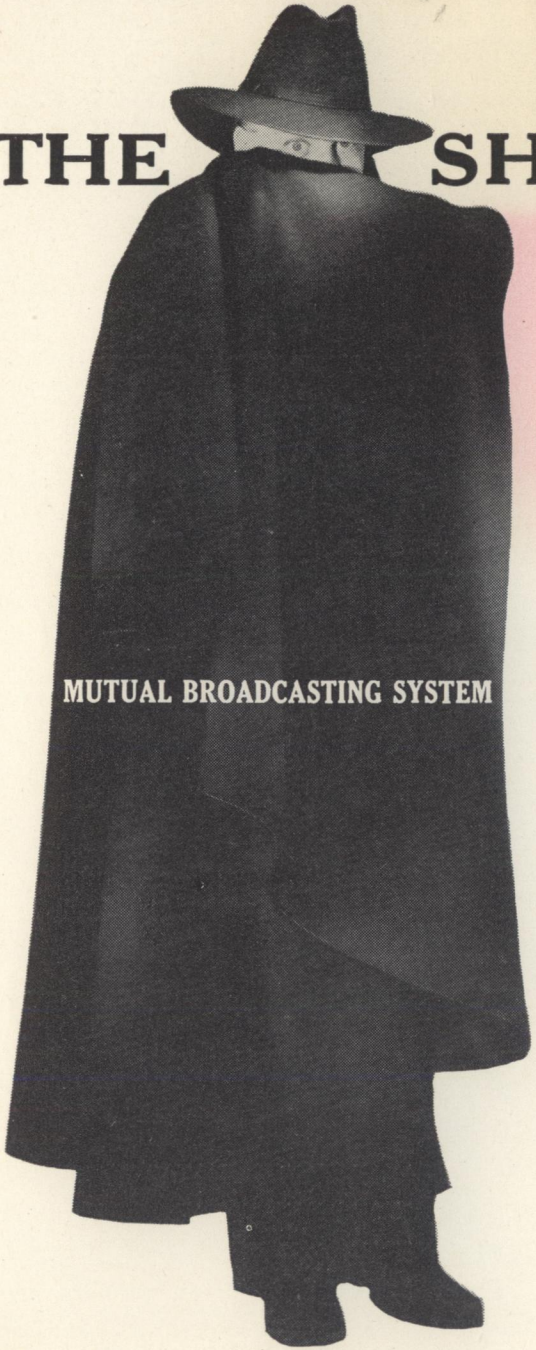

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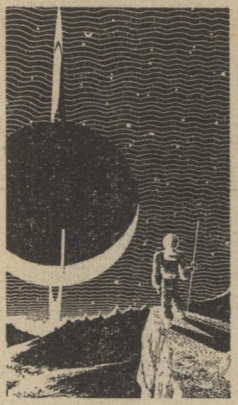

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VOLUME LI • NUMBER 3 **May 1953**

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EDITORIAL

THINKING MACHINE

Some while back I suggested that the ideal thinking machine should have the ability to start with bad data, inadequate in quantity, and improperly evaluated, and wind up with right answers. That it should be able to work with ten per cent error components, and derive answers as accurate as desired.

Naturally, I've been speculating on how that lovely dream might be achieved. Herewith some resultant speculations—produced, perhaps, by a mechanism working on precisely these principles!

Suppose we have the following components to start with:

1. An infinite data-storage device.
2. A set of perceptic devices, specifically including a device capable of searching the data-storage system and perceiving the data there stored.
3. A logic computer, working on binary digital mechanisms.
4. A GG unit (explained below).
5. A set of actuator units.

I propose that such a device, started with bad data, having faulty actuators, and faulty perceptors—save the internal data search mechanism—will, given time, be able to solve all the problems of the total Universe.

Now some definitions: The first item is that this postulates the separation of "memory" into two separate functions—which I hold to be valid. This page you are reading is data-storage, but not "memory"; your ability to read is not "memory" either. Put the two together, and the effect of "memory" is achieved.

The point is of interest, because it has been demonstrated many times—by hypnosis, for example—that there is frequently failure of the human mind to search the data stored in the mind. The data has been stored there, all right, but the search-unit, not the recording unit, has failed to do its job. The amnesia case is typical of this. "Memory," therefore, must be considered as a two-part function.

Now as to the GG unit. This I'll define for the discussion as a small sealed case, which cannot be opened

for inspection without destruction of the unit; therefore we don't know how it works—but we do know its function. It's called a "GG unit" because it's a Good Guesser. It has the remarkable characteristic of being able to guess right, without logical or other means, and apparently without any data consideration, slightly better than chance would allow. Assigned to guessing heads and tails in coin tossing, it would guess right say fifty point one per cent of the time.

Now let us start the machine with a collection of postulates, somewhat the sort of postulates that a young human being is apt to be started with:

1. All parents are infallible.
2. You cannot learn anything except by instruction by others.
3. You never remember anything you're told.
4. All human beings are evil at heart; they behave rationally only by force.
5. You always get wrong answers.

Shortly after this collection of data is fed in, and the machine turned on, the logic unit will come to a grinding halt. This set of postulates would stop any truly logical machine; the postulates hold that the machine always gets wrong answers, and can't learn, and doesn't remember its data anyway.

At this point, the GG unit goes to work, and kicks in a new postulate: "For 'all' read 'some'; for 'always' read 'frequently.'"

The logic computer starts working again, trying to balance the new system of postulates. It now comes up with a logical conclusion: "This system cannot operate unless it can distinguish between right and wrong answers."

The system stalls again, until finally the GG unit—after kicking in a lot of postulates that don't do anything but complicate the situation — comes up with one that says "A conclusion can be checked for validity by testing it with the actuators, and observing the resultant reactions via the perceptors."

Briefly, that a conclusion is correct if it works in the external world.

After a few more jams and postulations, this will be expanded to "works consistently" instead of merely "works."

The logic unit has been designed to find conclusions that integrate into a coherent system, *all* data and *all* postulates. The feedback postulate—that conclusions can be checked by test in the external world—force the machine to seek even more data.

Now by the nature of things, if this mechanism keeps going long enough, recycling the whole system of postulates and data each time it jams, it will eventually solve the total problem of the Universe—because *only* when the total Universe is solved, will all the data and postulate systems be

[Continued on page 161]

SPACE, TIME AND EDUCATION

BY JOHN E. ARNOLD

A unique type of course in creative thinking is in operation at the Massachussetts Institute of Technology — science fiction as a laboratory technology!

Professor John E. Arnold, in this article, gives one of the first discussions of the unique, and highly interesting educational technique he and his co-workers have developed at M.I.T.

Most of the articles we run in this magazine have to do with developments of physical science; there are very, very few social-science inventions available for discussion, wherein a clean-cut break-away from traditional methods can be defined concretely, the reasons for the break-away stated clearly, and the theory behind the change made definite.

Yet in our present world of gadgets, machines, and highly developed physical technology, social inventions are the crying need of Mankind. Perhaps a major reason for the extreme paucity of social invention is the lack of just such training in creative thinking as Professor Arnold's course is specifically designed to provide.

There is a curious and confusing paradox in the nature of human progress; men have, down the ages, been willing to fight and die for the ideals they hold valid and important. Men have shown full willingness to total self-sacrifice in defense of their heritage.

Yet by the very meaning of the concepts, it is impossible, and forever will be impossible, to maintain the "Ancient Heritage" and *progress in any way! No man today can defend the democracy that Washington and Jefferson established, because America has developed, has learned greater wisdom and invented new social ideas, the "heritage" of Washington and Jefferson is forever gone!*

For example, in their day, their concept of democracy held that no man who owned less than five thousand dollars worth of property had a right to vote. Their concept of democracy has long

since been changed; they would never have accepted the idea of woman voters.

The very fact that men are idealists, and will fight for their ideals, makes social inventions extremely difficult under our present-day understanding of what actually constitutes "our heritage." The more strongly and deeply idealistic a man is, the more genuinely and sincerely he holds his honest beliefs, the more valiantly he will defend these "truths" that are, to him, self-evident.

Social inventions are most desperately needed today—and are hardest of all to make, because each man, within himself, has limited his own creative thinking. By failing to find the fundamental core of his ideals, he may sacrifice everything in a pointless defense of a nonessential.

Fifty years ago, the engineering student was considered something of a second-class citizen of the college campus; only the Liberal Arts student was considered a true student. A social invention was making its way, however. Where major corporations and businesses were uniformly directed by lawyers and Liberal Arts students only one generation ago—today the technical man is taking a bigger and bigger part in executive control.

Educational methods, more than any other single factor, will determine what our world is like in another half century. Of all possible forms of education, it seems to me that the most critical is education to understand, use, and evaluate creative thinking.

It is my feeling that studies of creative thinking itself—such work as Professor Arnold and his co-workers at M.I.T. have started—are basic to understanding our Research Age civilization. Where such work as Newton did was necessary to understanding the physical world, studies of creative thinking are necessarily more fundamental; understanding gravity did not necessarily lead to understanding creative thinking. But if ever Mankind learned to understand creative thinking, that necessarily implies ability to generate an understanding of all physical forces.

No full solution to the problem of understanding creative thinking yet exists—but the M.I.T. group has launched a solid, conscious and directed attack on that problem. It's an engineering attack—"A theory that works may not be true, but it's useful until a better theory can be developed."

THE EDITOR.

Science fiction in the classroom? What! You're designing for non-humans on far distant planets? Aren't there enough unfulfilled human needs that you could design for and thereby better use your time? These are some of the typical questions that are asked when people first hear of the Arcturus Project used in the Product Design Course at M.I.T. After explaining the project and the course, however, these questions usually change to exclamations such as: "What an idea, I wish

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OFFICE OF THE
BOARD CHAIRMAN

3 May 2951

CONFIDENTIAL

K Wad Lee, Director General
T. E. C. H.
Hexagon Bldg., 187 Level
Washington 99, Terran

Dear K W:

I noticed on last nite's Newscope the announcement of the discov... of intelligent life on Arcturus IV. As you know, our company has been act... and for some time now in galactic trading and are well equipped for t... ...facture and distribution of machines and products for human ... recent expansion program qualifies us to handle new ... would appreciate it very much if you could send ... ...able system and, as in the past, keep me ... to this file.

INTER-OFFICE MEMO

Massachusetts Intergalatic Traders, Inc.

From: RZH To: J Sagmill 17 May 2951
Subject: Arcturus IV File No. 3463

I have just received the enclosed file from T.E.C.H. and suggest you look it over very carefully. This looks like a wonderful opportunity for our company to get in on the ground floor. Here is a large planet, inhabited by an intelligent people of a relatively backward culture. Without too much trouble on our part we should be able to design and build a wide range of machines and products that they can use. There will be, of course, some technical difficulties but I am sure that our engineering and design staff can solve them.

Before we have a company conference on programing our entrance into this market, I would like to have a first hand report on the general conditions there. With your past experience, Joe, you're the man to do this job. Your long interest in 20th century Terranian history should make you sympathetic to the culture on Arcturus IV.

Check with Peggy on the best route and accommodations. I feel that probably for a slight extra charge the Spica flight might be diverted off its course a little and let you off at Arcturus IV. I have checked with T.E.C.H. and they say that their headquarters is now ready for guests. Charge all expenses to order No. GK 2734, and good luck to you in space.

TERRAN
EXPORTING
COUNSEL
HEADQUARTERS
Hexagon Building 187 Level Washington 99 Terran

24 May 2951

R. Z. Hollenhead
Massachusetts Intergalactic Traders, Inc.
78 Massachusetts Avenue
Cambridge, Massachusetts

Dear Zepp:

Enclosed you will find copies of the file you requested on α Bootis. I think you are damned smart to get in on the ground floor on this new planet. Information about Arturus IV is very sketchy at this date, but what we have looks promising. We, of course, will keep you informed on new information as it comes in and you do the same with us.

I hope, you are planning to attend the Galactic Exporters Convention this fall so that I can have the pleasure of seeing you and your charming wife again. Maybe, we can ditch the girls again like we did three years ago on another "Technological Toot".

Cordially,

CONFIDENTIAL REPORT

Terran Exporting Counsel Headquarters

DATE 4 August 2951
FROM J.E.R. TO K. Wad Lee
SUBJECT Arcturus IV FILE NO. 3463

General Engineering Report

The construction of the permanent headquarters has now been completed according to plans and specifications on file in this office. All mechanical equipment is adjusted and running smoothly providing all the comforts of Terran. This report will deal primarily with the physical aspects of Arcturus IV.

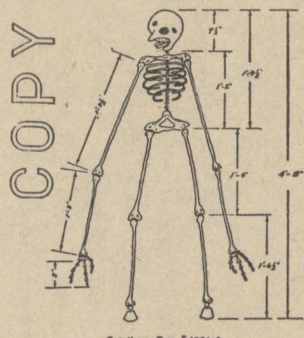
The ... Report) but a ... The world is ... tigated by th... a wealth of r... report.

The ... sea. The liq... in the winter ...

CONFIDENTIAL REPORT

Terran Exporting Counsel Headquarters

DATE 14 Mar 2951
FROM Gare E. Toff TO K. Wad Lee - T.E.C.H.
SUBJECT Methanian Male FILE NO. 3463



Sub-Human Type # 1046-A
Arcturus IX

Solar and Galactic
Explorers Union
Local 257

SATURN BRANCH
EAST ATOM 82

14 March 2951

CONFIDENTIAL

Mr. K. Wad Lee
Director T.E.C.H.
Hexagon Bldg., 187 Level
Washington 99, Terran

Dear Sir:

The suggestion in your letter of 26 Sol 2949 that investigation of the Arcturus Region might prove fruitful was a good one. I have just returned from that region having made contact with at least one planet containing sub-human intelligent life. It is a rather amazing planet as you can see from the attached form. The natives were friendly and welcomed Terran contact, but the conditions there make it very ... for human exist...

Trade possibilities seem unlimited, the state of culture reminding one very much of the descriptions of early 20th century America that I used to read about in our history books. Large deposits of pure uranium and platinum could provide more than adequate payment for any goods and ser... that we exchange with them.

My contact with them was relatively short because of the extrem... living conditions and other urgent matters. I landed near the largest ... observed in quick flight around the planet. This city is called Snafu ... the inhabitants are of a race called Methanians ... evolved from birds ...

COPY

CONFIDENTIAL REPORT

Massachusetts Intergalatic Traders, Inc

To: R. Z. Hollenhead
File No. 3463
From: J. Sagmill 10 Aug...
Subject: Arcturus IV

CONFIDENTIAL

Under order No. GK2734 issued by the Chairman of the Board R. Z. Hollenhead on 17 May 2951 the writer proceeded to lay plans for a first-... investigation of the conditions on Arcturus IV and to evaluate the trade possibilities with the intelligent life discovered there. Provision wa... ...the Commanding Officer of the Spica transport to make a side ... regularly scheduled flight of 22 May 2951, arriving ...une 2951.

...ple accommodations were obtained in the new permanen... ...T.E.C.H. and the investigation started. A number of ...ut due to the high gravity and the extremely slow ... available for hire very little can be accomplished ... six hours outside the degravitized headquarters bu... average human being can stand in any 24 hour peri... This means that at present we were limited to a ... seven mile radius of headquarters. The T.E.C.H., ... as small two and four place space ships and when ... ...greatly facilitated.

...esign and Produ...

EXTRA-SOLAR PLANET REPORT

Terran Exporting Counsel Headquarters

SUN α Bootis SPECTRAL CLASS Ko LUMINOSITY 87X MASS 6×10^{33} grams
DIAMETER 29×10^6 miles SURFACE TEMP. 4000° abs DISTANCE 33 L.Y.
PLANET NAME Arcturus IV NUMBER IV FILE NO. 3463
FIRST CONTACT 22 Jan. 2951 BY Gare E. Toff
DISTANCE (from sun) 1800×10^6 miles MASS 60×10^{27} grams DIAMETER 12×10^6 meters
ACC. OF GRAVITY (cgs) 11,000 SIDERIAL PERIOD (Terran time) 49.4 years
LENGTH OF DAY (Terran time) 159 hours DAYS IN YEAR (Local time) 2720
MEAN TEMP. (Winter) -110°C MEAN TEMP. (Summer) -50°C
LIFE Intelligent-sub-human TRADE POSSIBILITIES Excellent

REMARKS & FOLLOW-UP

1.) Atmosphere is largely methan and strangely enough the name of the local races translates to methanian.

2.) State of Culture - early 20th century, say around 1905, America.

3.) Intelligent life extremely friendly. Quite short (height of male in picture 4' - 6") - apparently evolved from birds - covered with feathery type fur. - third-eye seems to extend visual perception over much greater range than we are capable of. Hearing is much more sensitive ... and low frequencies.

4.) Many ...

Terran Exporting Counsel Headquarters

Spaceport 17321 Snafu Arcturus IV

Office of General Information

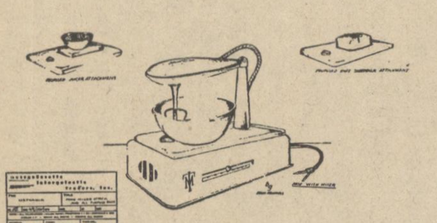
25 October 2951

Mr. Arnold Edward, Chief Designer
Massachusetts Intergalactic Traders, Inc.
78 Massachusetts Avenue
Cambridge, Massachusetts

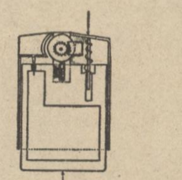
Dear Mr. Arnold:

You will find enclosed, a report which contains the answers to the questions you sent with your letter of October 3. I am happy to state that we have been able to collect data on all the questions. I hope that you will find the report complete and satisfactory.

It is our intention to supply all needed information as quickly and as accurately as possible, so do not hesitate to make further requests. We will be glad to serve you.



Boyard gardner, jr.



Ronson type lighter stamped
magnesium outer case, with
spark wheel attached....
Throw-away oxygen tank
is of silicone plastic,
with flint attached.

I could have taken a course like that!"

This course is relatively new at M.I.T., just three years old, and is part of a rapidly expanding program in creative engineering. The program started with one course elected by seniors and by next fall it will consist of a sequence of courses starting in the sophomore year. This rapid expansion is the result of the encouraging evidence presented by the initial experimental course. It *is* possible to train students to think more creatively; one *can* develop his imagination. The most encouraging aspect of the experiment is that this is as equally true for many who originally thought that they had little talent for design as it is for those who had previously exhibited a high order of imagination. The students claim that they leave the course with a new perspective with which to face a broad variety of problems.

Before describing the course in some detail it would be wise to define some of the terms that will be used repeatedly. Science and engineering like most other fields of endeavor use two main thinking processes, analytical and creative. They are quite different and should be carefully defined. There is a third important process, the judicial, that contains aspects of the two above and is used in conjunction with them to help insure meaningful results.

There are three ways to distinguish whether a problem is analytical or creative: first, the statement of the problem; second, the approach used in its solution; and third, the results obtained. An analytical problem is stated in quite definite terms—determine the deflection at the center of a given beam under uniform load conditions. The creative problem expresses a need—it is desirable at times to have the surfaces of sliced bread browned, heated and dehydrated. The approach used in the first problem is as definite as its statement. Knowing all the physical properties and dimensions of the beam, its span, and constraints and load per unit length, the straightforward application of $\frac{d^2y}{dx^2} = \frac{M}{EI}$ will yield the desired result. A second type of approach is frequently used in the analytical problem, that of building a model of the prototype, or using the prototype itself, loading it per specifications and then measuring the desired result.

The approaches to the solution of a creative problem may be without limit. Everyone knows that the use of the radiant energy of an electrical resistance element will solve the type problem listed above, but this is by no means the only way to solve that problem. It is possible that some chemical mixed with the butter—or any other spread—might do the job as well or even better. Maybe high-frequency heating, or slicing the bread with heated wires would be equally as effective. Changes in the structure or composition of the bread

itself should not be overlooked in solving the expressed need.

Looking at the results obtained is probably the easiest way to distinguish between an anlytical and creative problem. Taking into account the state of the art of any particular time, there is only *one* right answer to an analytical problem. The solutions to a creative problem, on the other hand, may form a complete spectrum, depending on the thoroughness with which it has been investigated. It is impossible to say that any one answer is *the* right answer, continued investigation may lead to a better one.

To summarize then, the analytical problem is very specific in its statement; two approaches are usually employed in its solution, a process of logical reasoning or one of empirical testing; and, within the existing state of the art, there is only *one* right solution. Ninety per cent or more of all the courses taught in our public schools and colleges deal with problems of this type. The creative problem, in contrast, is stated in very nebulous, very general terms. It implies or expresses a need in such a way that almost an infinite number of specific approaches may be formulated and carried out in search of a solution. The results obtained run the gamut from good to poor and there is always room for new approaches to better solutions. Very few courses attempt to handle problems of this type although the need for creative thinkers is as great, if not greater, than for those of the analytical type. The statement of this need implies a creative problem from the very start and the solution described below, by definition, is not the one, right solution. The results obtained indicate that it is a good one, but the search goes on for a better one.

The aim, then, of the M.I.T. Creative Engineering program is to provide an ever increasing number of young men trained, not only in the basic concepts of science and engineering but also in the use of their creative imaginations, to help solve the ever increasing problems, both in complexity and in numbers, that continue to face the nation and the world. Design courses provide an ideal vehicle for this kind of training, but by no means should this training be restricted to this field.

The Product Design course is conducted in an informal seminar fashion. Three two-hour seminars are held each week. These are devoted to discussions, demonstrations and laboratory work, so that the student will learn first, how does one think creatively and what is the creative process; second, what tools does the creative engineer work with and what factors should he take into consideration in the solution of his problems; and third, that through constant practice he will become more proficient in exercising his imagination and

will gain confidence in his ability to solve difficult, challenging problems.

It is not within the scope of this paper to discuss in detail the creative process and how it works. For those interested, a bibliography of recent papers and books on the subject is included at the end. A specific example, however, of how nonanalytical factors influence design will be given. Take for example the influence of semantics on the creative process. The students had been assigned, as one of their major design projects, a case study on a "Dual Sander." The case described in some detail some of the various types of sanding machines on the market, pointing out their good and bad features. Two types of machines were singled out for specific analysis, the rotary disk type and the vibrating plate type. Sufficient technical data and a list of desirable design specifications were included so that the students could confidently design either type of machine.

The case then pointed out the desirability of combining the two types of motion into one "all-purpose" machine. This machine would provide fast, rough sanding—disk type—and fine, finish sanding—vibrating type. Layouts for three possible solutions to this problem were included for the students' guidance or criticism.

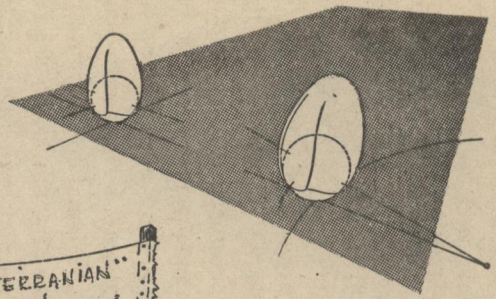
After the students had had an opportunity to read the case, one full seminar session was devoted to discussing the case in particular and finishing methods in general. At the beginning of the next seminar session the students were asked to write in their own words in as general terms as possible the aim of this project. They were also asked to list in outline form a method of attack for solving their listed goal.

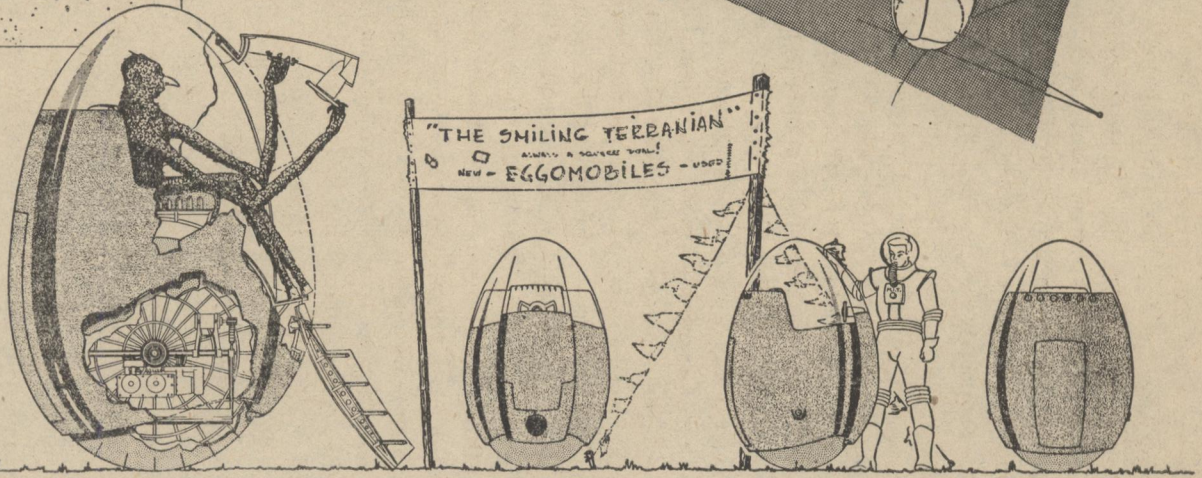
The majority of students put down quite specific aims and very definite *modus operandi*, this in spite of previous seminars on semantics and the very definite instructions given them before they were asked to write. A typical aim listed by this group was, "The aim of this project is to design a dual purpose *sanding* machine, to provide rough and fine *sanding*." A prosaic, standard approach was listed as the method of attack. These students without realizing it were greatly limiting themselves at the beginning of the creative process. This was in part due to the pre-conditioning effect that the case study had on their thinking.

A small group of students, however, were able to ignore the original statement of the problem and set up for themselves a new goal that gave almost unlimited scope to the problem. "The aim of this project is to design a multipurpose smoothing machine or process. Smoothing may be accomplished by either adding or removing material." A statement of this type naturally leads to a very general approach and the search for a solution would enter every technical field,

BAER DESIGN STUDIOS

"EGGOMOBILE"





SALES FEATURES

- MAXIMUM SPEED: 8 M.P.H.
- ENGINE: 4 CYLINDER OPPOSED
- HIGH SEAT POSITION - GIVES MAXIMUM RANGE OF VISION.
- INFRA-RED HEADLIGHT - LOW POSITION FOR FOG SERVICE
- ELECTRIC SERVO-STEERING
- SHORT STEP-RISER HEIGHT.
- TREADS LINKED TO FOLD UP AS ENTRY LADDER IS RAISED
- ALL HATCHES COUNTERBALANCED
- LUGGAGE SPACE IN REAR.
- BALLAST WEIGHTS ADJUST VERTICAL TRIM FOR BAGGAGE.
- SEGMENTED SPHERE FOR EASE OF MAINTENANCE
- ALUMINUM FRAME USED.
- AIRPLANE-TYPE CONSTRUCTION
- SILICONE-RUBBER FOAM SEAT.
- SAFETY-COATED METHYL-METHACRYLATE WINDSHIELD
- SHELL: STEIATED ALUMINUM
- SILICONE-RUBBER BONDED TO CLEATS FOR AMPHIBIOUS OPERATION, GROMMETED TO THICKER RUBBER SPHERE
- EXCELLENT COLLISION RESISTANCE
- PSYCHOLOGICAL SECURITY

WEIGHT DISTRIBUTION, STEERING, AND STABILITY..... FRONT VIEW SHOWN IN EACH CASE.

AUSTIN B. BAER 10-28-52

- WEIGHT "G" FIXED RELATIVE TO AXLE OF SPHERE.
- WEIGHT "B" SUSPENDED AS STEERING PENDULUM.
- CENTER OF GRAVITY LIES BETWEEN WEIGHTS.

- MOMENT IS APPLIED TO PENDULUM.
- CENTER OF GRAVITY SHIFTED TO RIGHT
- SPHERE STARTS TO ROLL TO RIGHT

POINT OF CONTACT AGAIN LIES UNDER CG
ρ INDICATES RADIUS OF TURNING CIRCLE.
TURNING CIRCLE ~ DISPLACEMENT OF PENDULUM

PENDULUM IS RELEASED, SWINGS TO VERTICAL.
CENTER OF GRAVITY MOVES TO LEFT.
THIS SIMULATES RELEASE OF STEERING WHEEL.

- SPHERE RETURNS TO VERTICAL.
- MOTION RESUMES STRAIGHT PATH.
- "EGGOMOBILE" IN STABLE EQUILIBRIUM

electrical, chemical as well as mechanical.

The remainder of this seminar was devoted to exploring the possibilities opened up by the more general type of goal. This was accomplished by everyone first listing all possible ways by which any material could be smoothed by adding or subtracting material. The listing was done without any critical evaluation of the method as to its practicality or even feasibility or to its economics. As the lists were individually read off new ideas were added until it was felt that the various fields had been fairly well exhausted. Then and only then was critical analysis applied to the many suggestions.

Of course, many of the proposed schemes had to be discarded because of their impractical nature or the possible high costs associated with them, but many of the suggestions were developed to a point where they looked as though they would be very profitable avenues for further research. A few had rather limited fields of application and were far removed from sanding machines. In many cases it was discovered that the proposed methods had already been incorporated in various machines and processes, e.g. smoothing by adding material, metal spray guns, and smoothing by mechanical compression, calendering of paper.

It was decided that actually Emerson's advice "to build a better mouse trap" would not have led to the "path-beating-act" unless the inventor had restated his problem in more general terms. Emerson's statement would have insured a trap being built but would have precluded the possibilities of electrocuting, poisoning, drowning or even frightening the mice to death.

The case that has had the widest publicity and engendered the most discussion is the Arcturus IV Project. It was designed, in part, to free the student of all preconceived notions about man-machine relationships and to strengthen the influence of environment on design. There are many other reasons for introducing a case of this type and they will all be discussed after describing the case.

Arcturus IV is the fourth planet out from the sun α Bootis (Arcturus), thirty-three light-years from our solar system. It was first contracted by a member of the Solar and Galactic Explorers' Union on January 22, 2951. It is a large planet, 12×10^6 meters in diameter, having a mass of 60×10^{27} grams and the acceleration of gravity at the surface is eleven thousand centimeters per second squared. It is a distance of 1800×10^6 miles from α Bootis and its siderial period is 49.4 Earth-years. The length of day is one hundred fifty-nine hours; the atmosphere is largely methane; and the mean temperatures range from $-50°$ C in the summer to $-110°$ C in the winter.

All the information about the planet and its inhabitants is obtained from

the files of the Massachusetts Intergalactic Traders, Inc. and each student receives a copy of this file. M.I.T. Inc. is engaged in the manufacture and distribution of products for extrasolar consumption. (For the students' benefit the products must be manufactured using Twentieth Century technology and materials.) This company and all others like it operate under the rules and regulations of the Terran Exporting Counsel Headquarters, a government agency. T.E.C.H. sets up a branch office on all planets with which Terra is doing business and its divisions such as the General Engineering Division, Physiological and Psychological Division, and the Design, Production and Marketing Division carry out detailed investigations and write and publish reports for all who might be interested. These are included in the files.

In drawing up this case study every effort was made to make everything as realistic and consistent as possible. So far no glaring errors have been discovered. All information in the file is on specially prepared stationery and report forms, stamped and handled in the best businesslike manner. The only thing that is lacking is reliable market reports on the sales and acceptance of the products designed.

The race of people—subhuman, of course—that inhabit the contacted portion of Arcturus IV are called Methanians. A good description of them is contained in a report from J. S. Wick, Director of the Physiological and Psychological Bureau of T.E.C.H. "Strangely enough the Methanian metabolic process is similar to Terran plant life. Carbon is obtained from the Methane atmosphere and oxygen from the plant and animal life eaten as food. There is no liquid water anywhere on the planet and due to the very cold temperature, little in the atmosphere. The water that is present is in the solid state resulting in a foggy condition both winter and summer. Ammonia is the Arcturian substitute for water.

"The Methanians weigh very little compared to us. One of the largest we met was weighed on a Terranian spring scale at one hundred eighty-seven pounds. (They are relatively strong, however, being able to lift twice their own weight.) Their bones are hollow and apparently filled with hydrogen and helium. There is no question but these people have evolved from a race of birds, their appearance seems to indicate it, their history seems to prove it. Their long arms and clawlike hands—three-fingered—are vestiges of once great wings. The only anomaly is their single-toed feet like that of a horse. This adaption to ground living evolved very rapidly once the power of flight was lost.

"The young are born in eggs and the eggs are carried around in skin pockets or pouches similar to those of the now extinct Terranian Penguin until the egg hatches. Both male and

female take turns in the hatching process. The young grow rapidly at first and are ready to take care of themselves in about twenty Terranian years. They seldom leave home, however, before physical maturity is reached, 49.4 Terranian years.

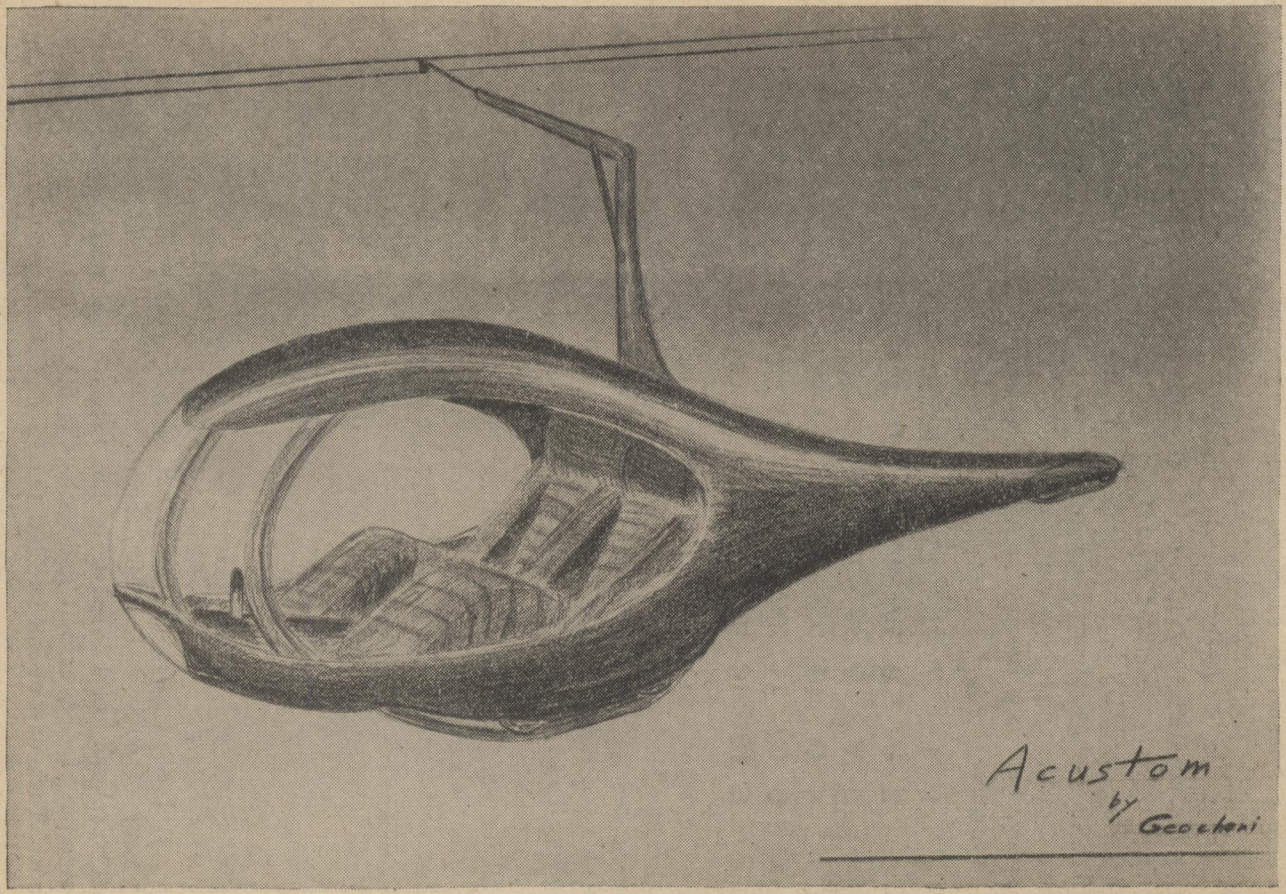
"The Arcturian normal body temperature is — 40° C and their pulse rate is five times per minute. As a result they are very slow-moving and they frequently walk using one or both arms as a cane or pair of crutches. Their normal walking pace is about one fourth mile per hour, but if pressed can go almost eight times as fast for very short periods. Even with HI-G units we don't travel much faster than they do. This slow pace does not seem to bother them since their whole system is geared to it. Their stimulus response time is about two seconds.

"Their auditory, vocal and visual range is extremely large. They can hear sounds with frequencies as low as 1/100 cycle/second up to 50,000 cycles/second. Their vocal range goes from 1/50 to 25,000 cycles/second and their visual range extends from the infrared up through the ultraviolet.

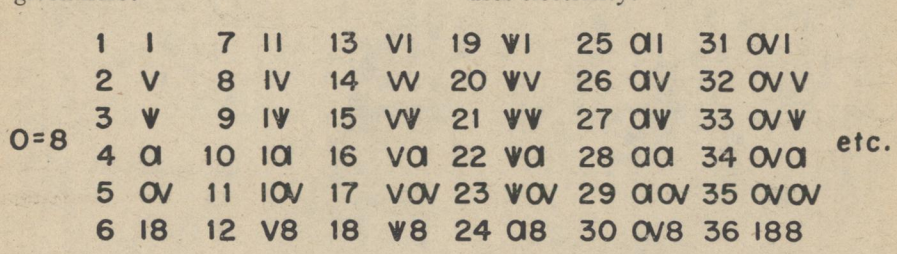
"As you might expect they are very stable emotionally, very slow to anger and with tremendous patience measured by our standards. They have a limited amount of telepathic ability but seem to use this form of communication only under duress. In the ESP tests we thought we had discovered a race with exceptional talent but later found out that their high, almost perfect, scoring was due to the X ray-like vision of the third eye."

The reports and letters in the file try to cover briefly, of course, most of the important phases of the life and culture of the Methanians and the physical features of the planet. As the students design, however, new information is frequently needed and it is part of the student's job to provide this information consistent with that already given. The first design project was limited to products of a household or personal use classification. One of the students wanted to design a clock for the Methanians and consequently was forced to devise a logical subdivision of the Methanian day and a numbering system for them. A portion of his report follows:

"The number system is based upon six (6), as would be suspected upon considering Methanian three-digit hands. The number system definitely evolved from finger counting. Thus 1, 2, and 3 are ı, ∨, and ∀. An alternate symbol for three was the closed fist, which gradually deteriorated into a small circle. Thus, four would be one finger and one fist or 01. This gradually became ɑ. Similarly, five is ɑ∨ and six would be two fists. This ultimately became two circles, one on top of the other, or 8. This is, of course, our figure "eight" exactly. The idea of building up larger numbers by ar-


Acustom
by
Geochoni

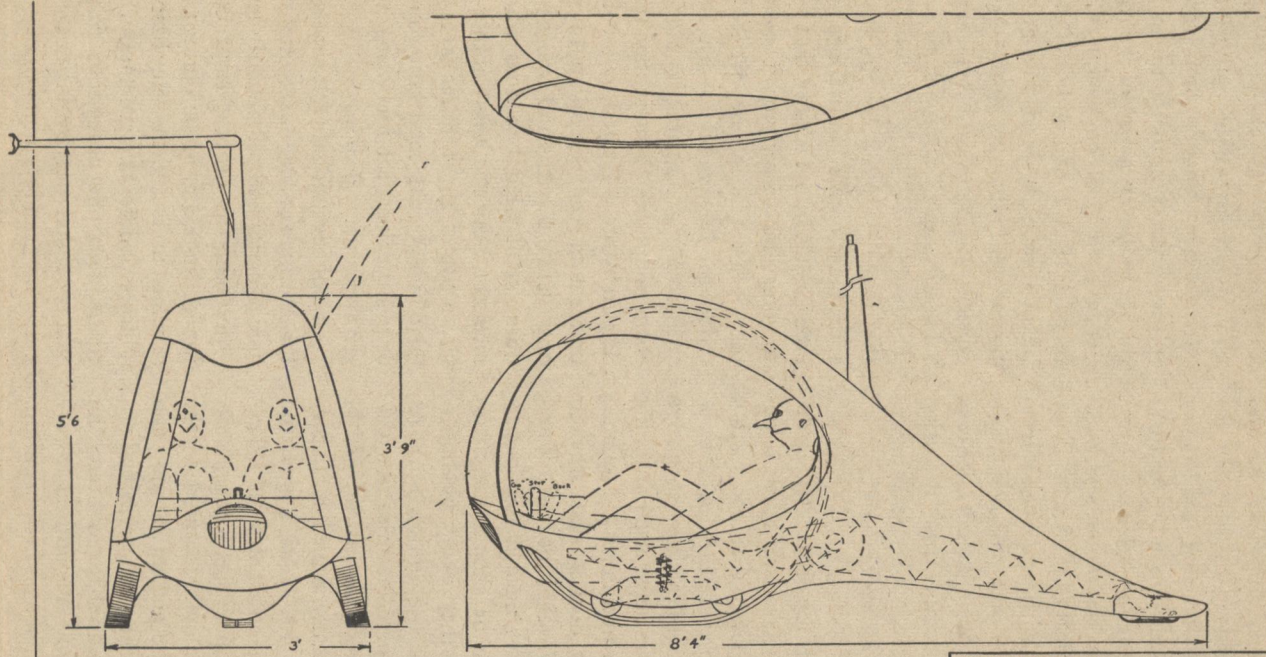
ranging symbols in sequence, and allowing the position of the symbol to indicate its value—as we do in Arabic notation — was introduced about eighty-five Methanian years ago and the symbol 8 became the zero. The complete history of the development of the number system is interesting, but only the final result is given here:



The reports in the file indicated that the Methanians used electricity generated from atomic power plants, but no details of the system were given. This same student, in order to power his clock with electricity, had to fill in the missing details. "Alternating current is generated. The frequency of the current is 1296 cycles per NAHLO —the shortest subdivision of the Methanian day. Note that 1296 = 6^4 = 18888 in Methanian notation. This is analogous to 10000 in Terranian notation. Since one NAHLO = 7.37 minutes = 442.5 seconds, than 1296/N = 1296/442.5 = 2.926 cps which is about 1/20 of standard Terran frequency of 60 cps. The Methanian electrical science is based upon the concepts of emf, current and resistance. Their unit of emf is called the GINT and is equivalent to 2.378 ± .001 volts. Electrical transmission over great distances is accomplished with an emf of 1296 GINTS = 3080 volts. Individual house voltage is stepped down to 1/36 of this, 85.6 volts. This standard emf of thirty-six GINTS seems to be available in almost every Methanian structure which uses electricity."

The description of the electrical system above combined with the information previously given about the Methanians gives rise to one possible inconsistency which is left to the reader to argue out for himself. Considering the very slow stimulus-response time, the wide range of auditory and visual reception and the very slow electrical frequency, would the Methanians be bothered by flicker from their electric lights? Another similar question is, at what frequency should motion pictures be projected?

Some of the other designs carried out by the first group of students subjected to this problem were chairs and tables, two different telephone designs, kitchen food-mixers, combination egg-incubator and baby-stroller, a stereo slide viewer and a complicated "lawn-



MAX SPEED – 10 MPH (TYP.)	POWER
CAPACITY – 50 LB. MASS	ELECTRIC – 2 HR
WEIGHT (DRY) – 100 LB.	SOURCE – PUBLIC LINE (GENERAL USE)
CONTROLS:	BATTERY POWERED FOR
SINGLE "JOY STICK"	PASSING 4 OFF LINE USAGE
TAIL WHEEL STEERING	AUTOMATIC BATTERY CHARGING
MATERIALS:	WHEN USED ON LINE
STRUCTURAL + SKIN – ALUMINUM	VACUUM JACKETED, HEATED
WINDOWS – VINYLCHLORIDEACETATE	Mg BATTERIES (MAX. CONT. USE – 3 HR. (TYP.)
FLEX-TRACK – POLYTETRAFLUOROETHYLENE	ELECTROMAGNET, AUTOMATIC CABLE-LINE TERMINAL
SUSPENSION:	" CABLE REEL
RESISTANCE OF FLEXING TRACK	

Massachusetts
Intergalactic
traders, Inc.

FOR ARCTURUS IV

TITLE "ACUSTOM" PERSONAL LAND TRANSPORT

DR. GDC	DATE 10/31/52	CK'D	DATE	AP.	DATE

NOTE – ALL TOLERANCES (UNLESS NOTED) FRACTIONS ± 1/64 – DECIMALS ± .005
ANGLES 1° – BREAK ALL EDGES – REMOVE ALL BURRS

MATERIAL	FINISH	PART NO.
NOTED		ASSEMBLY
TREATMENT	SCALE 1½" = 1'	

conditioner" for the upside down Methanian vegetation. In all cases the designs had to work and had to meet the exacting conditions of the Arcturus IV environment as well as being adapted to the Methanian's physical and psychological limitations. They had to be built with present-day technology and with materials now available on Earth. Weight limitation was hard to meet; temperature limitation caused the most trouble in getting reliable information on materials.

The second group of students to design for Arcturus were all asked to design means of powered transportation for the Methanians. The idea of introducing "automobiles" to a primitive culture that had never used anything but foot-power and domestic animals caused a great deal of discussion in the seminars. Would it be possible and desirable to introduce a highly perfected machine or should the introduction follow the history of the development of the automobile on Earth? An expert on primitive cultures was brought in to lead one of the seminar sessions and a furious battle was fought. Neither side won a clear victory so that designs following the two approaches were submitted. The Eggomobile pictured on the cover and in the accompanying plate was typical of the "conservative" approach. Due to its shape and resulting stability problems it is limited to very low speeds and changes in momentum. But again, its egg shape would be psychologically desirable and give the Methanians a sense of complete security, a very important factor in introducing these "demons" of the road.

The little Acustom Coupe pictured on page 19 on the other hand, is capable of very high speeds and accelerations—see limitations below—is very efficient in design and is typical of the "damn history" approach to design. The problem of roads is a difficult one that must be faced by the designer when he attempts to introduce a powered vehicle into a society that is used to going about slowly on foot on narrow paths. The large spherical drive unit of the Eggomobile and the flexible treads of the Acustom would make them adaptable to most any terrain. The Acustom is limited by its electric motor and trolley pickup to previously laid out paths and brings up the question of what one does when he meets or wishes to pass another vehicle. Most of the vehicles were powered by internal combustion engines or gas turbines, the fuel being hydrogen peroxide.

One of the students felt that due to the Methanians egg-birth they would hold the egg and all similarly shaped objects in the deepest reverence. It would, therefore, be bordering on the sacrilegious to use the wheel for such a lowly job as transportation. As a consequence, he designed a machine that propelled itself by walking. It was a comparatively simple design with

an ingenious system for turning. The ride was described as being similar to that obtained with a Terranian Camel although not quite as comfortable.

The major limitation in this car design was the very slow stimulus-response time of the Methanians. Without the use of automatic controls —that was too much of a new concept to introduce at this time—how fast should they travel and still be able to avoid hitting stationary or moving objects? In starting this discussion it was argued for some time whether or not the Methanians could even stand upright and walk. Considering the slow s-r time, the high acceleration of gravity and their high center of gravity, the poor Methanian might be flat on his face before he knew he was falling. It was finally decided, however, that the Methanian would have developed some anticipatory sense similar to that developed by the human child when learning to walk. The use of his long arms in walking, of course, increases his stability. Is it possible to apply similar reasoning to driving a car? The answer was yes.

The human being in learning to drive a car is consciously dependent on stimulus-response mechanisms to keep him going in a straight line and frequently overcorrects the detected errors. With practice, however, the subconscious soon takes over and errors are corrected almost before they are large enough to be detected. The amazing computing capacity of the brain is able to solve in a fraction of a second the many simultaneous equations that must be solved in order to pass safely through an intersection loaded with pedestrian and vehicular traffic. The equations involved might take days of conscious effort to solve. It was decided, therefore, that the Methanian could develop in a similar fashion over a period of time.

There was some question as to whether the Methanian brain could ever work as fast as the human brain because of the low metabolic rate and s-r time. It was arbitrarily decided that the maximum speed of all vehicles—subject to subsequent testing —be limited to fifteen miles per hour. It is very likely that this high speed would not be reached until a number of years of adjustment had passed by.

The reader can very likely imagine many other points that should be considered in designing for the Methanians but he can be assured that the chances are very good that the designers of the Massachusetts Intergalactic Traders, Inc. have given them due consideration. Do you think that the average, present day Terranian designer gives as much thought to human limitations?

The Arcturus IV project accounts for about one-fourth of the student's time in this course. The other three-fourths of the time is devoted to more

prosaic, earthly designs. Yet the three weeks or so spent out in space are richly rewarding and have a distinct carry-over value and a profound influence on the remainder of the course. The case was first set up because the answer to the question posed in the paragraph above seemed to be no. It was hoped that a dramatization of this type would forcibly bring home to the student the importance of the man-machine relationship and the influence of environment.

Some of the seminars held while the Arcturus case was in progress were devoted to examining some of the results of the Applied Psychologists of the Tufts College group and of the Special Devices Center for the Navy on Long Island. The students were amazed to see how much had already been done in the field of human-engineering or bio-mechanics, as it is sometimes called. They also realized that there is a great deal more to be done.

It is very difficult to accurately measure the influence of this one case on the students' subsequent thinking in the field of human engineering, but a qualitative measure can be obtained by sitting in on any one of the later design seminars, be it on Sanding Machines, Rug Shampooers or Turbo Cars, and comparing it with any other typical design group, in or out of schools. The enthusiasm for detail and the relentless search for all the factors, nonanalytical as well as analytical, that might influence a design is a very encouraging sight.

There have been many other beneficial results obtained with this first experiment with science fiction in the classroom. First of all, it provides a very stimulating jolt to the imagination, a jolt which some students probably couldn't survive. The more imaginative a boy is the quicker he adjusts himself to this new situation. The big adjustment demanded by the Arcturus case makes the subsequent adjustments relatively easy. He has to stretch his imagination to such a limit that it doesn't quickly shrink back to its former inconspicuous self.

In the second place, since it is almost impossible to prove or disprove some of the controversial issues that are raised by the Arcturus case, a student who conscientiously bases his design on principles which he thinks are logical and sound gains a confidence in his ability to design rationally and creatively that the most vicious design jury cannot destroy. This confidence in one's ability is one of the prime prerequisites for all good designers. If one doesn't have it or can't develop it, he had better look for something else to do. The weight of evidence that could be brought to bear by a design jury against a mistaken design principle used in an Earth-consumed product could materially affect the quality of the designer's subsequent work by shaking his confidence in himself. In the

Arcturus case the student designer can always rationalize that he is as much entitled to his opinion as the jury is to theirs and everyone lives happily ever after.

And lastly, a great many of the students with imagination are already science-fiction fans or else take to it very readily. The result is that the first case he works on is fun and not work; he learns while he enjoys himself. There may be some theory that education must be solemn and serious but the Creative Engineering Group at M.I.T. do not subscribe to it. The results of the informal seminars and lab sessions indicate that it would be desirable to hold all classes in a similar fashion. The Arcturus case is an excellent ice-breaker and strangers at the beginning of the course are good friends three weeks later.

It was indicated at the beginning of this paper that the program in Creative Engineering is expanding rapidly. This is due in part to the encouraging interest shown by all industries aware of the work that is being done. A number of grants have been received to be used for the preparation of new case material and other research and in one instance a large corporation went to considerable trouble and expense in the preparation of a very complete case history for one of the projects. The future of the program is limited only by the imagination of those participating in it, and this includes students as well as instructors. The course is designed for them, as every course should be, and they are encouraged to enter into its formulation which they freely do. The course then becomes a case study in Creative Engineering.

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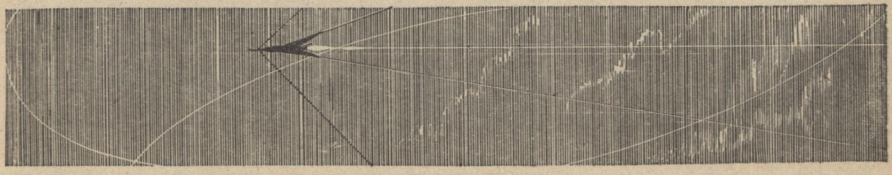
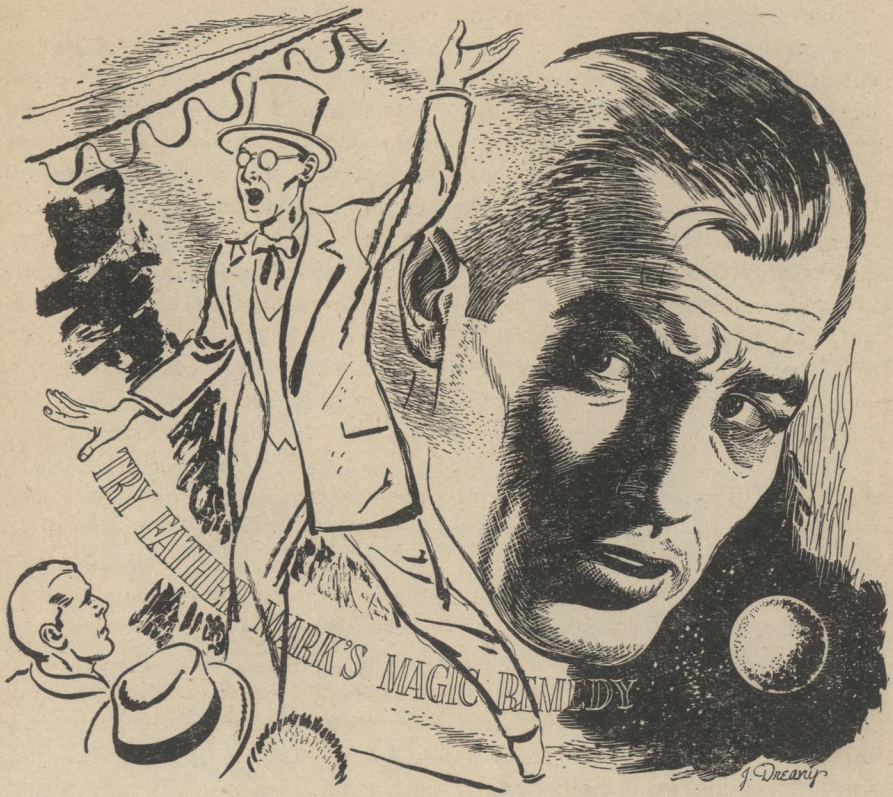
THE END





MEDICINE SHOW

***The medicine** show was a bit different—and one doctor saw that. But it took a true medicine man—a man whose work was healing people —to see that.*

Illustrated by Dreany

BY ROBERT MOORE WILLIAMS

In the night, riding in an old model truck, two men came into the town of Centerville. They set up a tent on a vacant lot. Then they waited, quietly and patiently, for what was to happen.

Young Dr. Harmon, called out of bed early in the morning by the news that old lady Washam was dying and would he get out there quick and take care of her again, saw the tent as he drove down the main street of town. He also saw the signs.

FREE SHOW TONIGHT

A second sign, in smaller letters, said:

TRY
Father Mark's
Magic Remedy
CURES EVERY HUMAN ILL

Dr. Harmon's first thought was one of vague annoyance—the tent was on the vacant lot directly across the street from his office, where his patients would see it. His second thought was one of annoyance also, expressed as a wish.

"If those fellows in the medicine shows could only do what they claim, this would be a wonderful world!"

At the thought of such a world, with sickness at a minimum, a warm glow came into existence inside the young physician. Although he was not well regarded by some of his colleagues because his views did not at all times correspond to theirs, he was a doctor who took very seriously the Oath of Hippocrates.

His one aim in life was to help a sick man get well.

Harmon did not much care how this result was achieved. Considering the complexity of the human organism and the number of variables involved, he was never quite certain that he or anyone else ever really knew how this result was achieved. He used medicine where medicine would do the job, soothing words where they would help, and he would probably have used witchcraft if he had understood it.

The result was that he got all the chronic cases that nobody else wanted to try to cure and all the hypochondriacs who could not afford the fees charged by Dr. Lapham, the town's biggest physician. Harmon also got via his back door all the sick puppies, the pet turtles that had quit eating, and the goldfish that had begun to think that swimming with the belly up was all that was left in life for them. The kids who brought their sick pets loved him and he loved them. Sick people loved him. When he came into a room, it was as if he brought with him something more potent than any medicine. Even old lady Washam, who hadn't said a kind word to or about a doctor in years, admitted that young Dr. Harmon maybe "wasn't as bad as the rest of them."

However, even if his patients liked him, he had one grievous failing in the

eyes of some of his colleagues—a poor memory. Although he had never been known to forget a technical matter such as a complicated blood count, or the details of a prescription he had written, he simply could not remember to send a bill to a patient who could not afford to pay it. This got him some criticism. "But what if they can't pay?" he protested once to Dr. Lapham.

"Then sue 'em!" Lapham had snorted. "They'll find the money somewhere when you slap a suit on them."

When he reached his patient, Dr. Harmon found exactly what he knew he would find, that she was not dying, yet. About sixty-five, she lay in a littered bed in a littered room in a small house just outside the edge of town. An anxious middle-aged son tried to stay out of the doctor's way. The patient was in pain and was complaining.

"We'll have to do something for that pain," Dr. Harmon said.

He took her blood pressure because she expected it, felt of the lumpy mass that was a part of her stomach, gave her a mild sedative from his kit, and told her a joke. When he left, her spirits were up.

His were down. He knew that she was dying slowly of cancer and that the condition was inoperable.

In his office that day, Dr. Harmon and his busy nurse saw a succession of patients. He set a broken arm, prescribed for a rash on a baby and reassured the frantic mother, and told burly Jason Kemper, who hadn't worked a day in years but who complained that something was wrong with his stomach, to "cut down the whiskey to just a pint a day, as a starter." Kemper left in a huff.

Working out his back door, Harmon mended the tail of a puppy named Bowser who had made a mistake in judging how fast and hard a screen door could close. He also mopped up the puppy's owner, Donna Culver, aged six, and stuffed her with candy, giving two pieces to the puppy, "because he needs something in his stomach to help him forget about his tail."

As he went about his routine, he was vaguely aware that the tent on the vacant lot was attracting a number of curious onlookers. It was his intention, later in the day, to go over and meet these peddlers. His secret opinion, which he never dared voice in public, was that some of the so-called quack remedies sometimes had curative qualities that modern medicine could well investigate and possibly use to advantage. His grandmother had had her home remedies, and she had not been a fool.

Late in the afternoon, the phone rang. Harmon answered it himself.

"Dr. Harmon?" a woman asked.

"Speaking."

"This is Dr. Lapham's secretary. Will you hold on for a moment,

please? Dr. Lapham will speak to you."

Harmon's lips formed a line but he held on. Lapham was a long time coming. Then he was shouting into the phone, his voice a bustle of impatient importance.

"Harmon, what's going on across the street from you?"

"I don't know. I haven't been over there."

"Well, I'll tell you what it is—it's a medicine show. I drove past there a few minutes ago and there is no question about it. They've even got signs up advertising some quack remedy."

"Is that so? As I said, I haven't been over to see what is going on."

"Well, get over there, Harmon, and report back to me. I'm not going to have any medicine shows operating in this community, spreading their poisonous nostrums among my patients, as long as I'm president of the medical society."

"We don't know they're poisonous," Harmon murmured.

"What? We can take that for granted, I think. Get over there and tell them to leave. Tell them I'm giving them twenty-four hours to get out of town."

"Why don't you tell them? You're president of the local society. If this medicine show needs investigation or action, it's your job to take care of it."

"What? Too busy, too busy, got an emergency case coming up, can't possibly make it. Also, I'm too well known. If I try to look in on them, they'll recognize me and I won't get a thing. But you're not so well known—"

"O.K., I'll look in on them as soon as I can find time," Harmon said, pain in his voice.

"*Make* time, Harmon, that's what I do. As soon as you report back to me, I'll call the sheriff." The phone clicked in Harmon's ear as Lapham hung up.

Evening had arrived before Harmon got away from his office. Walking across the street to the vacant lot, he saw that a makeshift stage had been erected. A speaker was on the stage and a crowd had already gathered. The spieler was tall, skinny, and hook-nosed. Words poured from him like water from a hose.

". . . I want to tell you tonight about Father Mark's remedy. However, ladies and gentlemen, I want to warn you in advance, there will be scoffers among you, there will be doubters, there will be people who do not, perhaps cannot, believe what I am going to say. I want to tell you that these people are justified in their attitude. I know from my own unfortunate experience that there are charlatans, frauds, and quacks among us, and that the honest citizen unfortunately is forced to make important and vital medical decisions on the basis of inadequate information, on what some friend tells him, on what

he has read in a book or in a newspaper, even on what the almanac tells him. The result is that sometimes we fall into the hands of blood-suckers whose only aim is to cheat us out of our money—"

Listening, Harmon was impressed. The selling technique was excellent, the delivery was powerful, and the man was telling the truth—so far.

"Ladies and gentlemen, I want to make one fact crystal clear—*if there is one thing we are not after, it is your money!*"

The words produced a stir. Harmon wondered what Dr. Lapham would say if this statement were reported to him.

The speaker paused. Harmon moved forward. The speaker glanced at him, glanced away, then pulled his eyes back to the young doctor.

"Hi, Doc," the speaker said, smiling.

"How did you know me?"

"I caught a glimpse of you in your office this afternoon, sir, and noted the name on your shingle. Go right on back into the main tent, Dr. Harmon. My colleague there will answer any and all questions you care to ask. With your medical knowledge, you will be able to ask many questions that these good people, not learned in the art of Hippocrates, do not know how to ask. Go right on into the tent, sir."

The speaker smiled and nodded. He had a compelling, magnetic quality about him. Without quite realizing why he did it, Dr. Harmon found himself moving past the platform and through the pulled-back tent flap that served as the front entrance to this medicine show.

A man wearing tinted, thick-lensed spectacles was sitting in a chair placed in front of a thick panel that formed part of a table. A second chair was beside the table. The eyes behind the glasses were indistinct but Harmon had the impression they resembled those of some wary, alert bird. The man's skin was sallow, his head was bald. He rose as Harmon entered.

"Ah, yes—" The voice was a hiss that accented all of the sibilants in a way that was somehow pleasing to the ear. "Ah, yes. You are a doc-tor, sir? Will you sit down, please?" He motioned to the chair beside the table.

As Harmon sat down, the man's hands darted over the control panel, adjusting switches. Harmon sneezed, an old hay fever symptom that had hung on for years. He glanced around the tent for the substance that was producing the allergic reaction, saw nothing that would account for it, blew his nose. In front of the table, the man scanned the meter readings with alert interest, then turned his attention to Harmon.

"Permit me to introduce myself, sir. My name is Yanvro. I have a degree, sir, but since it was not conferred by an institution of learning of your great country, you may not

recognize it. It corresponds very roughly to your own honored title of M.D."

"A privilege to meet you," Harmon said. He gave his name. The man's handclasp was warm and friendly and at the same time somehow alien and distant. "What school conferred your degree, Dr. Yanvro?"

This would be one of the questions Lapham would ask. When it was answered, Lapham would snort, "Never heard of it!"

"The University of Telinka," Yanvro answered, smiling.

"Never—" Harmon caught himself. "I don't recall that school. Where is it located?"

The question went unanswered. A hum came from the thick panel, a small light glowed on the front.

"Ah, yes," Yanvro said. From a receptacle in the side of the panel, he took two small pieces of metal. Turning to Harmon, his manner became subtly professional as if Harmon had somehow become the patient calling on his personal physician for medical advice and Yanvro had become the doctor. "I noticed when you came in, sir, that you had a slight rhinitis, hay fever is perhaps what you call it—"

"How did you know that? I showed none of the signs of rhinitis and I didn't sneeze until after I had sat down."

"Perhaps it was a lucky guess. But wasn't my guess correct? You do have hay fever, do you not?"

"Yes, a touch of it occasionally. I have never got around to identifying the substances to which I am sensitive. But—"

"If you will carry these in your pockets—not both in the same pocket but each in a separate pocket—I think you will find that within a day or two something very interesting is happening to your hay fever, sir." Yanvro handed Harmon two small pieces of metal.

Harmon took them. So far as he could see, they were simply flat pieces of metal.

"One in the right pocket, one in the left," Yanvro said. "I could give you a very detailed description of the metals and the way they are magnetized. While you were sitting in the chair, this equipment made a complete diagnosis of you. This is not a diagnosis as you understand and use the term, sir, your blood pressure was not taken, no blood count was made, and there was no manual probing for symptoms. These things, while useful to a young medical science"—Yanvro's voice became mildly apologetic—"have been superseded by more accurate methods of measurement. This equipment counted, measured, and analyzed the very complex electrical currents flowing within your body and the electromagnetic fields generated by these currents. Then, on the basis of these measurements, this machine magnetized the pieces of

metal in such a way that the aberrant, displaced current flows within your body—of which your hay fever is one manifestation—will come back to normal."

The description rolled from Yanvro's tongue as if he had memorized it.

"But—"

"Try them, Dr. Harmon, before you reach a decision. I know what I am telling you seems impossible to you. I suggest a test before a conclusion is reached. Ah, yes, Madam—" Yanvro was bowing to a woman who was coming through the opening of the tent. "Would you please excuse me, Dr. Harmon?"

His manner was deft. He was in this instant a professional man asking a courtesy from another member of the same profession, sure in advance that it would be granted. "I have another patient."

"Certainly." Harmon reacted instantly. He went out the side door of the tent.

The woman who entered as he left was old lady Washam.

As he returned to his office, Harmon felt that his head was spinning mildly. Both the spieler and Yanvro could certainly talk. If words could cure, they would be expert doctors. As to the two pieces of metal, he would examine them at his leisure.

Father Mark's Magic Remedy—two pieces of magnetized metal! How Lapham would love that!

The phone was ringing as he entered his office. Answering it, he thrust the two pieces of metal into his pocket, and promptly forgot all about them.

The owner of Bowser, the puppy with the broken tail, had fallen and broken her arm.

"She fell off of her bicycle, doctor. Will you come at once? She's in awful pain." The mother was on the verge of hysteria.

"I'll be right there."

It was a compound fracture and the splintered fragments of broken bone had penetrated the skin. The child was screaming with pain and was refusing to be touched. Looking at her, Harmon wished fervidly for the facilities of a large hospital but none were available in Centerville or anywhere near. Taking off his coat, Dr. Harmon rolled up his sleeves.

An eternity passed before the splintered fragments were back in place.

After that came penicillin.

"If an infection doesn't develop, she will be all right in a couple of weeks," he told the parents. "I'll come back and see her tomorrow afternoon. Take her temperature regularly and call me if anything unusual comes up."

As he left the house, he sneezed. He thought, absently, that his hay fever was getting worse. He made two more calls that night, reaching home well after midnight, utterly worn out, and sneezing even more violently than usual.

When he awakened in the morning, his hay fever was gone. As he pulled on his clothes, he realized its absence was only temporary, and sneezed suddenly.

At the office, he found only two patients waiting. He had finished prescribing for the second one, his nose continuing to run, when a knock came on the back door. He opened it. Yanvro stood there, a polite inquiring smile on his face.

"I came over to ask about your hay fever, Dr. Harmon."

Kachoo! Reaching for tissues, Harmon glared at the man. "You and your—"

Whaaaaang! sounded the telephone. Harmon answered it.

Silas Washam, the middle-aged son of old lady Washam, begged, "Doc, you got to come out here right away. Doc, you got to hurry. Doc—"

"What's wrong with your mother now?"

"She's crazy, Doc! She's plumb out of her mind."

Harmon restrained the impulse to tell Silas Washam to leave diagnosis to someone capable of making it. "What's she doing?"

"She's insistin' that there ain't a thing wrong with her, that she's been cured, and that she's gonna put out the wash today. Doc, I can't do a thing with her. Doc—"

"I'll be there right away," Harmon said. He glanced at Yanvro, still waiting at the back door. "I'll see you later," he said.

Yanvro's nod was polite, the quick smile came to his face. But under the smile was concern.

Silas Washam was waiting for him out by the main road, with additional information. "Doc, she says she is gonna chop up some wood after she finishes with the wash—"

Inside the house, he found his patient in the kitchen, just finishing breakfast. From the remnants on the table, he judged that she had eaten at least two stacks of hot cakes, ham and eggs, and had drunk he couldn't guess how much coffee.

"Oh, there you are, Doc," she greeted him. "Seems to me like I raised nothing but derned fool kids. That derned Silas gawkin' there behind you thinks I'm loony. He thinks I ain't able to put out the wash. For fifty years, ever since I was a girl—until I got sick—I put out a wash every week. I ain't aiming to change my habits now."

"Do you think you are able to do this?"

"Doc, don't talk like that idiot son of mine! Of course I'm able to do it. I wouldn't be saying I was able if I wasn't."

"Yesterday, you know, you weren't feeling so well."

"That was yestiddy. Yestiddy I was sick. Today is different. Today I'm a well woman."

She spoke with sureness and con-

viction. Was this the conviction of lunacy or did she know what she was talking about?

"Would you mind if I . . . ah . . . examined you before you put out that wash?"

"If it'll keep you and that idiot son of mine quiet, I'll let you do it."

A few minutes later a bewildered doctor put down his stethoscope. The heart action was strong, there were no wheezes in the lungs. The pulpy mass that had been apparent in the stomach the day before was still present but it was diminished in size and it had softened as if it was dissolving, going away. "What . . . ah . . . happened?" he asked.

"I went to the medicine show last night. I was certain you and the rest of your tribe wasn't going to get me well. If I was going to get well, I had to hunt me up another doctor." In her voice was the triumph of getting well, not triumph over Dr. Harmon. "I saw that doctor at the medicine show. He gave me something."

"Would you mind telling me what it was?"

"Heck, I'll show you." From her apron pockets she took two small pieces of metal. They were not the same shape as the ones Yanvro had given Harmon and they had obviously come from the same machine.

"The doc gave 'em to me. He told me to keep 'em in my apron pockets, and if I wasn't wearing an apron, to sew 'em on to my underwear. The way I am feeling this morning, you can bet I'm going to do exactly what he said."

Silently, too dazed to speak, Dr. Harmon left the house. Outside he faced the worried son.

"Let her do the wash," he said.

"Doc, you don't mean—"

"You help her."

"But—"

"And after she finishes with the wash, if she still wants to do it, let her chop wood."

Harmon headed for his car on the run.

On the vacant lot, a line of people were waiting to be admitted to the tent. Each carried a package or a container of some kind. One was on crutches, another hobbled with the aid of a cane, a third limped.

Dr. Harmon had seen such sights before, he saw them almost every day in his own office. Some of these people were his former patients that he had tried to help without much success. Now they were lined up in front of a medicine show tent, each one still hoping to find a way to be well again. If they found fraud in that tent, much promised but little delivered, what would their reaction be? Harmon knew his own people well enough to know how they would react to deceit.

But what if the activities carried on inside the tent were, by some miracle, a part of the spectrum of truth? What if—*Kachoo!* Harmon's sneeze rang a

warning bell inside of him.

As Harmon stopped his car, he saw that two other cars were stopping on the side street adjoining the vacant lot. Dr. Lapham, his pince-nez on crooked and his bedside manner showing signs of fraying at the edges, was getting out of one car. The sheriff, a gun holstered at his hip and a star prominent on his shirt front, was getting out of the other.

"Oh oh," Harmon thought. He went rapidly past the line of people waiting for admission to the tent. They greeted him and he saw what they were carrying. One had a pail full of peach seeds, the second had a box of walnuts, the third had hickory nuts. Another was carrying packages of seeds, nasturtiums, pansies, hollyhocks, violets, peas, beets, radishes, and lettuce.

Harmon went in the side flap of the tent. Yanvro, with every evidence of pleasure and satisfaction was accepting a box of—hazel nuts!—from a caller. The tall spieler was sitting in a chair in the back of the tent, quietly smoking a cigar.

The tent was partly filled with boxes and pails of nuts, seeds of every kind and description.

"I'm sorry to interrupt," Harmon said. "But I want to talk to you—*kachoo!*"

"Of course, Dr. Harmon." Yanvro quickly shooed his caller out. "I'm sorry about your hay fever. Did you—"

"Never mind the hay fever. It can wait. A patient of mine was in this tent last night. I examined her yesterday morning. She had an advanced and inoperable case of cancer—"

"Go right on in, sheriff," Dr. Lapham's angry voice came from outside. "Go right on in and do your duty."

The star and the round moon face of the sheriff came through the tent opening. Lapham, fuming, came right behind him. His eyes swept the tent. "You were supposed to report to me, Harmon. No! No excuses, no alibis, but it's a good thing we've got one physician in this city who is capable of taking intelligent action. What is that junk?" A wave of his hand indicated the big panel with its meters and its switches.

"That is our diagnostic and treatment equipment," Yanvro said quietly.

"Diagnostic and treatment equipment, bah! Magic gimcracks to deceive fools. And what's this?" Lapham kicked at a basket of walnuts.

"We do not accept fees, sir," Yanvro said. Harmon, listening, understood what the tall spieler had meant the night before when he said they were not after their listener's money. They accepted seeds as fees. But why seeds?

"If anyone feels that we have helped him, we will accept a free-will offering of seeds—" Yanvro continued.

"Seeds?" Lapham exploded. "Do you mean to tell me that you accept peach pits and hickory nuts as fees?"

From the tone of Lapham's voice, Harmon got the impression that the physician might have respected what was being done here if Yanvro had charged twenty dollars per office call.

"Yes," Yanvro answered. "The payment, the fees, if you wish to call them that, are purely voluntary, however. We ask no man to pay—"

"Voluntary!" Lapham's voice rose as if the thought itself were horrifying.

"I know it's a shame, Dr. Lapham," Harmon spoke impulsively. "It would be much better to sue them when they can't or won't pay."

Lapham's attention came back to the young doctor. "What are you doing here, Harmon?"

"Trying to discover something."

"Hah! In a medicine show tent! Well, if you're going to find out anything from these charlatans, you will have to do it while they're in jail. Sheriff, I want these two men arrested, for practicing medicine without a license—"

"Wait a minute," the tall spieler spoke quickly. At a gesture from Yanvro, he was quickly silent.

"Gents—" the sheriff began.

"Do you have a warrant?" Harmon spoke.

"Huh? A warrant?"

"He doesn't need a warrant to arrest these malefactors!" Lapham said, angrily. "They have been detected in the act of committing a crime. Har-

mon, you keep out of this."

"It's a shame you haven't been detected in some of the criminal acts you have committed behind the protection of the name of medicine!" Harmon said, heatedly. He turned to the sheriff. "Do you have a warrant, officer?"

"Well, no—"

"Then it would be best to get one, I think, before you act."

"Harmon, I told you to stay out of this. You're interfering with the process of justice."

"On the contrary, I am making certain that the process of justice is carried out. The law prescribes a warrant before an arrest. *Kachoo!* As the situation stands now, you have no evidence that these men have broken any law or committed any crime. If you want them arrested, get a warrant. Isn't that right, sheriff?"

"'Fraid you're about right, Doc," the sheriff admitted. "But Doc Lapham made me come—"

"Then we'll get a warrant!" Lapham snapped. "That won't be any problem. I know the magistrate personally. We'll get a warrant all right."

"Do that. And when these men have been arrested in the manner prescribed by law, I will consider it a privilege to sign bail bonds for them!" The young doctor spoke with growing heat.

"You'll what? You'll bail these frauds out of jail?" Lapham was goggle-eyed at the thought.

"You heard me. Now get going. I have something I wish to discuss with Dr. Yanvro."

"But—"

"Get out!" Harmon's voice had power in it. The outraged physician and the confused sheriff left the tent.

The eyes Yanvro turned toward Harmon held appreciative awe. "Well done, Dr. Harmon."

"Thank you. As I was saying—*kachoo!*"

"Your hay fever, sir!"

"Forget my hay fever."

"But give me just a moment, sir. Just one question."

"All right," Harmon said. "But make it fast. I've got more important things to talk about than my hay fever or me."

A shy, approving smile appeared on Yanvro's face. "The fact that you think more about your patients than you do about yourself is making you a great doctor, sir. Your patients know you put their interests first, they respond by getting well for you—"

"Sometimes they don't get well for me and I have to sign a death certificate. I don't like that. Get to your point."

"But you must also consider yourself, sir." If this was a reproof, it was very gentle. "Now as to those pieces of metal which I gave you last night—"

"Got 'em in my pocket. They didn't work for me." Harmon pulled them out.

"Did you put *both* of them in the same pocket?" Yanvro said.

"What difference does that make? Actually, I forgot them completely."

"It makes a very great difference, sir. If both are carried together in the same pocket, they reinforce the disease currents instead of cancelling them. Will you put them in different pockets, sir, and see what happens to your hay fever?" Yanvro's eyes pleaded with Harmon to obey.

To oblige the man, and to get on to more important matters, Harmon slid the little pieces of metal into different pockets. "Now about this patient of mine, I don't know whether my original diagnosis was wrong, or her cure is an example of spontaneous remission—"

"She is getting better?" Yanvro asked.

"*Better? She's getting well!*"

"Then what are you complaining about, sir?"

"I'm complaining because I am not certain your magnetized pieces of metal account for her improvement. If they do account for it, I am complaining because I don't know how they work. Man, this is the greatest thing in the history of medicine, if you can make it work. I want to know—Yes?"

Harmon's nurse, white-faced and out of breath, came through the entrance of the tent.

"Dr. Harmon, Mrs. Culver just called. Donna's temperature is 105."

Automatic reaction patterns instilled so deeply in him that he had forgotten their existence, patterns which said the sick patient came first and everything else came second, instantly made Harmon's decision for him. Heading for the tent opening, he paused just long enough to say over his shoulder to Yanvro, "I'll see you later."

The child was delirious. The father and mother hovered in the background as Harmon sat down beside the bed. Bowser crouched in the corner and wet himself and whimpered as if he sensed the presence of something here in this room that frightened him down to the bottom of his puppy soul. For thirty minutes, Dr. Harmon sat beside the bed, while the mother and father slowly went frantic.

"What is it, doctor? What is it?"

"Some infection I do not understand."

"What can we do?"

"I gave her penicillin. Apparently this organism is penicillin-resistant. I can try some other antibiotic but if penicillin does not even check the infection, I am afraid we have run into something that no antibiotic will stop."

"Doctor—"

"If you believe in prayer, now is the time to pray."

The mother went silently from the room.

In the corner, the puppy whimpered. On the bed, the little girl moaned and twisted. She was not in contact with this world but with some other world in which strange shapes came and went like ghosts across a wasteland. In this other world were sights that frightened her. Harmon shook his head.

Suddenly he realized that he had not sneezed since he left the medicine-show tent.

At the realization, something inside of him came unhinged. For an instant —and it was an instant of pure madness—panic such as he had never known blew through him with hurricane force. He caught the panic, righted it, and knew what he wanted to do. It blew up again, with more than hurricane violence, as he considered the possible consequences to him of doing what he wanted to do.

"I don't care what happens to me," he said.

The panic, for this time at least, subsided.

He lifted the child in his arms.

Donna's parents went with him. Getting out of his car in front of his office, Harmon carried the child across the street toward the tent of the medicine show.

Many people were on the lot now. There was a stir and a flurry among them. Coming out of the tent was a procession of four men, Dr. Lapham, Yanvro, the spieler, and the sheriff. On the sheriff's hip, the gun was clearly visible. Yanvro and the spieler were in handcuffs.

The child in his arms, Harmon walked up to Dr. Lapham.

"Get out of my way, you young fool. These men have been arrested. The warrant, I assure you, is legal."

"I have a sick child here," Harmon said.

"So I see." Lapham's eyes widened. "Harmon, you don't mean that you were bringing her to a medicine show for these charlatans to treat?"

"I mean exactly that," Harmon answered. He was ice and iron inside, with no panic anywhere. The sheriff moved forward and looked at the child in Harmon's arms with bewildered concern, then looked at her parents.

"Sam, what's wrong with Donna?" the sheriff said.

"Some kind of an infection," the father answered.

"Bad?"

"Yes. Very bad."

The crowd on the lot formed a circle around them.

"It's a good thing I'm here," Lapham said. "Harmon, if you had let these charlatans treat this child while she was under your care, I would have been forced to ask for a cancellation of your license to practice medicine."

Harmon turned to Donna's father. "Hold her, will you?" The twisting

child went into her father's arms.

"My license to practice medicine is hanging on the wall of my office," Harmon said. "If I let this child die without doing everything in my power to save her life, I'll tear up my license myself, Dr. Lapham."

Something like a gust of wind moved through the listening crowd. Yanvro's watching face was suddenly alive with light.

"Release this man," Harmon said. He pointed to Yanvro.

"But—" the sheriff said.

"Release him."

"He will be released when the court turns him loose, which will be about ten years from now," Lapham said. "As to bail for them, I am going to see that it is set higher than any figure you can reach."

"Time is very important. This infection is at the crisis point. I want Yanvro to see what he can do to help the child. I admit I do not know what to do."

"You're out of your mind," Lapham said, coldly. "Stand aside."

"I see," Harmon said. He did not move. "This is Donna Culver," he said to the cheriff.

"I know it is," the sheriff answered. "I didn't even know she was sick until now."

"She's your niece, isn't she?"

"Yes."

"Well, you know now that she is sick. And there is something else I want you to know." Harmon moved forward to whisper in the sheriff's ear.

"Without more help than I can give, she is going to die. If you will take orders from me for just a little while, she may have a chance to live."

"W-w-what?"

"Stop that whispering!" Lapham snapped.

"This is your alibi for what is going to happen," Harmon whispered to the sheriff. As the officer leaned forward to listen, Harmon slipped the pistol from its holster on the sheriff's hip.

"Unlock the handcuffs on these two men."

Staring at the gun, the sheriff turned the key in the cuffs.

"Harmon, you have gone completely crazy!" Lapham said. "You haven't heard the end of this, I promise you." The outraged physician stalked from the lot.

"Carry her into the tent," Harmon said, to Donna's father.

The crowd surged behind them. At the entrance Harmon paused. "If you folk will be both quiet and patient, I will appreciate it."

"Hurry up, Doc!" Jason Kemper shouted from the crowd. "There're others waiting."

Changes had been made inside the tent. The truck had been backed into the far end and the boxes of seeds had been loaded into it.

"Set her in this chair beside the table," Yanvro said to the father.

"Is this all right, Doc?" Culver spoke to Harmon.

"We're gambling. The way she is going now, there is nothing I can do for her. We're taking a chance that something can be done—here." Harmon's voice was suddenly choked and taut.

"I'll back your gamble, Doc," the father spoke, his voice tense. "I'll bet my last dollar on one thing—your heart's in the right place."

"Thank you."

"When one's heart is in the right place, all other things may be possible," Yanvro said softly. Behind his thick-lensed spectacles, his eyes seemed to glow with dancing lights.

The needles on the dials jumped wildly as the child was placed in the chair. Watching, Harmon saw color go out of Yanvro's face. Yanvro darted a quick glance at the twisting child. More color drained from his face. He turned mutely appealing eyes to Harmon as if begging not to be judged too quickly or too harshly, that some things were beyond human power to control.

"You've got to save her," Harmon said. His voice was a prayer.

"My friend, we will do the best we can, but it may be that what you call a miracle is needed here. I have never seen such readings on these meters—"

"Then work a miracle!" Harmon said firmly.

"We will do our best. Pienster—"

"Yes." The spieler was instantly beside Yanvro.

Harmon watched the two men work as he had never seen two men work before. Yanvro and Pienster made a *team*. What one thought, the other seemed to act out. They moved, acted, and thought, in such perfect rapport and understanding that they were, in effect, one man, one mind. The panel hummed softly, the light glowed. Pienster snatched the pieces of metal from the receptacle. Using pieces of cloth torn from her nightgown, he clamped them into position on the child's body. The first two pieces of metal went on the broken arm, around the spot where the infection had its source. Yanvro watched the meters, changed the switches. The second two pieces of magnetized metal—Father Mark's Remedy—went on the child's head, one down at the base of the skull, the other on her forehead. Always they used two pieces of metal, like the two poles of a magnet. Did these pieces of metal set up a magnetic flux in the child's body and did this flux in turn change the course and intensity of the infection?

The meters changed. Yanvro watched, Pienster acted. As they watched and moved and worked, they spoke rapidly to each other. Harmon hardly realized they were speaking in a tongue he did not know.

The language they used was unimportant, its meaning was universal.

The sounds in the tent were the soft weeping of a woman, the harsh,

mumbled prayers of the father, the voice of a child moaning that she was in a land that was full of fear and would somebody take her by the hand and lead her home? The quick alert voices of the two men were overtones against the hum of the panel. Outside voices shouted in argument. Harmon did not hear them. His eyes were on the child and now and again he glanced at Yanvro.

Yanvro seemed to have stopped breathing. On the panel, a meter reading was changing, changing, changing. Harmon did not know whether it was going in the right direction or the wrong direction. He did not know which was the right way for the meter to go. Yanvro knew but Yanvro was holding his breath. Piensster was holding his breath too, now, his eyes glued on the meters. The tent was silent.

Again the panel hummed. Another pair of pieces of metal came from it. Pienster tied them into place, on both sides of the chest, as if he was trying to strengthen the beating of a tiny heart already working beyond the limits of its load.

There was no sound anywhere.

The meter shifted, began a slow retracing of its course.

Then there was sound.

A small voice said, "Mommy?"

The word was said plaintively, a single chirp of sound, like the voice of a young bird in the nest.

The mother moved to gather the child in her arms.

Yanvro held up his hand. The mother stopped moving.

"Mommy? Mommy?" The voice came again, stronger now.

"All right," Yanvro said.

The mother lifted the child. "Yes, dear. Yes, darling."

"Mommy, where am I? Where is daddy? Where is Bowser?"

"Daddy is right here, honey. We left Bowser at home."

"Mommy, who are these two funny-looking men?"

"Friends, darling."

"They're nice men, Mommy." There was delight and happiness in the voice. Then the voice changed.

"Mommy, I'm hungry."

"Yes, dear, I know. You will have something to eat very soon."

Harmon wiped the sweat from his forehead and breathed again. He did not need to see Yanvro nodding happily to himself to know that the miracle had been accomplished.

"Mommy, Mommy, I'm hungry."

The mother looked at Harmon. Harmon said softly, "Take her home and feed her. And give Bowser something too, so he will also feel good in his stomach."

In front of the panel, Yanvro nodded happily again as if including Bowser was the one final thing that was needed to make this child well again.

Carrying the child, the parents left the tent.

Harmon, clearing his throat, looked at Yanvro. "There's something I want to ask you."

"What about your hay fever, sir?"

"Gone. It's gone. It went away." For a moment, Harmon marveled about that. Then his old self asserted itself. "What I want to know is . . . hey—"

From the entrance to the tent, Pienster, looking out, spoke, "*Se floton throm!*"

"What?" Harmon said. "I didn't understand."

As if they had not heard him, or had forgotten all about him, the two men moved. Each taking an end of the table that held the panel, they lifted it into the back end of the truck.

"Hey! Wait!"

They set the table beside the boxes and sacks that contained the seeds. Pienster remained in the truck. Yanvro dropped back to the ground. Harmon seized the man by the shoulder.

"I've got to know—"

That was as far as he got. A new voice was suddenly exploding in the tent, a rough voice, loud and unruly, a demanding, arrogant voice, the voice of a man who would not take any answer except his answer.

"You've got to do something."

Jason Kemper stood there. It was Jason Kemper who had shouted at Harmon as they had carried Donna into the tent. Kemper had a gun in his hand.

Harmon looked hastily for the weapon he had taken from the sheriff, then remembered he had given it back.

"You've got to do something for me, too!" Kemper shouted.

The man had the constitution of a horse. The only thing that was wrong with Kemper was his refusal to work.

"You can cure yourself," Harmon said. "There are people in this world who cannot help themselves. They come first, before you."

"I don't want any arguments out of you, Doc!" Kemper flared. "You can keep your big mouth shut. If these guys can cure old lady Washam's cancer, and can cure a kid that nobody else thought had a chance to live, they can do a lot of other things, too."

"As Dr. Harmon has suggested, you can cure yourself. However, we might make it possible for you to work better." In that single statement made on the spur of the moment, Harmon recognized a shrewd and competent diagnostician.

"Work!" Kemper spat. "Who said anything about working? That's for fools! What I want is for you to make me so smart I can get rich without working!"

The gun centered on Yanvro.

"And no arguments!" Kemper said.

Phut!

The soft sound came from somewhere up above. Glancing around, Harmon caught a glimpse of Pienster, in the truck, hastily putting some-

thing back into his pocket.

Kemper dropped the gun he was holding. A glazed look appeared in his eyes. Very gently he sat down. Then, as if the effort of sitting erect was too difficult for him, he laid down.

"Somebody was sure to think that he could use our skill and our knowledge to make himself rich without working," Yanvro said, apologetically, to Harmon.

"But—"

"As for him, he will be all right in a few hours."

"I don't care if he lies there until he rots!" Harmon said. "I want to know about *you*. I want to know about Father Mark's Remedy."

"We bought this truck and tent from a man who was using that name for the product he was selling," Yanvro said. "*Father Mark's Remedy* was as good as any other name, so we retained it. If you will get into the truck—"

"Huh?" Harmon had the impression that this was happening too fast for him. "Why should I get into the truck?"

"Perhaps because we are leaving. Perhaps because I ask it," Yanvro said. "Perhaps because outside this tent there is a milling throng that will become a mob in another few minutes."

"A mob?"

"They will burst through this tent like water through a broken dam. They will demand everything, from treatment for hives to potions to make some woman love them. But they will never take into consideration what part they are playing in giving themselves hives, nor will they think to ask whether or not the woman wants to love them. Failing in that, they will fail in everything. If you will get in, please, I will explain while Pienster drives."

Harmon got into the truck. As Pienster, at the wheel, exploded it out of one side of the tent, the mob flowed in the other side.

"You see?" Yanvro said, gently.

"I see," Harmon said. Sadness was in his voice.

He took a wild ride in the back of the truck, with hickory nuts, walnuts, and brightly-colored packets of vegetable seeds bouncing all around him. Pienster either had no knowledge of speed laws or no respect for them. In the back end, Yanvro tried to explain. "It is a matter of seeing the human organism in many ways. Of seeing it as muscle and bone and blood and plasma."

"I know that," Harmon protested.

"It is also a matter of seeing how all these parts fit together and how the whole determines the function of the parts—"

"Hold on. That wasn't what I was taught in school."

"It may be possible that some of the things you were taught were not in accordance with the evidence,"

Yanvro said. His eyes twinkled gently behind the thick-lensed, tinted spectacles. "It is also a matter of seeing the human organism as an electrical system, with minute but exceedingly important currents being generated in every bit of tissue, even in every cell, and how these currents blend together and flow through the organism and form the whole."

"I—"

"To see all of this as we see it is not easy, my friend," Yanvro said. His voice was very gentle.

"I'll try."

"Good. In turn, I will try to explain."

Harmon listened. He knew he was grasping and retaining very little of what was said, that Yanvro was explaining what could only be demonstrated. "The tools, the concepts, with which to think, you do not as yet have them, my friend," Yanvro said, over and over again.

"I'm trying to get them," Harmon said sadly.

The truck came to a halt. Harmon looked wildly around. Piensterhad brought them into the hills, into wooded high country where the road stopped. He had halted the truck beside a thick grove of trees. Hidden in the grove was something that startled Harmon as he had never been startled before.

Harmon whispered. "You—"

"Yes," Yanvro said. He took off the tinted, thick-lensed spectacles. What was behind them was clearly revealed.

The eyes that looked out from the face were not human eyes.

For some time thereafter all three of them were very busy carrying boxes of seeds and the panel from the back of the truck. Harmon protested every step of the way. He did not succeed in making himself heard until they had finished with the carrying.

"But you don't *have* to leave!" He had said the words over and over before Yanvro answered.

"You and your kind would make us welcome," Yanvro said. "We know that. But Dr. Lapham—"

"I'll kill him," Harmon said. Lapham was now interfering with the best dream he had ever known.

"What would be the gain if you destroyed him? There are millions like him. Another Dr. Lapham would take his place. If you destroyed that one, there would be another one. Then there would be others like the burly man, like Kemper, and the seekers of love potions, and—"

"I know," Harmon said.

"Why don't you humans grow up as a race?" Yanvro said. "We cannot understand at all your failure to mature as a race. There is so much waiting for you, when you grow up." His nonhuman eyes lifted to the sky as if somewhere in those vast depths was some world about which he knew.

"I guess we will, in time, but it seems a slow process."

"Do not be sad, my friend. We—"

"But I still can't understand the seeds," Harmon interrupted. "If you wanted them, why didn't you just take them?"

"Such an act would have been a breach in our sense of justice. We never take unless we give something of value in return. We had to give something for the seeds, our own laws require it. We gave health."

"But why nuts?"

Yanvro smiled. "In spots, the plains of my world are barren. Our native growth is failing. We need new life from another planet, new seeds. In what we have gotten from your world will be some plant that will grow, for us. Then, when you reach us, it may be that you will find peach trees blooming in a different soil."

A glow appeared on Yanvro's face. "We will be waiting for you, for all men, when you come to us, as come you will, in time."

"Will we?" Something of the glow on Yanvro's face was appearing in Harmon's heart.

"You will, you will," Yanvro answered. "It is in the stars. And in the meantime, my friend, when I or any of my people come your way again, you will be one on whom we will call."

The glow in Harmon's heart burst into life. "Will I?"

"You will," Yanvro said, smiling.

A few minutes later, from the grove of trees, something went with a rush into the sky. Harmon waved and watched it vanish. Quietly he returned to the truck, drove back to town.

Across the street from his office, the tent was in tatters and shreds of torn canvas upon the ground, mute evidence of the fury that had been vented there.

Entering his office, he found Dr. Lapham and two other doctors whom he recognized as the disciplinary committee of the medical society. They rose. Lapham spoke.

"Harmon, I am bringing charges of malpractice against you, of using unproved and untested remedies, of meeting with charlatans and quacks, of risking the life of a patient, this child, Donna Culver. I am going to take action to have your license canceled."

From the wall, the license looked down at Harmon. "Just one moment." He went to the phone, called a number.

"She's wonderful, Dr. Harmon," Mrs. Culver's happy voice came over the phone. "She's eating, she doesn't have a temperature, she's—"

In the background, Harmon could hear childish shouts of glee, the laughing voice of a six-year-old girl, the excited yapping of a puppy. Very gently, he replaced the phone, turned to the three men.

With all the strength that he possessed, he hit Dr. Lapham in the nose, a smashing, blood-letting, crashing blow. Harmon felt the blow tingle through his whole body. Everywhere

he felt it, it felt good. He turned to the other two doctors.

"Gentlemen, I'm ready to answer your charges."

"Well struck, Harmon," the nearest one said, holding out his hand. "You saved me the job of doing it."

Harmon, staring, took the hand that was offered to him, saw that the other doctor was also holding out his hand, he took it. His eyes found the license on the wall. In that moment, the license seemed to fade away and he seemed to look into the glass and through it—into a burst of pink color, the seeds of transplanted Earth trees blooming on what had once been barren land.

Then the frame again held his license to practice medicine.

When the doctors had gone, Harmon went into his back office. He sat down and put his feet on his desk.

Exultation was in him, such exultation as he had never known. In time, strange visitors would knock on his back door in the dark of the night, to confer and slip silently away before the dawn. In time, riotous blooming of peach trees on another world. In time, healing—on Earth.

THE END

THE ANALYTICAL LABORATORY

In the March Brass Tacks we published a letter from Charles Leedham suggesting a new system of rating stories; several of the readers who voted for their choices in the March issue used that system, scoring stories on an all-time basis, rather than on a relative-to-this-issue basis.

I'm in full agreement that we do need a scoring system which would be based on a long-time relative basis, rather than the this-issue basis; the problem is to get enough of the readers to agree on it. Temporarily, at least, I'll have to continue to use the simple system of voting for relative standing of best, next best, et cetera, in the current issues—but I'd very much like to have those of you who will take the trouble to do so, rate stories also on the long-term basis, where rating a story 10 means you feel it's an all-time, long-term classic, 9 means an exceptionally fine story, and so on down to 0, meaning it should never have been published. On this basis, a story rating 8 should mean "a good story, and worthy of first place in any ordinary good issue of the magazine." Then in some exceptional issue, a story might rate 8, and still not be first, because of some 10-point classic.

If this were Heaven, of course, I'd print issues full of nothing but 10-point stories, and all authors would always write classics. Since it isn't, an 8-point story deserves a bonus; when reader letters indicate that the situation of a 10-point classic and an 8-point bonus-worthy story both appear in one issue—both stories will get a bonus.

But YOU have to tell me when that happens!

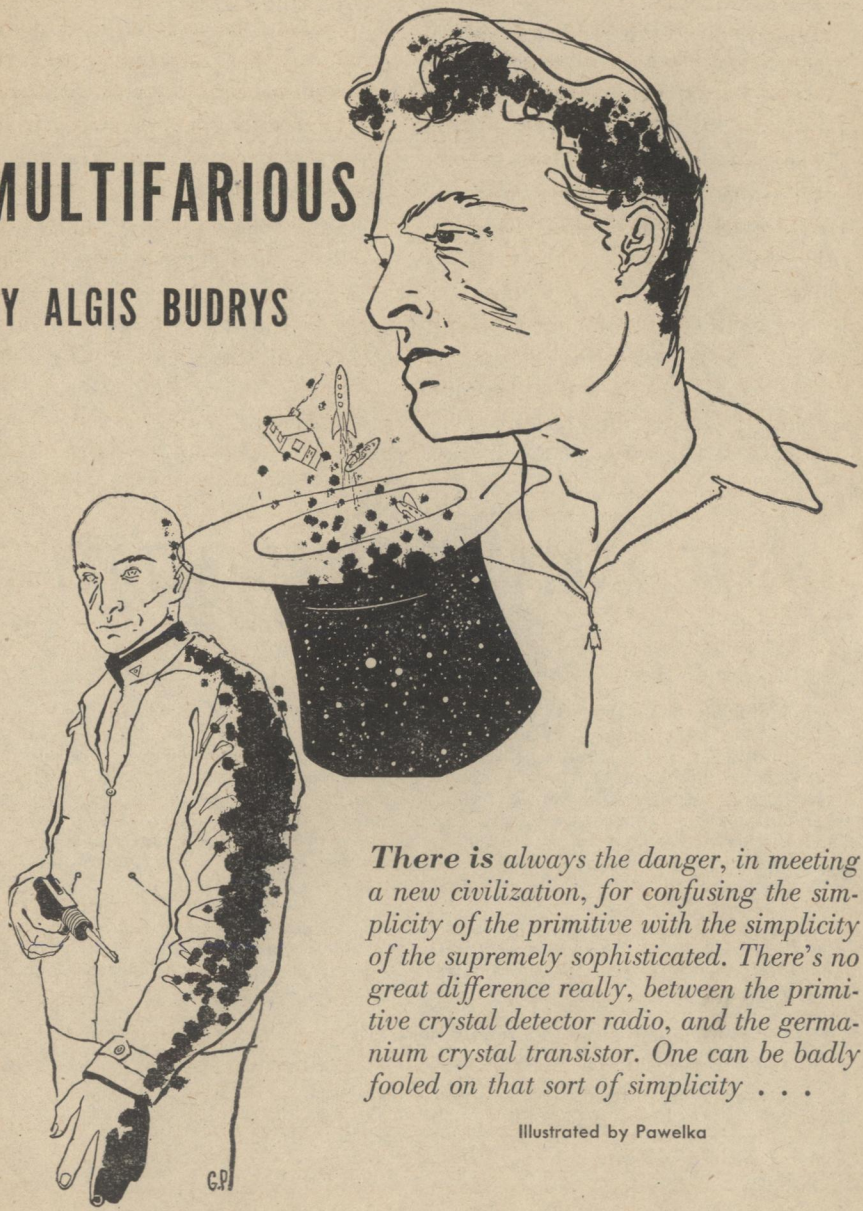
But for the February issue, the scores stood thusly:

PLACE	STORY	AUTHOR	POINTS
1.	Nightmare Brother	Alan E. Nourse	2.64
2.	Null ABC (Pt. 1)	H. Beam Piper & John J. McGuire	3.06
3.	Crucifixus Etiam	Walter M. Miller, Jr.	3.17
4.	For The Glory of Agon	Irving Cox, Jr.	3.23
5.	The Cog	Charles E. Fritch	3.88

THE EDITOR

MULTIFARIOUS

BY ALGIS BUDRYS



***There is** always the danger, in meeting a new civilization, for confusing the simplicity of the primitive with the simplicity of the supremely sophisticated. There's no great difference really, between the primitive crystal detector radio, and the germanium crystal transistor. One can be badly fooled on that sort of simplicity . . .*

Illustrated by Pawelka

There are certain stretches of southern New Jersey which, after the suction hoses and mucktreads of the cranberry picker have passed on, are rarely visited for the remainder of the year. It was into one of these bogs that Taj lowered his advanship, and it was at the brushy edge of a narrow path traversing such a bog that he encountered his first Earthman.

He had just scrambled up the bank with his collection pack and analyzer, and had started to part the bushes, when he heard a *ping!*, and a gentle voice said "Warning."

Taj spun back into the bog, hanging on to his equipment somehow, but going to his knees in the mud. Even while he was cursing his lack of foresight in not having kept his sidearm ready, the voice continued to speak.

"Warning. You are within the personal protection field of another individual. Kindly make yourself known to him." There was a rustling in the bushes, and Taj looked up to see an Earthman staring down at him.

"I'm damned," the Earthman said, scratching his thigh.

"I'm damned," Taj replied, suiting his form of address to the other's.

"Uh-uh, pal, you got that wrong. The usual form of greeting is 'Lo,' " the man answered. He scratched his thigh again. "You're not from Earth."

"No, I'm not," Taj said, inspecting the man, who was dressed in a set of extremely light coveralls, and wore a gracefully designed helmet.

"Hiking," the Earthman said. "Wouldn't be caught dead in more than my hat, ordinarily, but these mosquitoes aren't worth the trouble of maintaining a full strength field. Now come out of there. You look like you're praying to a cranberry bush."

Taj floundered out of the mud and climbed up the bank to the Earthman's side. "I am called Taj," he said, bringing his arm up from the elbow, palm outwards. The man shook his head.

"Name's Potter, Styles Potter," he said, extending his hand, the heel and little finger down, his fingers slightly curved, his thumb up. "That's how you say it, and this is what you do with your hand. Now take my hand firmly in yours."

"Name's Taj," Taj said, shaking Potter's hand. "Right?"

"Got a last name?"

"No."

"Right, then. How do you people tell one Taj from another?"

"We're all Taj. Aren't you all Styles Potter?"

Potter's lips pursed, and one of his eyebrows moved a bit. He hesitated before he answered. "No . . . not exactly, that is. We're all Styles, but we have different last names indicating our duties. Mine denotes a specialized ceramicist."

Taj considered this. "I've heard of that system. We ran across it on one or two worlds where different classes

still intermingle. Our own cadres of specialists are kept isolated, and one's as good at his field as another, so there's no point to it for us."

"I can see that." The Earthman's glance flickered over the bog. "Don't see your ship, though. Got it hidden?"

"That's right. SOP for contact work. Not much point to that now. Care to see it?"

"Sure do. Never seen a spaceship."

"Come on, then." Taj started back into the bog.

"Wait a minute while I turn this field up a little, will you? No sense getting any muddier," Potter said. He reached up and touched the side of his helmet. "O.K. Stick close to me. This dingus broadcasts a yielding sphere that'll flatten out enough to walk on, even on mud, as long as I deep the intensity relatively low."

"Sounds handy," Taj said.

"It is. You can turn it up for rain, too. Wind, anything. Even mosquitoes, but that way, of course, you cut out any breeze that might come along, and any smell it might be bringing with it. Hiking's no fun if you can't smell trees and bushes and stuff."

"You sound more like a naturalist than a ceramicist," Taj commented absently as he watched the shallow concavity in the mud that kept pace with their feet as they walked.

"Uh . . . yeah, I do, don't I? As a matter of fact, I sort of took a day off from the shop."

"Can't be a very stiff penalty, if you're willing to risk it on something as intrinsically purposeless as doing something outside your knowledge," Taj said curiously.

"It isn't—a day's pay doesn't amount to much in the pottery line."

"Pay?"

"Uh . . . in credits toward my retirement, of course." Taj noticed that the Earthman's expression had lost some of its self-possession during the last verbal exchange, but made no comment. His mind was racing as it assimilated the information Potter had unconsciously revealed in his speech and actions since they had met.

Item: For a world that showed no sign of spaceflight as one of its technological achievements, Earth had a remarkably advanced practical scientific culture.

Prime Evidence: Potter's helmet, which was obviously not unique, and which had been demonstrated to possess the following attributes:

(1) Protection for the wearer, in easily varied degrees.

(2) Automatic announcement of its wearer's presence, combined with a mild warning and an alarm to the wearer.

(3) An automatic translator—probably a vastly more compact version of the baSymbolic transpeaker—which allowed its wearer to enter into immediate verbal intercourse

with any chance foreigner, even one so foreign as Taj.

Syllogism One: Possession of this device will be of untold value to Taj. Potter has such a device. Therefore, it must be taken from him.

Syllogism Two: The value of this device, and of any further information regarding Terrestrial technology, together with any other samples of such technology, will be greatly enhanced if the Terrestrials remain unaware that they are in Taj hands. Potter has the two prime utile features of being both an excellent source of said information and samples, and of being the only Earthman as yet aware of Taj presence on this planet. Therefore, Potter must be questioned further, and then killed.

"Here we are," Taj said, stopping. "O.K. Pick yourself something solid to stand on. I'll soften up the field so you can open the air lock," Potter replied, touching the side of his helmet once more.

Inwardly exultant over the series of coincidences that had provided him with such an excellent contact at the very outset of his mission, Taj unlocked the entrance hatch. "I'm afraid you'll have to cut off your field to get in here," he said to Potter.

"That's O.K.—I'm not that scared of the world that I've got to be armored all the time," Potter said, dropping through the hatch. "It's more or less of a habit, anyway. The hats sort of take the place of clothes in the cities." He touched his coveralls. "These'll be enough."

Taj carefully pulled the bushes and mud-covered mats back over the hatch before he closed it, then switched on the lights.

"Sounds like you've got an interesting culture," he said. "Women wear those helmets, too?"

"Certainly."

"Well, fair's fair, I guess," Taj said, leering. Potter looked at him uncomprehendingly.

Taj recovered rapidly. "How come I can still understand you with the field off?" he asked, though the answer was obvious.

"I only cut the protection screen off—Man, you don't think I'd be without my *hat*, do you?" Potter looked genuinely startled.

"Of course not. Hadn't thought of it, that's all."

Item: From Potter's reaction, it would seem that the entire culture was built around the helmets. Analysis of the properties of these devices will probably enable us to collapse their civilization quite easily.

"Come on," Taj said. "I'll show you around."

"Good. I'd like that." Potter followed him into the engine compartment.

"That's the converter, over there," Taj said, pointing. "When we cut in or out of subspace, it channels the kinetic energy of our velocity into

the warp generator, and gives us the necessary power to accomplish the shift." He turned his head to see Potter's face, and was surprised to see the Earthman smile when he asked, "You're familiar with the concept of subspace, of course?"

"Oh . . . uh . . . yes, yes, of course."

Taj frowned. Once again, behind Potter's obvious confusion, he thought he noticed something quite different. That smile, too. That didn't belong. There seemed to be lot of inconsistencies in this avowed ceramicist-turned-holiday naturalist's character. Potter's next question served to becloud the issue even further.

"But, if you use your kinetic energy to shift from and to subspace, that would mean you'd have to build up velocity again every time you made the shift. Doesn't that take an awfully long time?"

If the question was meant to present a picture of a not unintelligent being who was nevertheless ignorant of the principles of spaceflight, then it served exactly that purpose. On the other hand, if it was a deliberate probe for information, then it was just as effective in that context. Taj decided to hedge.

"Inertialleviator," he said shortly.

"Oh," was Potter's answer.

Which covers a multitude of sins, Taj thought. Only the knowledge that he was in complete control of the situation as long as the helmet's field was off kept him from killing Potter immediately for caution's sake. He considered drawing his sidearm and operating on a captor-prisoner basis, but decided against that, too.

The strongest weapon is the opposition's failure to grasp the true situation, he remembered from his indoctrination. As long as he knew things about Potter that the Earthman didn't know he knew, the situation was still under his control.

In any case, it was entirely probable that Potter was just as naive as he pretended to be. Taj's nerves had played tricks on him before.

"Well, look, Taj—I'm no physicist. All I'll ever get out of looking at a spaceship's engines will be the satisfaction of normal curiosity. That, I've done. How about showing me the rest of the ship?" Potter said.

"Sure, Styles, sure. Follow me," Taj said, his spirits rising in triumphant relief at Potter's obvious inability to understand the drive's workings. With the dissolution of the uncertain mood he had experienced in the engine room, he led the Earthman confidently into the control cabin, and showed him the fairly simple instrument board without misgivings. He even permitted himself to smile over Potter's awe of the celestial globe which did most of the actual work of pilotage.

The Earthman peered into the tank, his eyebrows drawn together. "This thing actually a scale model of

the galaxy?" he asked.

Taj chuckled. "I'm afraid that would be a little beyond us," he said. "It's a model—but far from scale—of the sector of space we are capable of reaching. It shows all suns with worlds of practical value to us, though, of course, we couldn't, and don't have to, reproduce the planets themselves."

"I'd say that was good enough," Potter commented in an impressed tone.

After a few more minutes of staring into the tank, he turned back to Taj. "I guess that about wraps up the grand tour, doesn't it? Let's find a place to sit down and talk."

"Certainly. Come on into the living quarters," Taj said, and led him into his cabin.

They found seats, Taj carefully picking a chair where his arm would be free to draw his gun whenever he decided that Potter had given him enough information. Potter lounged back in a padded seat.

"Nice layout—but then, with the traveling you do, I guess comfort's one of your main concerns."

"Naturally."

"That's all you do, isn't it, Taj? Just go on one contact mission after another."

"All you do is work with ceramics. I think my line's more exciting, personally," Taj shrugged. He began to feel a certain impatience with Potter's conversational trend.

"What's your world like?" Taj asked, hoping that bluntness would work better than simple waiting for the Earthman to drop hints in the course of normal speech.

"Oh, about the same as yours, I guess," Potter said casually. "Say—I'm hungry. You don't mind if I eat while we're talking, do you?"

Taj restrained an impulse to put a hand on his gun butt and inform the Earthman of the true situation. For some reason, Potter was reaching up toward his helmet.

"Well, I'm not so sure you should try eating Taj food before we know more about the metabolic differences," Taj said hastily, realizing at the same time that his hand was hovering at his side, halfway down to his holster. He moved it quickly to his knee and shot a rapid glance at Potter's expression.

The Earthman displayed no sign of having noticed the awkward movement of his arm. Rather, he smiled. "That's the reason I'm not offering you any of mine," he said. "Don't worry—I could have myself a banquet, if I wanted to."

Taj did not even attempt to unravel the various allusions of this remark, for the Earthman had reached up and removed his helmet. He held it between his hands and looked inside it, then reached in and withdrew several sealed packages. He opened one, took out something completely

unrecognizable, and began to eat.

"Say, that's quite a trick," Taj said. "Looking at that helmet, you'd never know there was so much room inside it. That sure is one handy device."

"Sure is," Potter agreed, taking another bite of his sandwich. He ran a fingernail along one corner of a square box, flipped back a lid, and took a drink. "Don't know where we'd be without our hats."

Taj decided to take the bull by the horns. "Everybody has one, huh?"

"Everybody old enough to know how to use one properly, yeah." Potter said. "Whole culture's built around them."

"That so? You wouldn't mind telling me about it, would you? After all, I *am* supposed to be gathering information about you people."

"Sure. Glad to," Potter said. He leaned forward, the helmet resting on his lap.

"Look at it this way—what're the basic requirements for existence? Food—always, then shelter, in most climates, and clothing ditto. The easiest solution used to be that of building your house as close to the market place as possible, right? As your population grew, though, your market place had to get bigger and bigger, and you had less and less room for your house. You wound up living in a sort of heap, with your neighbor's nose over your shoulder, and the competition at the market place getting rougher and rougher.

"All right. Now, you could reach a temporary solution by finding new market places, or building them in likely spots. But the more market places you had, the more room there was for people, so, in a generation or two, there you were, right back with your neighbor's breath on your neck.

"So they tried something else. They spread the shelters all over the world, and started bringing in products directly from the source to your door. This meant transportation, and fast and cheap, too. Combined with improved methods of storage, so that you could lay in a big supply of necessities at one time, this worked pretty well, until the population grew again, to the point where your transportation media were clogging up every clear bit of traffic lane, and your neighbors were right back in your lap again, even if you lived in what used to be a desert area.

"About this time, your sources were feeling the strain, too. So, they tried spaceflight—oh yeah, we eventually touched every habitable spot in the solar system. The trouble there lay in your definition of 'habitable.' You can't do much in the way of a culture if it's confined to a pressure dome, and spends five dollars in maintenance and special equipment for every three it gets back in products from an aterrestrial environment.

"So, they were about to try inter-

stellar flight when some bright boy came up with a simpler solution. He figured out a way to get rid of two of the three basics—clothing and shelter—combined with a system of food distribution that cut the transportation problem down to a matter of supplying one central location, which, in turn, supplies every individual. In other words, the helmets.

"With all the old facilities that produced clothes and houses now abandoned, there's lots of room, time, and labor, for food production.

"Funny thing, too. When we junked our old transportation system, life became a lot more fun. It sort of slowed down, you might say, and we all got a chance to look at the scenery. Not just the countryside—all kinds of scenery. Art forms, philosophy—all the gentler pastimes. Once you didn't have to beat your neighbor off with a club, and then run like hell to get to the store before he did, you had a chance to relax and take a couple of deep breaths."

Taj considered this. Somewhere in Potter's description, his subconscious had spotted a flaw, but hadn't been able to resolve it into sufficient coherence to enable him to put his finger on it. He looked at Potter. Perhaps, if he launched into what would be an almost automatic description of his own culture, he'd think of it in the meantime.

"Sounds interesting," he said. "Our solution to the same problem was very different. Perhaps not as good as yours." He realized with a perceptible shock that he actually meant that.

Potter smiled. "I know. I figured that out within the first few minutes. Suppose I tell you?"

And how do you like *that?* Taj thought. I've been pumping him, but he knows enough to tell me about my own culture. "Go ahead," he said, unable to keep the disbelief out of his voice.

"O.K. In the first place, you landed your ship where it wouldn't have been spotted ninety-nine times out of a hundred. In the second place, you tried to hide from me. The obvious conclusion is that you wanted to know all you could about us, but didn't want us to get wise to you. That's a sign of a fiercely competitive attitude.

"Again, you're all named Taj. It's the same as if all of us were called 'Man.'" Potter smiled again. "I'm afraid I lied to you—that was when I first started putting two and two together. And, when you showed surprise that I'd taken a day off, that I was getting paid for my work, and that I was interested in and appreciative of something completely out of my supposed line, that clinched it. It became pretty evident that things are tough in your culture. There's no individuality, and all your efforts are confined to one narrow line of endeavor, which, when integrated with

the efforts of other extreme specialists, serves to promote the well-being of your culture.

"There's the difference—you work for your culture. We work for the individual.

"Well, after I'd put all that together, it became pretty easy to extrapolate. Obviously, you had the same problems we did, but you never discovered the helmets. So you took the faulty solution, which is really no solution. You just expanded your civilization to include numerous stars, thereby postponing the inevitable, but not obviating it.

"Tell me, Taj, what did you figure on doing after your interstellar empire outgrew your technology's ability to sustain it?"

"I don't know," Taj answered, half his mind still on the problem of the flaw in Potter's statements about the helmet culture. "I never thought about it."

"Of course not—it's out of your line. You were trained for just one thing—contact work. There's the difference between us as individuals. You've got a rigid set of rules which probably work very well, as long as you stick to your line. Even then, you're stuck if you have to operate on any basis except competition."

"I don't think that's true."

Potter smiled again. "Oh, no? You mean you weren't going to kill me for my helmet?"

"All right, Potter." Taj pointed his sidearm at the Earthman.

"Relax, Taj. You want it? Take it. In fact, we'll provide you with specifications, and you can manufacture your own. Say the word, and we'll broadcast them right to your home world."

Taj's gun wavered. "Why? What's in it for you?"

"See what I mean? No comprehension of a non-competitive attitude. Simple. You want to take over our planet. You couldn't do it, but that's beside the point. What isn't, though, is the fact that your culture is butting its head against a stone wall. It's painful to watch, so we're going to show you how to get around the wall."

"That's twice you've said 'we.' Meaning all Earthmen, I presume. Where do you get the right to speak for them?"

"Helmets are wonderful things, like I said. I've been in communication with our Population Vote center for the last two hours. A majority of Earthmen have already voted to give you the specifications."

"I don't believe you."

"Put the helmet on. Listen in." Potter tossed the helmet into the chair. "Go ahead. You can do it with one hand while you keep your gun on me."

Gingerly, Taj put the helmet on. He listened to the dry running count of the votes for a moment, then took the helmet off again.

"Two billion—!" he said in an

awed voice.

Potter nodded. "And mighty few against."

"I don't believe you."

"You said that before. You're right, though. I might be lying, and the count could be fudged. I'm not, and it isn't—lying's a competitive trait, but you'd have to break down all your conditioning before you could convince yourself of that."

At this moment, Taj finally got it. The gun steadied in his hand.

"*I* just put two and two together. Item: Your solution of the transportation problem. Item: Your reference to 'broadcasting' the helmet specifications to my home world. Add to that the manner in which you pulled your lunch out of your hat." He cursed. "You've got matter transmitters!"

"Right." Potter grinned. "Surprise, surprise. I let you figure that one out for yourself. *Now* do you realize we're making an honest offer?"

"I do *not*." His finger took up the tension on the stud.

"Man, I could have killed you in a particularly revolting manner, just a minute ago. If I were trying anything, I would have."

"That's a lie. You're weaponless."

"You were wearing my helmet," Potter said quietly.

"What about it?"

"I just ate lunch out of it, right?"

"So?"

"There's a definite cycle built into the operation of eating, isn't there? Particularly when you have containers to dispose of? The helmet's built to take care of it automatically. Some of the controls are manual. This one happens to be on voice."

"Which means?"

Potter picked up the wrappings from his lunch and tossed them into the helmet. "Garbage disposal," he said in a monotone.

Taj stared. The wrappings fell through the bottom of the helmet and disappeared.

"That could have been my head!"

"Exactly. Now do you trust us?"

"I don't know. I—How do I know you didn't let me live so you could find out where my home world is? Sure," he said desperately, "that's the answer!"

"Don't be stupid. It's marked in red in your celestial globe."

"I . . . I still don't know whether or not to believe you," Taj said, his mind, laboring on a completely unaccustomed track, wavering.

Potter stepped forward and took the gun out of his hand. "I don't expect you to. But your kids will," he said. "Come on—let's get out of this swamp. There's a car coming to pick us up." He smiled again.

"You can wear my helmet, if you'd like."

THE END

LADY WITH A PAST

***A world**—a whole civilization—was lost in the violence of war. And of course, it is necessarily a terrible thing to lose a whole civilization . . .*

Illustrated by Orban

BY IRVING E. COX, JR.

For a moment there was a shadow across the setting sun, a black shaft plunging toward the heart of the new forest. Peter Hallen sprang to the rail of his Watch House, waiting for the sound of the crash. Minutes passed and he heard nothing.

It was his last day of annual Service Duty, and he wanted no flash fires to mar his record. He jerked on his plastic emergency jacket. Beneath it he wore jodhpurs of the same material; his boots, too, were plastic, as light and pliable as silk and as tough as Marsmetal.

He ran down the stairway and sprang into his two-seated turbocar. In a spray of splattered gravel, he spun off the paved highway into the twisting, dirt road that led to the new forest.

The redwoods on both sides of the road towered tall and straight from an uncluttered floor of soft, black loam, each tree an equal distance from its neighbors. The new forest was a rectangle of a thousand acres which had been recently cut. The roots of the giants had been ripped out of the earth and rows of year-old saplings planted in the rich soil. Most of the work had been done during Hallen's period of Service Duty, and he was immensely proud of it.

He pulled his turbocar to a stop beside the clearing and ran up the steps of the emergency watchpost. Half a mile from the road he saw a thin plume of smoke rising toward the dusk-red sky, but whatever it was had nearly burned itself out. None the less, it was necessary to extinguish any smoldering debris that might still lie on the earth.

Slipping two of the chemical bombs into his pocket, Hallen moved off through the saplings toward the dying ribbon of smoke. He was a large man, chunkily built, with a suggestion of primitive savagery in his walk and in the flat, massive bones of his face. His hair was black and thick, lying tightly curled against his skull; yet, in spite of the impression that he gave of untamed brute strength, his slanting blue eyes were alert and intelligent, his hands almost poetically delicate.

Since he did not have sufficient data, he made no attempt to guess what had fallen in the forest. It could have been a Stratocargo robot, an Asia Transport, or one of the Venusian pioneer expedition rockets. If so, it

was a unique disaster. Hallen was twenty-five years old and, in his lifetime, he had never heard of the crash of any aircraft. The last disaster had been a century before, when a robot carrier had fallen in Tibet; but it had been an old model not equipped with the safety automatics.

It was dark when Hallen reached the site of the fire. The smoke was gone, the ground already cool. A score of saplings was crushed and burned in an ovoid pattern, which surrounded a long, shallow depression in the earth. It was coated with a gray-green film, like the waste dust that periodically choked the exhaust vents of the city power plants.

The only ready explanation that occurred to him was that a meteorite had fallen. As a precautionary measure, he broke two bombs over the waste and jumped back as the thick, white cloud spread over the ground. Behind him he heard a labored gasp, and a sharp crack as a young sapling was broken at the roots.

Angry at such heedless desecration of young trees, he ran toward the sound. He caught a glimpse of a crude, robelike costume as a muffled figure fled from him. He followed easily. In a small turn-around clearing beside the road, Hallen came face to face with the stranger. For a split second he glared at Hallen, beady eyes blazing with terror in a small, white face. Then, ludicrously, he launched himself in the air, springing upward as if he wore wings.

Screaming, his body twisting violently, the stranger followed the proscribed laws of physics. His head hit the ground and he lay moaning painfully. It was only when Hallen bent over him and pulled back the hood of the robe that he discovered the stranger was a woman. She was very small and beautiful, her skin so white it seemed transparent.

"I forgot about the gravity," she whispered.

"You mean you actually expected to fly?" He bent to examine the bruise on her forehead. She pulled away, screaming again as he picked her up and carried her to his turbocar.

"I've a wound kit at the Watch House," he assured her. "I'll have that bruise—".

"No! Please, leave me here!" She fingered the edge of his car, and glanced up at the overhang of rocks above the road. "But your car's blue, and—"

"Obviously."

". . . And this is the right place!" Very slowly she asked, "Is the weather fine?"

"For all it matters right now, it might snow before morning."

"Snow before morning! That's it. Everything's right, after all." She held out her hand. "My name is Diane Landers."

After a moment he gathered that her odd gesture was a form of greeting.

He extended his hand, too, since she seemed to expect it. She grasped his fingers briefly and shook them.

"I'm Pete Hallen," he said. "On Forest Duty in this sector."

"That gave you a convenient excuse, didn't it?" Her voice was abruptly calm. "You won't need to take me to the city for nine or ten hours, Mr. Hallen. The transmissions won't begin until dawn."

He laughed. "Now, that's right considerate of you, Miss Landers, since I have no intention of leaving until my replacement comes. If you don't mind, answer one question for me: What are you doing here?"

Her eyes widened. "Why, I came here to meet you."

"You don't know me!"

"Of course not. Why should I?"

It was at that point that he began to wonder if she were sane. He slid behind the wheel and turned the switch; the turbine began to hum quietly. The woman studied the complex controls with a curiously frightened expression.

"Your surface-car, Mr. Hallen — what kind of power does it use?"

"It's no different from any of the others. Regulation steam turbine drive; atom-pile unit, renewable every six months."

"You built it yourself?"

"I did a tour in a Fab Plant, if that's what you mean."

"It seems—strange. There was nothing in the prognosis about machines."

"Prognosis?"

"But of course the overall picture remains the same." She settled deep against the cushions, twisting her hands together in her lap. For a long time she studied the pattern of redwoods that lined the road. "It's not what I expected," she said at last. "The forest should be tangled with shrubs and dead branches."

"You're thinking of the game preserves farther up in the Sierras. This is part of the International Tree Plantation."

"Oh."

She seemed puzzled, so he added, by way of explanation, "You know, the forest land we restored as a conservation measure. Now we're cutting for export and reforesting as we go."

"It . . . it's wrong!" Her quiet whisper was tense with fear. When he tried to talk to her again, she ignored him. She said nothing until the little car ground to a stop before Hallen's Watch House. She looked up appraisingly at the thick, log walls; what she saw seemed to satisfy her.

"Typical primitive," she decided.

"My cabin? Now that is something I built for myself. From start to finish in less than—"

She grasped his hand impulsively. "You poor man!" Then, brightening, she added, "But everything's going to be better shortly. I promise you that."

She walked up the long flight of

steps ahead of him, but before she came to the top she fell against the porch railing, gasping for breath. He reached out to catch her. As his arm encircled her waist he felt, instead of the pliant curves of a woman's body, a band of ridged metal bars concealed beneath her robe. Frantically she jerked away from him.

"Don't touch me!"

He shrugged noncommittally and went into the cabin, the autolights blazing up as he passed through the door. Certainly she was mad, a fugitive from the isolation sanitarium in the forest. When he saw her in the light, Hallen fully expected to find the tiny "I" tattooed on the lobe of her ear. It was the mark of the incurably insane, legally barring them from marriage. Hallen felt a slight twinge of regret, for he had found Diane Landers attractive, in her fragile way. And he had already decided he liked her.

He was, therefore, agreeably surprised to see that her lobe was clean. She was as sound of mind as he was himself. She leaned against the door jamb staring at him, while a wave of pity welled into her face. "Well—it's almost over."

He backed away from her. "Now, wait a minute! Let's start getting a few things straight. Nothing you've said makes sense. I don't know who you are, or what you're doing in the Plantation. I saw a meteorite fall in the new forest, and when I—"

"Only a meteorite?" Her eyes widened in terror. "But your surface-car is blue and you were on the road at the exact spot where—" She gasped. "Mr. Hallen, are you a Linkist?"

He began to laugh. The Linkists were an exotic splinter sect, amusingly harmless. In their badly printed tracts they were alternately threatening to overthrow world civilization and loudly lamenting their imagined persecution as an unprotected minority. Vaguely Hallen knew the Linkists pretended to believe the legend about the great ones who had fled during the Suicide War; the Linkists confidently expected, one day, to find their survivors.

"So that's what you're afraid of," he said. "No, Miss Landers, I'm just as normal as you are." He took a transparent capsule out of a wall wound kit and broke it in his palm, applying the cool gelatine to the bruise on her forehead. "We both seem to have gotten off to a side-rocket start. I took you for one kind of an idiot, and you took me for another. You're from the lodge, aren't you?"

"Lodge?"

"The hotel up on the lake. People are always wandering off to look at the trees, and getting lost. No point going back now. I'll drive you over in the morning, on my way back to the city. This is my last night of Service Duty."

"Mr. Hallen, I—"

"Call me Pete."

"But I don't know you!"

"You will," he grinned.

"I must go, Mr. Hallen . . . Pete." Her voice had the patient, patronizing tone of a mother addressing a little boy. "Thanks for all you've done, but you . . . you just wouldn't understand."

"Understand what?"

"Pete, I've made a mistake. When I saw the kind of a machine you drove, and the way the trees were planted, I began to wonder if the prognosis was wrong." Tears gleamed in her eyes, "I said you wouldn't understand, Pete."

Suddenly the folds of her robe shifted and he saw a weapon gleaming in her hand. It was a primitive gun, a museum piece three or four centuries old. Hallen was shocked; to bear arms was on a social level with refusing to perform a Service Duty. Once again his eyes searched the lobe of her ear for the telltale brand.

"Stay where you are, Pete." She backed toward the door.

"Diane! You can't leave here carrying that thing. Give it to me and I'll get rid of it for you." He moved toward her; she raised the gun. He did not believe she would pull the trigger until the explosion echoed through the cabin and the sudden, flaming pain stabbed into the flesh of his arm.

In the nightmare of dizziness, he staggered and fell. He heard her feet on the steps, and the hum of his turbo car as she drove it toward the highway. As the undulating blackness moved around him, he had the presence of mind to reach for one of the gelatine capsules and break it over the wound in his arm.

The relief from pain was immediate and in less than a minute his head had cleared. He examined the wound critically. The bullet had broken cleanly through the flesh, burying itself in the cabin wall. Hallen worked a synthacell strip into the wound, sealing it with another gelatine capsule.

Then he went about the business of winding up his tour of Duty in the Forest Service. He set the automatic fire control on his sector of the Plantation and completed the recapitulation of statistics on the cutting and planting which had been done under his supervision. Only after he had pulled off his plastic jodhpurs and relaxed on the bed did he begin to consider the problem of Diane.

Immediate pursuit did not occur to him. It was his job to stay on duty in the Watch House until his replacement arrived. If a situation seemed to him to be an emergency, he could have suspended his allegiance to duty. But his brief encounter with Diane had given him no data for such a conclusion. For the same reason, he did not send in a general alarm.

Now, he considered the facts that he had about her. Certainly her behavior was unusual; he could not ap-

ply a more specific adjective.

Yet she was sane, since the lobe of her ear was unmarked. For more than a century, the Medical Service had been able to identify the incurables and withdraw them from society before they reached the age of five. Generation by generation, the number had diminished to the vanishing point. Out of a world population of more than three billion, only a fraction of one per cent was still isolated in the institutions. After half a millennium, the effect of the radiation unleased during the Suicide War had been very nearly wiped out.

Then, since Diane had a rational mind, the nonsense she talked must have made sense. On the surface, that seemed absurd. She carried a gun: quite seriously she assumed that he was a Linkist; and she resorted to both emotion and violence to solve a problem.

Hallen picked over the details of their conversation. It was not a difficult thing for him to do. His mind was uncluttered with warring emotion or insatiable frustration. Nurtured by the precision of a psycho-mathematical society, his memory functioned with the unbiased exactness of a mechanical calculator.

When he first saw Diane, she had literally tried to leap off the surface of the earth; she had said she forgot about gravity. Such a comment suggested that she was physically acclimated to conditions of space flight and temporarily unadjusted to planetary gravity. Her breathlessness after climbing the Watch House steps argued the same hypothesis.

It was possible, Hallen supposed. For two centuries ships from Earth had explored both Mars and Venus. Millions of tons of rich, Venusian soil had been brought back to restore the deserts burned into the earth during the Suicide War. Ore from Mars built the city power plants, the continental networks of distro-tubes, the rocket jackets for the Stratocargo robots. If Diane had been among the personnel of a Venusian expedition, the meteorite Hallen had seen had been a space rocket. But, if such a ship had destroyed itself, how could Diane have survived alone?

At last Hallen's hypothesis made sense.

He sprang up, clenching his fists, angry because he had made no attempt to stop her. He had allowed her to plunge blindly into chaos!

He remembered her reaction when she first saw his turbocar. She had mistaken him for someone else who had obviously intended to meet her in the new forest. Of course it would be a Linkist. She would have returned to the new forest road, now, to wait for the right man. If Hallen could find her first, he could still save her.

He jerked on his jodhpurs and boots and ran down the Watch House steps. It was a moonless night, but

Hallen knew the forest well enough to take a short cut through the redwoods. He was whistling tunelessly and, after a moment, he recognized it as the folk-melody of "The Ballad of Alamagordo," with its vicious refrain,

For man, we made atomic fire to break the mists of space.
He scorned our words and used our strength to kill the human race.
And so we leave your shattered cities, torn and stark with pain.
Destroy yourselves! But save this hope: someday we come again.

It was a long, rambling epic, preserved in several variants in the national gallery. Considered one of the more typical relics of the Transition, it was reprinted in all the anthologies; generations of students were forced to wade through the complexities of the archaic language.

The ballad also symbolized the legend of the Linkists. For the first time, Hallen got the point.

As he emerged from a ravine beside the new forest road, he saw his turbocar in the shadows beneath the overhang of rock; a second car had just pulled to a stop beside it.

Hallen ran frantically toward them. Diane saw him and screamed. In her haste to climb into the second car, she caught her robe. As it jerked free from her shoulders, the band of metal cylinders bound to her waist was ripped loose, spilling over the gravel.

She scrambled to retrieve them, while the man who had come to meet her fired one of the ancient weapons at Hallen. The bullets spattered the road and Hallen was forced to take cover in the ditch. A second later, Diane sprang into the second turbocar and it roared away in the darkness. Hallen ran to his own car, intending to follow, but he found that Diane had smashed the fuel tube. The repairs could be easily made, but they were time consuming. As he slid beneath the turbine unit, he saw one of Diane's cylinders lying under the car.

He examined it carefully. Eight inches long, it was made of crudely machined iron. At one end was a square, grid-protected disk, a receptor of a relatively primitive design, built to receive and amplify microwave impulses transmitted over a vast distance.

"The transmissions won't begin until dawn," she had said.

Hallen, then, had until dawn to save her.

It took him more than an hour to repair the fuel tube. Afterward he drove back to the Watch House long enough to alert the Central Watch Station for emergency relief. In any case, his tour of Service Duty would end when his regular replacement came in the morning. He changed into the brief, skin-tight leisure clothes which he would wear for the next six months until his turn came again for another half year's Service Duty.

Hallen drove out of the Tree Plantation and took the broad highway to the city. Surfaced with a gray alloy made from Martian metals, the road glowed softly in the darkness. On both sides of it were the curving roofs of the distro-tubes, which lay on the continent like a network of giant, metal tentacles. Through the complex inner coils, the tubes distributed raw materials and fabricated goods to the consuming-producing units with a speed approximating that of sound. As a result, manufacturing centers were small and widely scattered. A man could perform any choice of Service Duties in his own community, and sometimes within his own home.

No metropolis, therefore, existed; but the old names carried over. The sixty comfortable villages clustered around the bay were always referred to as "the city" and there was no other close union of towns quite like it on the face of the earth. Built on the sites of San Francisco, Berkeley and Oakland, the sixty shared a common name, Moreville; for it was there that the new civilization had begun, and Moreville still served as the symbolic world capital.

What centralized government there was met irregularly in Moreville. Logically the aggregate of towns had been Diane's destination. She could not have visualized or conceived the integrated civilization sprawling over every continent. In a sense, she was unable to see man for the trees.

Although each of the sixty villages was small, Hallen had no illusion that it would be easy to locate her. And it was four hours before dawn when his turbocar rolled into the bayside town where he lived. Like all the others, it was a clean, self-sufficient, machine-serviced community of rambling dormitories and individual dwellings. The heart of the village always was the recreation building, flanked on one side by the community eating hall and on the other by the stately towers of the learning center.

The Linkist strength, such as it was, was concentrated in Moreville. They would take any means to conceal Diane, Hallen knew, for she could prove their case. That doing so might destroy her own personality would never occur to them. Afterwards, when they saw what happened, they would be sorry and ashamed; but contrition did nothing to restore an individual.

Hallen had an elderly great aunt who had recently taken up Linkism, since her sight was too poor for reading and her body too age-fragile for any other form of recreation. After five minutes of pounding on her door, he aroused her and forced his way into her room.

"Pete!" she cried in alarm. "You shouldn't be home tonight! Your tour isn't over until morning!"

"Emergency, Aunt May. I want to know where the Linkists meet."

"Why? So you can bring your

friends to laugh at us?"

"We're not playing games tonight. I'm Pete Hallen, remember? I've known you all my life; I know your mind's as logical as mine."

"Very well, Pete; so it's just a game." She squared her thin shoulders angrily. "It happens that I like Linkism."

"The Linkists think they'll contact the others sometime, isn't that it? Those deserters who ran away when—"

"Not deserters. They were the greatest minds in the world."

"Perhaps — more than five hundred years ago. What happens, Aunt May, if there are any survivors?"

"That's purely theoretical, Pete. You know as well as I do—"

"Survivors from an isolated community, inbred for generations, separated from their own species for half a thousand years?"

"Pete!"

"No, it isn't quite that bad, Aunt May. Biological evolution moves more slowly."

"But I just remembered! One of the men up in Village Forty-three, on the north shore, is supposed to have made

some sort of microwave contact with them. Months ago. I haven't heard him tell it himself, but there are all sorts of rumors."

"He succeeded, Aunt May. He's brought one of them here. A woman whose concept of our world was built on data from the Suicide War period. In point of time, a universe stands between us. When she has to face that, her whole logical integration will be threatened. I have until dawn to find her."

"You're sure? There actually is a woman here from . . . from wherever it is?"

"Diane Landers. She landed in the Plantation."

"Why dawn, Pete?"

"She brought some sort of a primitive receptor with her. I suppose it is meant to subjugate us, somehow; to make us harmless so the others can come back safely."

"And when it doesn't . . . oh, the poor child!" Aunt May pulled a soft, fur-lined cloak around her shoulders and pushed her feet into brightly colored plastic boots. "When the Linkists have a general meeting," she explained, "it's in an old Fab shop on the other side of the bay. He's taken her there, of course. I'm going with you, Pete. She may adjust more easily if a woman talks to her."

Bridges spanned the bay at nearly the same places where they had previous to the Suicide War, or so Hallen's teacher in Cultural Archeology had once assured him. But the structures were very different; each was a single span of unsupported metal, built in a graceful curve close to the water.

In his blue turbocar, Hallen and his Aunt May crossed to the point of the peninsula, known locally as the San Francisco Landing. Left a naked, sterile desert after the Suicide War, the point had been converted into one of the five world spaceports. Beyond the vast area dominated by the gigantic launching frames was a fringe of low-roofed fabrication shops.

Hallen left his turbocar beside the field. As he followed his aunt toward the row of shops, the first gray light of dawn washed over the night sky. Silhouetted against the bank of clouds was the sharp nose of a Venusian rocket, lying in the skeletal launching frame while humming, robot-brained machines pumped activated fuel into the power tubes. Stacks of supplies piled on the field indicated that the expedition would blast within three or four hours, but at the moment the port was deserted.

That there were no men on the field was a customary condition, entirely normal. To have found guards protecting the heaps of equipment would have struck Hallen as fantastic. Equally improbable was the idea that men might have had to work through the night to have the rocket ready for a morning launching. Machines were the routinists, the labor slaves; not

the men who made them.

Aunt May led Hallen more than half a mile across the metal-surfaced field to a fabrication shop where the autolights glowed dimly behind sheltered windows. Since the lights were on, someone was obviously inside; yet, as they opened the door, they heard no sound.

In the entry hall there was a litter of torn, red cardboard on the floor. Aunt May pieced two of the fragments together. She looked up at Hallen, an uncomfortable frown on her face.

"Membership cards," she said. "Some of the Linkists have been here, Pete."

"And they're gone now?"

"Furthermore, they've thrown their cards away. It's happened, Pete—the way you thought it might. They're ashamed of what they've done to her, and they're trying to run away!"

She hurried through the inner door into the shop. Hallen followed. An elderly man lay on the floor beside an overturned lathe. His hand was clenched on a bleeding wound in his side, and his lips were working in soundless, helpless torment.

"It's the man from Village Forty-three." Aunt May bent over him, lifting his head. Hallen found an emergency wound kit, and broke a gelatine capsule in the wound. The old man smiled gratefully.

"I couldn't make it myself," he whispered.

Methodically Hallen worked a synthacell strip into the wound as the bleeding stopped. "What happened?" he demanded.

The old man sat up. The pain drained slowly from his face. "You're the Forest Service man I shot at, aren't you?" he asked. "Sorry; she gave me the thing and told me to use it. I was a fool."

"We all were," Aunt May put in. She fumbled in the pocket of her cloak and took out a red card, tearing it grimly into shreds.

"It's odd," the old man said. "All the others did exactly that. We enjoyed being Linkists, until we found out we were right."

"Where's the girl now?" Hallen asked.

"Diane Landers? I don't know. At first she thought we were savages. When I drove her through the city, she asked all sorts of questions about it—about us. I couldn't understand her reactions. She seemed surprised and pleased, and frightened at the same time."

"What happened after you brought her here?"

"The sight of the Landing bewildered her."

"But she accepted it—the idea that we're exploring the planets?"

"She kept saying repeatedly that she couldn't go through with it. So much fuss seemed just plain nonsense to me. All I wanted her to do was prove our point for us. We were right, after all; the others have survived!

There actually is an existing link with the past. I called the key Linkists as soon as Miss Landers and I reached the shop. But she wouldn't talk to them about herself. She asked all sorts of questions about the spaceport, and the Venusian rocket on the field. And she kept clutching those childish receptors she had brought with her, and telling us what a wonderful world we had made out of the wreckage."

Hallen gnawed thoughtfully on his lower lip. "But if she adjusted to the idea that her original premise was wrong—"

"Suddenly she began screaming at us; she had a foolish notion she was doing us harm. We tried to reason with her, but she simply didn't understand logic in a separate context from emotion. She wanted to leave. When she threatened us with her gun, there was pandemonium. Everyone began to run away. I tried to calm her down, because I'm more responsible than anyone else for her being here. I made contact with them six months ago, and I arranged for her mission. In the confusion she shot me, but I'm very sure—"

"The Venusian rocket!" Hallen broke in. "Her thinking is logical; it always was. She's simply the go-between. She has no idea what her receptors will do, and she doesn't want to harm us!"

He ran out of the shop and stood, for a moment, looking out over the spacefield. The sky was brighter, streaked with glowing orange. Dawn was her deadline, and she was still driven blindly by her own frame of reference. Hallen saw her, lurching half-crouched toward the open port of the rocket.

He caught up with her quickly. She was still fighting her inability to move easily in Earth's field of gravity. It had taken her more than an hour to negotiate the half mile across the field from the shop to the rocket. When she turned to face Hallen at the foot of the rocket ramp, she was gasping hysterically for breath and her face was drawn with exhaustion.

"No, Pete!" she cried hoarsely. "Let me go!"

As she fumbled for her gun, his arms encircled her, pinning her hands to her sides. She struggled weakly.

"Pete, I have to get away before the transmission begins!"

He reached beneath her robe and jerked away the band of metal cylinders. "These things are harmless, Diane."

"No, they're not, Pete! They were built to destroy you!"

"How?"

"The Director told me to put them at different places in your city and—"

"But there are millions of villages like ours. How could you destroy them all with a handful of gadgets?"

"We didn't know that, Pete; the only city we could observe was this one." She glanced up at the brighten-

ing sky. "But it doesn't matter how they work, Pete. For centuries we've waited for a chance to come back and rule Earth."

"Why so long?"

"It took all our manpower at first to build Magordo and keep it functioning; generations spent just keeping alive. It wasn't until twenty years ago that we were organized enough to begin experimenting with space flight again."

"Just what do you think these receptors will do?"

"Oh, I don't know, Pete! We're wasting time! Let me—"

"What happens if you leave one cylinder behind?"

She glanced down at the receptors scattered at their feet. "One would do as much damage as— But one is missing, Pete!"

"You left it on the road in the new forest. You can't get that back, so there's no point in running away with the rest, is there?"

Slowly she slid down out of his arms, falling against the railing of the ramp. He sat beside her, holding her trembling hands in his.

"I examined that receptor, Diane. It's nothing. It could have been dangerous, I suppose, to your conception of our society; but not to ours."

Quietly she began to cry. "I'm like a virus, Pete. They sent me to smash up your world; and now I'm helpless to prevent it. Of course that's why the Director ordered me to destroy my ship as soon as I landed—so I couldn't get away. We always thought that Magordo alone had preserved the culture of man. The others who survived the Suicide War were nothing but savages. We could return and wipe you out or enslave you with no more compunction than we feel toward our own Expendables."

"Expendables?"

"Our labor bands; the feebleminded, the morons, the criminals. They take the place of machines on Magordo."

"What's a crimnal?"

"A lawbreaker."

"But who could break a law? It's an independent statement of fact which is always true. If you could break it, you would have a new truth; the law would never have been valid. Why should you punish a man for—"

"You're talking about a scientific law, Pete."

"Is there any other?"

"I meant disobedience. If one of us doesn't obey an order from the Director, if we're undisciplined—"

"Another man literally tells you what to do? Then how can any of you develop integrated personalities as individuals?"

She pulled her hand away and stood up, frowning introspectively. "Maybe we don't, Pete; I never understood that before." She gestured toward the villages gleaming on the distant bayshore in the golden light of the rising sun. "How did it happen, Pete?"

"Our world, the way it is? Men can learn from old mistakes, you know. Not everyone was wiped out in the Suicide War. Most of the people in Africa and Australia survived; and there were probably ten million scattered throughout Asia, with another million here. But the planet was wrecked and we had to rebuild it or no one could have lived; and we had to work together to do it. Once we got the habit, it was easy. We've been working together ever since."

The light of the sun touched the field. As it did, the six receptors emitted a piercing, discordant scream, followed by throbbing drum beats. Hallen listened calmly. Diane held her hands over her ears, her eyes glazing with terror. After a time the din diminished and a resonant voice came from the grid.

"We are the invisible power, living unseen in the sky above. Bow down, you men of Earth, and worship us! Soon we shall come among you, and those who are true in their worship shall have nothing to fear. The rest we shall grind into dust with the fire of our wrath. Bow down, Earthmen, and worship us!"

The exhortation continued repetitively. Laughing, Hallen threw the cylinders far across the field, and greater distance made the voice relatively quiet.

"Imagine a voice like that speaking out of nowhere in a village of primitives," he said to Diane. "Highly effective—if the prognosis of your psychologists had happened to be right."

"But how could we have been mistaken?" Her voice was choked and stifled. "What happened in the beginning, Pete?"

"There's a charming legend in our children's books. On the day the old cities were smashed in the Suicide War, a young teacher—one of the few survivors—was walking dazed and half-mad through the rubble. He was carrying a book, the only whole thing he could find. He looked at the waste and he repeated over and over, 'Two and two make four; two and two always make four. Didn't they know that?' Suddenly someone took his hand. She was a cook from one of the university living houses. 'Yassah, boss,' she said, 'it sure do. Only trouble is, you ain't never tol' us what four means.' He looked up at her and smiled. In spite of the flaming ruins, he felt confidence while he held her hand. 'Next time we will,' he said; 'next time we will.'"

After a silence, Diane asked, "And that's all?"

"That's all. He was a teacher of mathematics, and that's the way his mind worked—in terms of number logic. He and the woman became the leaders during the first generation afterward. They created the whole pattern of our civilization for us."

"What was the book he found, Pete?"

"'Utopia,' by Sir Thomas More. Moreville's named after him."

"I've read it; we have it on microfilm in Magordo." Abruptly she drew her pistol and plunged awkwardly to the top of the rocket ramp. She stood panting at the open port. "Stay where you are, Pete. I know what I'm doing."

"But you don't need to run away, Diane! You saw what happened. The cylinders are harmless."

"But I'm not. I'm the virus of the past. If any of us comes home, we'll bring the old ideas with us."

"And are we so instable that it would overthrow us?"

"All of you, no; a few, yes. In time, that few would multiply into a multitude."

He moved tentatively up the ramp, but she leveled her pistol deliberately.

"I'm going back to Magordo, Pete. I'll make sure none of us ever tries to come home again. In two or three generations, it won't matter. We'll all be feeble-minded Expendables by that time, and as harmless as a cage full of apes."

"Diane, you're thinking with your emotions, not your mind. You're men in Magordo, just as we are. You belong here."

"We're deserters; we ran away when the going got tough."

"All that's over and forgotten. Your people reacted normally in terms of the thinking of their day."

"Answer a question for me, Pete; answer it honestly! Would you have been different if the mathematics teacher had found a different kind of book? Something by Clausewitz, for instance?"

"Conceivably, but the book wasn't everything. It's men that made our world, Diane, not words."

"We're something worse than a book, Pete. We're a virus, a contagion." She gestured toward her gun. "Like this; a weapon is the symbol of our ways."

"You can learn ours, Diane. Do you think we're unarmed because we don't know the techniques? We use all sorts of weapons when we vacation in the hunting preserves; most of us are expert marksmen. And if your virus could change us, why am I unarmed now? I knew you had a gun. Why didn't I bring one of my own, to defend myself? We simply don't live on that emotional level of action, Diane! Can't you see it? We solve our problems differently."

For a moment she hesitated; her pistol wavered. Then her shoulders stiffened and she plunged into the rocket. Before he could follow her, the port slid shut and he was forced to leap back to avoid the backwash of flame from the rocket tubes.

He looked up a moment later and watched the thin line of black dart across the face of the rising sun. To the end, she had retained her own internal integrity, true to the ancient

confusion of emotion and logic which had once wrecked the world.

He knew that if he acted quickly enough, he could use the spacefield monitors to trace the rocket and locate her destination among the stars. Instead, he turned away deliberately. Diane had sacrificed herself to an idea that seemed entirely valid to her; he had no moral right to intervene by force, if the persuasion of his argument had failed.

And he realized, suddenly, that the future could survive only when the past was dead. Hallen's world and Diane's were mutual contradictions; neither could compromise or communicate with the other.

He waved toward the morning sky in solemn salute, feeling somehow proud of Diane's transparent childishness, her foolish and unnecessary courage. But chiefly he was proud of her consistency of self. His world had no reason to be ashamed of hers, which had germinated it.

THE END

PI EQUALS ANYTHING BUT 3.14159...

Pi is the ratio of the circumference to the diameter of a circle.

Pi, however, is a transcendental number — the ratio cannot be expressed exactly in any system of units.

But pi is a concept of Euclidean geometry, and applies only to plane circles and straight-line diameters. In the more general case of a curved surface, pi can have *any* value less than pi. For a nonuniformly curved space, the ratio could have any value less than pi; in spherical space, anything between 2.000 and pi.

But — our real space is curved.

Therefore, whatever the real value of pi in our real space is, it is both variable and less than Euclidean pi! What, then, is the value of pi appropriate in the intensely distorted space of an atomic nucleus? Or at the surface of a white-dwarf star?

OPERATING INSTRUCTIONS

BY ROBERT SHECKLEY

Wild talents *aren't much use ordinarily—but if just possibly, the talent could be made to work in the critical business of getting a just-barely-capable rocket off, the chance might pay off . . .*

Illustrated by Schecterson

Since this was such an important moment, Captain Powell walked into the Main Room with a light, inconsequential air. He thought fleetingly of whistling, but decided against it. Spacemen were adept at smelling out little inconsistencies.

"Hi," he said, dropping into a padded chair. Danton, the navigator, yawned elaborately and nodded. Arriglio, the power engineer, glanced at his watch.

"We still blasting on schedule, Sam?"

"Sure," Powell said. "Two hours." Both men nodded, as though flights to Mars were an everyday occurrence. Powell paused, then said in an offhand manner, "We're adding another crew member."

"What for?" Danton asked at once, suspicion in every plane of his tanned face. Arriglio's mouth tightened ominously.

"Last minute order from Command Three," Powell said casually. The two men didn't move; but they seemed to come physically closer. Powell wondered what made spacemen so clannish.

"What's this job going to be?" Arriglio asked. He was small and dark, with close-fitting, curly black hair and sharp teeth. He looked like an unusually intelligent wire-haired terrier; one prepared to bark at a strange dog even before seeing him.

"You boys know about the psi's, don't you?" Powell asked, with seeming inconsistency.

"Sure," Arriglio answered promptly. "Those crazy guys."

"No, they're not crazy," Danton said, his broad face thoughtful.

"I suppose you know," Powell said, "that a man named Waverley has been organizing the psi's, trying to find jobs for them. He's got telepaths, lightning calculators, all sorts of things."

"I read it in the papers," Danton said. He raised a thick blond eyebrow. "That's the extrasensory stuff, isn't it?"

"That's right. Well, Waverley has been taking these psi's out of the sideshows and placing them in regular work. He feels that there's a place for their talents."

"So our extra crew member is a psi?" Danton said.

"That's right," Powell said, observing the two men carefully. Spacemen were funny ducks. Many of them adjusted to their lonely, dangerous work by adopting an intense asociality. Spacemen were extreme conservatives, also, in the world's newest work. Of course, that conservatism had survival value. If something old works, why try something new that may cost you your life?

It all tended to make acceptance of the psi very difficult.

"Who needs him?" Arriglio asked angrily. He had a notion that his authority in the engine room might be superseded. "We don't need any mind

reader aboard this ship."

"He's not a mind reader," Powell said. "The man we're getting will fill a very important place."

"What's he supposed to do?" Danton asked.

Powell hesitated, then said, "He's going to help us in our takeoff."

"How?" Danton asked.

"He's a telekinetic psi," Powell said quickly. "He's going to push."

Danton didn't say anything. Arriglio stared for a moment, then burst into laughter.

"Push! You mean he's going to run along behind and shove?"

"Maybe he's going to carry *Venture* on his back!"

"Sam, where did you leave your brains?"

Powell grinned at the taunts, congratulating himself on his phrasing. It was better to have them laughing at him than fighting with him.

He stroked his mustache and said, "He'll be here pretty soon."

"You're serious?" Danton asked.

"Absolutely."

"But Sam—"

"Let me explain," Powell said. "Telekinesis—which is what this man does—is an unexplained form of power. It involves moving masses—often large ones—with no evident physical interaction. And it *does* work."

The two men were listening intently, though skeptically. Powell glanced at his watch and went on.

"Command figured that if this man could exert some of that force on our takeoff, we'd save an appreciable amount of fuel. That would give us a nice safety margin."

Both men nodded. They were all for saving fuel. It was the biggest single problem in spaceflight. Only so much could be packed; and then, a little error in calculation, a little added expenditure of the precious stuff—and that was it. Of the five ships that had gone out so far, two had been lost for that very reason.

"I assure you," Powell said, "he won't infringe on your jobs. All he's going to do is try to give this thing a push." He smiled, and prepared to give them the rest of the unpleasant news.

"Well, as long as he leaves me alone," Danton said.

"Sorry," Powell told them, "but you can't leave him alone."

"What?"

Powell had many qualifications for his job. The most important one couldn't be taught in college, though. Powell knew how to handle people. He called upon that ability now.

"Psi's, you know, aren't normal people. They're maladjusted, unhappy. There even seems to be some correlation between that and their psi abilities. If we want this psi to help us, we're going to have to treat him right."

"I wasn't planning on spitting on him," Arriglio said.

"You'll have to do better than that," Powell said. "I had a long talk with Waverley about this. He gave me a list of operating instructions." He drew a piece of paper from his breast pocket.

"He gave *you* operating instructions?"

"Sure. For the psi. Listen now." He straightened the paper and began to read:

"Psi ability has perhaps existed as long as man himself. But operationally, it is very new. Already it has shown some of its potentialities as an extension of man's will. But it will be a while before we understand the why and how of it.

"Therefore, for the interim, these imperically derived operating rules are given as an aid to those working with the psi. We have found that the best results—and often the only results—are obtained by using them.

"Operationally, the psi may be considered a unit of tricky, delicate, powerful machinery. Like all machines, certain maintenance and operating rules must be observed.

"To function, any machine must be:

1. Well-seated.
2. Fueled.
3. Oiled.
4. Regulated.

Taking these in order we find:

1. *In order to function at all, a psi must feel at home, secure, wanted.*

2. *Praise must be afforded the psi at frequent intervals. Since the psi is unstable, his ego must be periodically boosted.*

3. *Understanding and sympathy must be used at all times when dealing with the psi.*

4. *The psi must be allowed to run at his own pace. Excess pressure will break him.*

Powell looked up and smiled. "That's all there is to it."

"Sam," Danton asked softly, "isn't it enough trouble running a ship without wet-nursing a neurotic?"

"Sure it is," Powell said. "But imagine what it would mean to us—to spaceflight—if we could get off Earth with most of our fuel intact."

"That's true," Arriglio said, remembering times he had sweated blood over the fuel gauges.

"Here's a copy of the operating instructions for each of you," Powell said, taking them out of his pocket. "I want you to learn them better than you know your own names."

"Great," Arriglio said, frowning at the typed sheet. "Are you sure he can do this pushing?"

"No," Powell admitted. "No one knows for sure. His ability works about sixty-five per cent of the time."

"Oh, no," Danton said.

"I'm going to bring him in now, so get those papers out of sight when you hear us." He smiled, showing his teeth. "Rest ye merry." And left the room. He began to whistle as he

walked down the corridor. They had taken it very well, on the whole.

In ten minutes he returned. "Boys, this is Billy Walker. Walker, Steve Danton, Phil Arriglio."

"Hiya," Walker said. He was tall—a good six-three, Powell estimated—and impossibly thin. A floating nimbus of pale yellow hair remained on his bald, bony skull. He had a long-nosed, homely unhappy face, and at the moment he was biting his flat lower lip.

A nice looking companion for a few months, Powell thought.

"Have a seat, Walker," Arriglio said, shaking Walker's hand enthusiastically.

"Sure. How's everything, boy?" Danton said.

Powell suppressed a smile. *In order to function at all, a psi must feel at home, secure, wanted.* The boys were making the best of the bargain. They knew what that extra push at takeoff could mean.

Walker sat down, eying them suspiciously.

"How do you like our ship?" Arriglio asked.

"It's O.K.," Walker said, with the air of a man who has seen bigger and better; despite the fact that this was the only completed spaceship, at present, in the United States.

"How do you feel about the trip?" Danton asked.

"Just another trip," Walker answered, leaning back in his chair. "Shouldn't be too tough."

"Would you like to see the rest of the ship?" Powell asked hastily. He could see that Arriglio was smoldering, and Danton didn't look too happy.

"Naw," Walker said. "I'll get plenty of chance later."

There was an awkward silence, which didn't seem to bother Walker. Powell watched him out of the corner of his eye as he lighted a cigarette. Neuroticism he had expected. But Walker was plain arrogant.

Walker grunted, and thrust his hands in his pockets. Powell watched, and realized that the man was clenching and unclenching his fists.

He must be nervous, Powell thought, and tried to think of something pleasant to say.

"How fast you figure you'll shove the ship?" Arriglio asked. Walker looked at him scornfully. "Fast as she'll take," he said, and gulped convulsively.

Not nervous, Powell decided. Scared. Just plain scared, and trying to hide it.

"Well, you'll find this a nice little boat," Danton said inanely.

"Nice little boat," Arriglio repeated.

"I want a candy bar," Walker said.

"How about a cigarette?" Powell said, offering him one.

"I think I'll just step outside and get a candy bar. There's gotta be a hawker on the landing field."

"We're taking off soon," Powell said. "I'd like to run through the briefing—"

"Nuts," Walker said succinctly, and left.

"I'll kill that guy before we're through," Arriglio murmured when Walker was out of the room. Danton looked grim.

"We'll just have to bear him," Powell said. "He'll fit in."

"He's insufferable," Danton said. They sat and glared at the doorway. Powell began to feel sorry for himself. What had Command talked him into?

"I decided I didn't want a candy bar," Walker said, coming back into the room. He looked from face to face. "You guys been talking about me?"

"Why should we?" Arriglio asked abruptly.

"You guys probably figure I can't push this crate," Walker said.

"Now look," Powell said sternly. "We don't think any such thing. Each of us will do his job, and that's all there is to it."

Walker just looked at him.

"Let's go through the briefing," Powell said. "Come with me, Walker."

He led Walker into the control room and showed him the line of force diagrams, explained the sequence of orders and told him what he was supposed to do. Walker listened carefully, still chewing his lower lip.

"Look, captain," he said. "I'll do my best."

"Fine," Powell said, rolling up his charts and laying them aside.

"Just don't count on me too much," the psi said, and hurried out of the room. Powell shook his head and checked his instruments.

Powell strapped himself in, and snapped on the intercom.

"Danton. Set?"

"Set, captain."

"Arriglio."

"Just a moment—set, captain."

"Walker?"

"Yeah."

"Right." Powell received his field clearance from the tower. He leaned back. "Ten seconds. Main drive on."

"On," Arriglio said. A roar shook the ship as the engines leaped into violent life.

"Get it up," Powell said, reading his dials. "Fine. Hold it there. Danton. Get set on auxiliary."

"I'm on."

"Six seconds. Walker, stand by."

"Yes, sir."

"Four seconds." Half a dozen fine adjustments, oxygen.

"Two seconds. One second."

"Blast! Come in, Walker!"

The ship started to rise, balancing on her jets. Then, a great force seized her. Powell was slammed back in his seat, knowing that Walker's telekinetic force was shoving now. He read the climb dial. As soon as they had reached five hundred feet, he cut a switch.

"Main drive off! Give it all you've

got, Walker!"

The roar stopped, but the ship leaped forward faster. The ship performed an incredible wrench. Powell wondered what it was. Not acceleration, certainly . . .

The ship was wrenched again. Powell gasped and blacked out.

When he recovered, the ship was surrounded by the blackness of space. Acceleration was still a giant hand against his chest, but he struggled forward and looked out a port.

Stars, of course.

Powell grinned weakly and decided to buy Walker a drink when they got back. The erratic, powerful psi dynamo had functioned—with a vengeance. He wondered how far from Earth they were.

Touching the instrument panel, he got a screen-view behind him. He searched it for the blue-green globe of Earth.

Earth wasn't there.

Manipulating the view, he quickly found Sol. But why was it so small? Earth's sun looked about the size of a large pea.

Where were they?

Powell unstrapped himself. He could feel that the ship was beginning to lose its acceleration. He checked his instruments and calculated their velocity.

Fantastic!

"Danton!" he shouted into the intercom.

"Ouch," Danton said. "Brother!"

"Get up here and check our position. Arriglio?"

"Yes, Sam?"

"See how Walker is." Powell looked out at the stars again, then at the sun. Finally he frowned and rechecked his figures. He *had* to be wrong.

Half an hour later, Danton came up with an answer. "As near as I can figure out," he said, "We're somewhere between Saturn and Jupiter. Probably closer to Saturn."

"That's impossible," Powell said flatly.

"Sure," Danton agreed. "Try it yourself." Powell went over the navigator's figures, but could find no error in them. They were five hundred million miles from Mars, give or take ten million.

Powell shook his head. The figures had no real emotional impact on him. They couldn't, since no one could grasp what five hundred million miles really meant. He reduced it, automatically, to an understandable size.

Which was just as well, under the circumstances.

"So here we are," he said matter-of-factly. "Well," Arriglio came in, and he asked him, "how are we on fuel?"

"So-so," Arriglio said. "That psi-assisted takeoff saved us a lot, of course. But we still haven't got enough."

"Of course not," Powell agreed.

A ship powered for a Mars trip, with refueling on the planet, couldn't expect to get back from Saturn.

Saturn! He tried to think what that meant in terms of straight-line acceleration, but gave it up. The telekineticized ship must have skipped a portion of space, somehow.

Walker came into the room, his lips pallid and twitching. "Did you say we were around Saturn?" he asked.

"Saturn's orbit," Powell said, automatically forcing a grin. "Saturn is on the other side of the sun now." He widened the grin, and remembered rule two in the operating instructions. *Praise must be afforded the psi at frequent intervals.*

"Boy," he said, "you've really got something there. Magnificent!"

"I suppose . . . I suppose—" Walker looked at them, his face drawn into a pout. Then he started to cry.

"Take it easy," Powell said, feeling extremely uncomfortable. His machine didn't seem to be responding.

"I knew I'd louse it up," the psi dynamo blubbered. "I just knew it."

"Nothing's lost," Powell said, keeping his voice pleasant and even. "You just don't know your own strength. You'll bring us back."

"I can't," Walker said, covering his face with his big hands. "I can't do it any more."

"What?" Danton shouted.

"I can't! I've lost the power! I felt it all whoosh out of me! I can't do it any more!" He screamed the last at them, and half sat, half slid to the deck. Placing his face against his knees he wept uncontrollably.

"Come on," Powell said to Danton. Together they lifted Walker and carried him to his bunk. Danton gave him a sedative, and they watched until the psi fell into a restless sleep. Then they returned to the Main Room.

"Well," Arriglio said. They didn't answer him. The three men sat down and stared out a port.

After a while, Danton said, "If he really can't do it any more—"

"Suppose he's a one-shot?" Arriglio said in a whisper.

With an effort Powell turned from the port. "I don't think so," he said. "You don't lose psi power that easily, I've heard." He had heard no such thing; but morale was still a factor.

"The point is," Danton said, "he doesn't have to lose it. If he just believes he's lost it—"

"We'll talk him out of that," Powell said. "Just think of him as a machine. A tricky one—but we've got the manual."

"I hope some of the spare parts aren't on Earth," Danton said.

They were silent for a few moments.

"We'd better get the engines going," Powell said. "We have to turn the ship, or we'll be out of the system in no time."

"That's going to take a bit of fuel," Arriglio said.

"Can't help it. Work out the curve, will you Danton? As tight as we can take."

"Right," Danton said.

"And then we'll eat."

Once the ship was turning, they ate. Then they held a conference.

"It's all up to us," Powell said. "His arrogance before we took off was sheer bluff. Now his nerve is shot. We have to restore his confidence."

"Easy," Arriglio said. "Telephone a psychiatrist."

"Very funny," Danton said.

"Not so funny," Powell told them. "A psychiatrist might come in very handy now. In the absence of one, we have the operating instructions."

Danton and Arriglio took out their copies and looked them over.

"For the duration," Powell said, "we'll have to think of Walker as a machine. It brought us out here. It can take us back. Now, any suggestions on getting it back in running order?"

"I've got an idea," Danton said

hesitantly. They discussed it for several minutes, and decided it was worth a try. Arriglio went back for Walker.

When he came in, Powell and Danton were shuffling a deck of cards. "Care for some poker?" Powell asked carelessly. "Nothing else to do until we round the curve."

"Do you want me to play?" Walker asked in a whisper.

"Sure. Sit down." The tall psi took a chair self-consciously, and picked up his cards. The game began.

Since the psi is unstable, his ego must be periodically boosted. It was the craziest game Powell had ever seen. They had decided to let Walker win, in hopes of restoring his confidence. But Walker was a hard man to lose to. Timidly he glanced at his cards and threw in hand after hand. He folded when anyone raised. His hands ran amazingly low, even with Arriglio's skillful dealing. Walker never even opened a hand.

But the men were persistent. Silently they worked, throwing away good cards in hopes of getting poor ones. They tried to beat Walker to the punch by folding before he could. Bit by bit, Walker forged ahead.

Powell watched the psi play. The man's sad, homely face was tense with strain. He took each card as though his life depended on it.

Powell had never seen a man who played so seriously, and so poorly.

Finally, a big pot came up. Walker, who hadn't drawn any cards, seemed to pick up confidence. He bet. Powell had drawn one card, splitting up a pair. He raised. Danton and Arriglio raised. Walker hesitated, then raised back.

After several rounds, Walker called.

Powell had a ten high. Arriglio had an eight, and Danton a queen. Walker had stayed with an ace.

"Good bluffing," Powell said. Walker stood up, his face contorted.

"I can't lose," he said in a strange voice.

"Don't worry about it," Danton said.

"I put you guys in this fix—and then I win your dough," Walker said. He hurried away.

Only then did Powell realize that Walker had wanted to lose. Expiation, he thought, but didn't bother to explain it to Danton and Arriglio. He hurried after Walker.

Walker was sitting on his bunk, staring at his hands. Powell sat down beside him and offered him a cigarette. He felt safe in doing so, since their food and water would run out long before their oxygen.

"No thank you," Walker said dully.

"What's wrong?" Powell asked.

"Oh, me," Walker said. "I've gone and done it again."

"Done what?"

"Loused everything up. I've always done something like that. You can count on it."

Understanding and sympathy must be used at all times when dealing with the psi.

"No reason to feel that way," Powell said in a soothing, fatherly voice. "You did something no one else could. That push you gave the ship—"

"Wonderful, wasn't it?" Walker said bitterly. "I pushed us right where we didn't want to go."

"It was still the most wonderful thing I've ever seen."

"And now what?" Walker said, knotting his fingers together in agony. "I can't get us back. I've killed us!"

"You can't blame yourself—" Powell began, but Walker interrupted him.

"I can! It's my fault!" He started to cry, and wiped his nose on his sleeve.

"All you have to do is push us back," Powell said.

"I've told you," Walker gasped, his eyes wild. "I've lost it. I can't do it any more." His voice started to get louder.

"Now listen to me," Powell said sternly. "You don't lose it. That's defeatist talk." He went smoothly into his best inspirational speech, one reserved for extra-bad moments. It was good, he had to admit. He talked about the stars and Earth, and science, and man's mission on the planets. He talked of the undeveloped psi powers, and their importance in the scheme of things.

Walker stopped crying. He listened, his eyes knotted on Powell's face.

Powell told him about the future of psi, making it up as he went along. How the psi powers would some day link the stars. But until that day, it was up to men like Walker to lead the way.

And a great deal more.

"Come on, boy," Powell cried, after he saw that his audience was thoroughly hooked. "You haven't lost it. Try again!"

"I will!" Walker wiped his nose on his sleeve again and shut his eyes. Cords in his neck stood out. Powell held on to the side of the bunk and watched his precious dynamo begin to operate.

Across the room a door flew open, then slammed shut. Walker's face grew red.

Fascinated, Powell watched the psi's face. The long nose glistened with sweat, the wide lips were peeled back. Walker was in an agony of concentration.

Then he relaxed, and sagged back against the bunk.

"I can't do it," he said. "I just can't."

Powell wanted to tell him to try again. But he remembered Rule 4: *The psi must be allowed to run at his own pace. Excess pressure will break him.*

"Take a rest," Powell said, resisting a strong temptation to throttle the man. He stood up, taking care to keep his face expressionless.

"I've killed you all," Walker said.

Powell left the room.

The ship rounded the great curve and started the long fall sunwards. Arriglio cut the engines, mourning the expenditure of fuel. They were *really* short now. Just how short, Danton set out to discover.

In free fall now, with all apparent motion stopped, the ship seemed to hang in space. The sun grew in size—too slowly. Much too slowly.

Walker remained in his bunk, refusing any more conversation. Powell knew that the man was judging himself—and condemning, over and over again. He wanted to do something about it, but couldn't figure out what.

"Here's the score," Danton said, in the Main Room. He showed Powell a graph. "Here's course and speed, here's destination." He pointed out the lines. "We run out of food here—" The line fell far short of their destination. "And we run out of water here." That line was still shorter.

"How about if we accelerate?" Powell asked.

"Too far to go," Danton said. "I've tried juggling it every way around, and it still comes out no good. We couldn't even make it if we ate each other, and drank the blood."

"That's a pleasant thought, you gory pig," Arriglio said from the other side of the room.

"Don't you like it?" Danton asked.

"Not a bit." Arriglio pushed himself off a wall and floated forward, moving easily in the weightless ship.

"Then do something about it," Danton said, pushing himself forward to meet Arriglio.

"Hey, stop it," Powell said. "Come on, break it up." The two men parted suddenly.

"The guy I'd like to get is that—"

"Stop it," Powell said sharply. He heard a noise. Walker floated in. Powell hoped he hadn't heard the conversation.

"Come on in," Powell said.

"Sure, pull up a chair," Danton said, with an effort at friendliness.

Powell knew that they would love to cut Walker into little pieces; but the requirements of the situation forced them to be pleasant to him. It was an added strain, having to cater to the man who had put them in this spot.

"I wanted to say—" Walker began.

"Go on," Arriglio encouraged, determined not to be outdone by Danton. "Go on, boy." His tone was friendly, but his bleak eyes contradicted it.

"I wanted to say I'm sorry," Walker said. "I wouldn't have even gone on this trip, only Mr. Waverley thought I should."

"We understand," Danton said, his fingers clenching into fists.

"Sure, it's all right," Arriglio said.

"You all hate me," Walker said, and floated out.

"Haven't you guys any control

over yourselves?" Powell asked when Walker was gone. "Rule 3, remember? *Understanding and sympathy must be used at all times—*"

"I *was* understanding," Arriglio said angrily. Danton nodded.

"Understanding! The way you looked at him!"

"I'm sorry, captain," Arriglio said formally. "I'm no actor. If I don't like a guy, I don't like him." He glared at Danton. Danton glared back.

"I told you to think of him as a machine," Powell said. "Arriglio, I've seen you pamper those engines of yours outrageously."

"Sure," Arriglio said, "but I can swear at them, too, and kick 'em if I want to."

That was the trouble, Powell thought, with working with a sentient machine. You couldn't take out your frustrations on it.

"Well, don't start anything, you two," Powell said.

Arriglio pushed himself to the opposite side of the room, found the cards and started to deal himself a hand of solitaire.

Powell went to the control room to think things out.

Outside the port the stars glittered. Dead space lay, a grave five hundred million miles long.

There had to be a solution. Start from there.

A way out, Powell thought. Their psi dynamo had functioned on the way out. Why wasn't he functioning now?

He took out the instructions Waverley had given him and studied them.

These empirically derived operating rules are given—

Those rules were a long way from the truth, Powell thought. Waverley still had a long way to go.

Certain maintenance and operating rules must be observed—

They had observed them, to the best of their ability. Theoretically, there should be nothing wrong with the psi. But still, the delicate intricate dynamo in Walker's mind refused to function.

Powell slapped a hand against his thigh. It was so frustrating, to have all that power bottled there. Enough to take them home with ease—enough, probably, to take them to Alpha Centauri, or the galactic center. And they couldn't tap it.

Because they didn't know how to operate the machinery.

Operating instructions. He was no psychiatrist. He couldn't hope to cure Walker of his neuroticisms. All he could do was relieve them enough to get him to work.

What had he left out?

He read back over the instructions, and an idea began forming in his mind. There *was* something else. He almost had it now—

Captain!"

"What do you want?" Powell asked, angry for the first time on the

trip. He had been so close! He glared at Danton.

"It's Walker, Sam. He's locked himself in one of the rooms. I think he's going to kill himself!"

Powell pushed himself against a wall and shot down a corridor, Danton following. Arriglio was at the door, hammering on it and shouting. Powell pushed him aside and floated up.

"Walker. Can you hear me?"

Silence.

"Bring something to get this open," Powell whispered. "Walker!" he shouted again. "Don't do anything foolish."

"I'm doing it," Walker's voice came through.

"Don't! As captain of this ship I order you—"

Walker's gurgle cut him short.

Arriglio hurried back with a blowtorch. They melted the lock, and Powell swore he would never ride another ship with as much as a door in it. If he ever rode another ship.

They burst the door open and floated in. Then Arriglio burst into laughter.

Their unhappy, overloaded dynamo was floating in midair, his arms and legs jerking grotesquely. Around his neck was a rope, the other end attached to a stanchion in the ceiling. The amazing fool had tried to hang himself—in weightless free-fall.

But then, suddenly, it wasn't so funny. Walker was strangling, and they were unable to loosen the rope. Frantically they worked on it, trying to get some purchase in the weightless air. Finally, Danton had the foresight to burn the rope loose with the torch.

Walker had knotted the rope to the ceiling, tying the other end around his neck. But to make it really effective, he had tied a constrictor knot in it. This knot would tighten easily, and stay tight. It could be loosened only by yanking both ends in a certain way.

Walker had tied the ends around the back of his neck in a square knot, out of reach. He had braced himself against the ceiling, and kicked off hard. The knot had tightened—

It was a close thing, and an adequate measure of Walker's desperation.

"Pull him up," Powell said. He glared at the gasping, red-faced Walker, and tried to think.

He had coaxed him and kidded him, followed the rules and added the oil of sympathy and the fuel of praise. And what had he gotten?

His precious machine had almost ruined itself.

That's no way to run anything, he told himself. If I want an engine to turn over, I turn it over. I don't stand around patting its case. To hell with the rules!

"We're through playing games," Powell said, and he was addressing all of them now. "Take your positions. We're blasting off."

He silenced their questions with a

glare, and pushed himself off.

In the control room he said a silent prayer. Then he snapped on the intercom.

"Danton. Set?"

"Set, captain."

"Arriglio?"

"All set."

"Walker?"

"Yes, sir."

"Ten seconds. Main drive on." The engines thundered into life. "Get it up there," Powell said. "I want max plus."

"Right, captain."

"Danton, get set on auxiliary."

"Set, captain."

"Six seconds. Walker, stand by."

"Yes, sir," the frightened voice of Walker said.

"Four seconds," Powell said, hoping that Walker wouldn't have time to tell himself he couldn't do it.

"Two seconds." Come on, he told himself. This had better be it. Let it be it.

One second.

"Blast! Come in, Walker!"

The ship surged forward, but he could feel no response from Walker. The ship was operating on her engines alone.

"Fine, Walker," Powell said coolly. "Give her some more."

Still there was no response.

"Excellent work," Powell said. "Arriglio, cut the main drive. Take over, Walker."

For an agonizing second there was nothing. And then the ship surged forward.

There was a wrench, milder than on the takeoff, and the stars began to blur.

"Get your course from Danton," he said to Walker. "Fine work, Mr. Walker."

So that was it, Powell thought. Those rules Waverley had given him might work on Earth. But in a stress situation—well, he had some interesting information to bring back.

Walker's self-induced paralysis had passed in the swift, taken-for-granted orders. Naturally.

Cancel all other instructions. The cardinal rule for operating the psi: *A psi is a human being, and must be treated as one. A psi's abilities must be accepted—and used—as accomplished skills, not freak talents.*

"Sir?"

"Yes?" Powell said, recognizing Walker's voice.

"Shall I boost her up a little faster?" the psi asked.

"Do so, Mr. Walker," Powell said in a fine, serious, commanding voice.

THE END

MISSION OF GRAVITY

BY HAL CLEMENT

***Second** of Four Parts. Magellan was a piker beside this tiny adventurer—exploring a giant world with a savage gravity seven hundred times Earth's!*

Illustrated by van Dongen

SYNOPSIS

For the first time in history, the scientists of Earth and the planets of nearby stars have acquired the opportunity to make studies of a really intense gravitational field. The solitary planet of the brighter component of the binary star 61 Cygni has a mass some five thousand times that of Earth, but because it consists largely of degenerate matter has a volume not much larger than that of Uranus. Ordinarily this would mean a surface gravity of about three hundred times that of Earth, and for several similar worlds this has been the case; but the 61 Cygni planet has such an enormously rapid rotation rate that, while its effective equatorial gravity is only three times that of Earth, the extreme flattening gives it well over six hundred G's at the poles.

Recognizing the opportunity, the governments of several planets pool resources and construct a special research rocket which will be capable of landing in those polar regions without destruction, and load it with as much varied apparatus as their scientists can devise. Under remote control, the rocket lands at the south pole of the giant planet, presumably secures its data—but fails to respond to the take-off signal. Some of the data was telemetered, but some is on

records that must be physically recovered; and no known living creature can survive in the gravity of the polar regions.

However, a station is built at the equator to do what can be done; and Charles Lackland, while conducting xenological investigations near the dome, encounters Barlennan, a native of the world, which he calls Mesklin.

Barlennan is the captain and owner of a tramp ship, half trader and, Lackland suspects, half pirate, exploring the almost unknown equatorial zone of the world. He has beached his ship, the Bree, *near the station for the season; Mesklin is approaching periastron, which is also the northern hemisphere's midsummer, and the boiling of the cap of frozen methane which has built up around the northern pole during the preceding four Earth-years creates tremendous storms which render the seas impassable. Lackland and Barlennan form a friendship, partly because each sees a chance of obtaining what he wants from the other and partly because of natural sympathy. The Mesklinite, over a period of several weeks, learns a great deal of Lackland's language, and a tentative agreement is reached whereby Barlennan is to make the thirty-thousand-mile voyage to the south pole, find the grounded rocket, and transmit its*

information by a specially designed radio-television unit which the scientists of the expedition devise to withstand Mesklin's cold, pressure, and gravity—it is a solid block of material, using only printed circuits, transistors, and similar non-living parts. In return the expedition is to furnish weather predictions for Barlennan until he returns to his own country, thus enabling him to carry safely a far larger cargo.

The trip cannot be started until the beginning of spring in the southern hemisphere, and in the interval it is discovered through the examination of photographs made from space that the downed rocket is very awkwardly located—an overland journey of several thousand miles will be needed for the Bree*'s crew to reach it. Another body of "water" also reaches the south polar regions, and a river feeding it passes within a few miles of their goal; but no navigable passage to this second sea can be found on the photographs. However, an incident which occurs when Lackland and Barlennan are exploring some miles from the station gives the latter an idea. The tank in which they were riding is crippled, and the Earthman's cumbersome armor makes it impossible for him to reach the dome in the triple gravity; but the crew of the* Bree *is able to tow him back on a sled made of metal from the wrecked tank. Barlennan now suggests that a similar sled be made for his ship, and towed to the other ocean by another tank.*

This proves feasible, as the ocean extends into the low-gravity regions of the equator where Lackland can survive to operate the tank. The route is laid out with the aid of more aerial photographs, the sled constructed at the main expedition base on Toorey, Mesklin's inner moon, and ferried to the equatorial station. As winter draws to a close, the Bree *is loaded aboard—the ship is only forty feet in length, and easily carried by her crew in their present near-weightless environment—and the trip starts.*

Barlennan, through a misunderstanding of Lackland's, has already had an experience which has jarred out of him the ingrained, conditioned fear of height characteristic of all natives of his part of the planet—a fear amply justified by the savage gravitation under which they live, which makes a fall of even half their eighteen-inch body length almost certainly fatal. The very idea of a fall is strange to them; in their land, an object released at a height simply disappears, to reappear almost simultaneously on the ground below in a well flattened state.

Part 2

VII.

Up to this time, most of the hills had been gentle, smooth slopes, their irregularities long since worn off by weather. There had been no sign of the holes and crevasses which Lackland somewhat feared before starting. The hilltops had been smoothly rounded, so that even had their speed

been much higher the crossing of one would hardly have been noticed. Now, however, as they topped such an acclivity and the landscape ahead came into view a difference in the next hill caught every eye at once.

It was longer than most they had crossed, more a ridge across their path than a mound; but the great difference was in the top. Instead of the smooth, windworn curve presented by its fellows, it seemed at first glance actually jagged; a closer look showed that it was crowned with a row of boulders spaced with regularity that could only mean intelligent arrangement. The rocks ranged from monstrous things as big as Lackland's tank down to fragments of basketball size; and all, while rough in detail, were generally spherical in shape. Lackland brought his vehicle to an instant halt and seized his glasses—he was in partial armor, but was not wearing the helmet. Barlennan, forgetting the presence of his crew, made a leap over the twenty yards separating the *Bree* from the tank and settled firmly on top of the latter. A radio had been fastened there for his convenience long before, and he was talking almost before he had landed.

"What is it, Charles? Is that a city, such as you were telling me about on your own world? It doesn't look very much like your pictures."

"I was hoping you could tell *me*," was the answer. "It certainly is not a city, and the stones are too far apart for the most part to be any sort of wall or fort that I could imagine. Can you see anything moving around them? I can't with these glasses, but I don't know how keen your eyesight is."

"I can just see that the hilltop is irregular; if the things on top are loose stones, I'll have to take your word for it until we're closer. Certainly I can see nothing moving. Anything my size would be impossible to see at that distance anyway, I should think."

"I could see you at that range without these glasses, but I couldn't count your eyes or arms. With them I can say pretty certainly that that hilltop is deserted. Just the same, I'll practically guarantee that those stones didn't get there by accident; we'd better keep our eyes open for whoever set them up. Better warn your crew." Lackland mentally noted the fact of Barlennan's poorer eyesight; he was not physicist enough to have predicted it from the size of the native's eyes. The only way they could have matched Lackland's in resolving power would be to use shorter wave lengths of light—and even the brighter component of 61 Cygni radiates less ultraviolet than does Sol. The fainter sun of the pair is too distant from Mesklin at its closest to help much, and is even redder than its companion.

For two or three minutes, while the sun moved far enough to reveal most of the areas previously in shadow, they waited and watched; but nothing except the shadows moved, and fi-

nally Lackland started the tank once more. The sun set while they were descending the slope. The tank had only one searchlight, which Lackland kept aiming at the ground in his path; so they could not see what, if anything, went on among the stones above.

Sunrise found them just crossing another brook, and tension mounted as they headed uphill once more. For a minute or two nothing was visible, as the sun was directly ahead of the travelers; then it rose far enough to permit clear forward vision. None of the eyes fastened on the hilltop could detect any change from its appearance of the night before. There was a vague impression, which Lackland found was shared by the Mesklinites, that there were now more stones; but since no one had attempted to make a count of them before, this could not be proved. There was still no visible motion.

It took five or six minutes to climb the hill at the tank's five-mile speed, so the sun was definitely behind them when they reached the top. Lackland found that several of the gaps between the larger stones were wide enough for the tank and sled, and he angled toward one of these as he approached the crest of the ridge. He crunched over some of the smaller boulders, and for a moment Dondragmer, on the ship behind, thought one of them must have damaged the tank; for the machine came to an abrupt halt before the sled was far enough up for its occupants to see into the next valley. Barlennan could be seen still on top of the vehicle, all his eyes fixed on the scene below him; the Flyer was not visible, of course, but after a moment the *Bree's* mate decided that he, too, must be so interested in the valley beyond as to have forgotten about driving.

"Captain! What is it?" Dondragmer hurled the question even as he gestured the weapons crew to the flame tanks. The rest of the crew distributed themselves along the outer rafts, clubs, knives, and spears in readiness, without orders. For a long moment Barlennan gave no answer, and the mate was on the point of ordering a party overboard to cover the tank—he knew nothing of the nature of the jury-rigged quick-firer at Lackland's disposal—when his captain turned, saw what was going on, and gave a reassuring gesture.

"It's all right, I guess," he said. "We can see no one moving, but it looks a little like a town. Just a moment and the Flyer will pull you forward so that you can see without going overboard." He shifted back to English and made this request to Lackland, who promptly complied. This action produced an abrupt change in the situation.

What Lackland had seen at first—and Barlennan, less clearly—was a broad, shallow bowllike valley entirely surrounded by hills of the type they

were on. There should, Lackland felt, have been a lake at the bottom; there was no visible means of escape for rain or melted snow. Then he noticed that there was no snow on the inner slopes of the hills; their topography was bare. And strange topography it was.

It could not possibly have been natural. Starting a short distance below the ridges were broad, shallow channels. They were remarkably regular in arrangement; a cross section of the hills taken just below where they started would have suggested a very pretty series of ocean waves. As the channels led on downhill toward the center of the valley they grew narrower and deeper, as though designed to lead rain water toward a central reservoir. Unfortunately for this hypothesis, they did not all meet in the center—they did not even all reach it, though all got as far as the relatively level, small floor of the valley.

More interesting than the channels themselves were the elevations separating them. These, naturally, also grew more pronounced as the channels grew deeper; on the upper half of the slopes they were smoothly rounded ridges, but as the eye followed them down their sides grew steeper until they attained a perpendicular junction with the channel floors. A few of these little walls extended almost to the center of the valley, but they cut off with startling abruptness before actually reaching it. They did not all point toward the same spot; there were gentle curves in their courses that gave them the appearance of the flanges of a centrifugal pump rather than the spokes of a wheel. Their tops were too narrow for a man to walk on; even one of Barlennan's people would have had difficulty in maintaining footing on what looked from this distance almost like a sharp edge, from which the sides sloped away at better than a forty-five degree angle and grew even steeper as they descended until they merged with the perpendicular lower walls.

Lackland judged that channels and separating walls alike were some fifteen or twenty feet wide where they broke off. The walls themselves, therefore, were quite thick enough to be lived in, especially for Mesklinites; and the existence of numerous openings scattered over their lower surfaces lent strength to the idea that they actually were dwellings. The glasses showed that those openings not directly at the bottom of the walls had ramps leading up to them; and before he saw a single living thing, Lackland was sure he was examining a city. Apparently the inhabitants lived in the separating walls, and had developed the entire structure in order to dispose of rain. Why they did not live on the outer slopes of the hills, if they wanted to avoid the liquid, was a question that did not occur to him.

He had reached this point in his

thoughts when Barlennan asked him to pull the *Bree* over the brow of the hill before the sun made good seeing impossible. The moment the tank began to move, a score of dark figures appeared in the openings that he had suspected were doorways; no details were visible at that distance, but the objects, whatever they were, were living creatures. Lackland heroically refrained from stopping the tank and snatching up the glasses once more until he had pulled the *Bree* into a good viewing position.

As it turned out, there was no need for him to have hurried. The things remained motionless, apparently watching the newcomers, while the towing maneuver was completed; he was able to spend the remaining minutes before sunset in a careful examination of the beings. Even with the glasses some details were indistinguishable — for one reason, they seemed not to have emerged entirely from their dwellings; but what could be seen suggested strongly that they belonged to the same race as Barlennan's people. The bodies were long and caterpillarlike; several eyes—they were hard to count at that distance—were on the foremost body segment, and limbs very similar to, if not identical with, Barlennan's pincer-equipped arms were in evidence, though once again it was difficult to tell just how many were possessed by each individual. The coloration was a mixture of red and black, the latter predominating, as in the *Bree's* complement.

Barlennan could not see all this, but Lackland relayed the description to him tensely until the city below faded from sight in the dusk. When he stopped talking the captain issued a boiled-down version in his own language to the tensely waiting crew. When that was done:

"Have you ever heard of people living this close to the Rim, Barl? Would they be at all likely to be known to you, or even speak the same language?"

"I doubt it very much. My people become very uncomfortable, as you know, north of what you once called the 'hundred-G line.' I know several languages, but I can't see any likelihood of finding one of them spoken here."

"Then what shall we do? Sneak around this town, or go through it on the chance its people are not belligerent? I'd like to see it more closely, I admit, but we have an important job to do and I don't want to risk its chances of success. You at least know your race better than I possibly can; how do you think they'll react to us?"

"There's no one rule, there. They may be frightened out of their wits at your tank, or my riding on it—though they might not have normal instincts about height, here at the Rim. We've met lots of strange people in our wanderings, and sometimes we've been

able to trade and sometimes we've had to fight. In general, I'd say if we kept weapons out of sight and trade goods in evidence, they would at least investigate before getting violent. I'd like to go down—they might well have stuff worth trading, and this town is not a hopeless distance overland from our own sea if we want to come here later. Will the sled fit through the bottom of those channels, do you think?"

Lackland paused. "I hadn't thought of that," he admitted after a moment. "I'd want to measure them more carefully first. Maybe it would be best if the tank went down alone first, with you and anyone else who cared for the ride traveling on top. That way we might look more peaceful, too—they must have seen the weapons your men were carrying, and if we leave them behind—"

"They didn't see any weapons unless their eyes are a great deal better than ours," pointed out Barlennan. "However, I agree that we'd better go down first and measure—or better yet, tow the ship around the valley first and go down afterward as a side trip; I see no need to risk her in those narrow channels."

"That's a thought. Yes, I guess it would be the best idea, at that. Will you tell your crew what we've decided, and ask if any of them want to come down with us afterward?"

Barlennan agreed, and returned to the *Bree* for the purpose—he could speak in a lower tone there, although he did not feel that there was any real danger of being overheard and understood.

The crew in general accepted the advisability of taking the ship around rather than through the city, but from that point on there was a little difficulty. All of them wanted to see the town, but none would even consider riding on the tank, often as they had seen their captain do so without harm. A habit that amounts to a fixed conditioning is extremely hard to break. Dondragmer broke the deadlock by suggesting that the crew, except for those left to guard the *Bree*, follow the tank into the town; there was no need to ride, since all could now keep up with the speed the vehicle had been using up to this time. Barlennan approved of this suggestion.

The few minutes this discussion consumed brought the sun once more above the horizon; and at Barlennan's signal the Earthman swung the tank ninety degrees and started around the rim of the valley just below its coping of boulders. He had taken a look at the city before starting, and saw no sign of life; but as the tank and its tow swung into motion heads appeared once more at the small doors—many more of them, this time. Lackland was able to concentrate on his driving, sure now that their owners would still be there when he was free to examine them more closely. He attended to his

job for the few days required to get the sled around to the far side of the valley; then the tow cable was cast off, and the nose of the tank pointed downhill.

Practically no steering was required; the vehicle tended to follow the course of the first channel it met, and went by itself toward the space which Lackland had come to regard—wholly without justification—as the market place of the town. Approximately half of the *Bree's* crew followed; the rest, under the second mate, remained as guards on the ship. Barlennan, as usual, rode on the tank's roof, with most of the small remaining supply of trade goods piled behind him — most of his crew by now were willing to throw things, even though they wouldn't climb or jump.

The rising sun was behind them as they approached from this side of the valley, so the seeing was good. There was much to see; some of the town's inhabitants emerged entirely from their dwellings as the strangers approached. Neither Lackland nor Barlennan attached any significance to the fact that all who did this were on the far side of the open space; those closer to the approaching travelers remained well under cover. They supposed, if they thought of the matter consciously at all, that it was only because the more distant individuals felt safer.

As the distance narrowed, one fact became evident; the creatures were not, in spite of initial appearances, of the same race as Barlennan. Similar they were, indeed; body shape, proportions, number of eyes and limbs — all matched; but the city dwellers were over three times the length of the travelers from the far south. Five feet in length they stretched over the stone floors of the channels, with body breadth and thickness to match. Lackland hoped that their muscular strength would only match the gravity where they lived, but realized that this was unlikely — no creature so feeble could compete against its neighbors from points a little farther from the equator.

Some of the things had reared the front third of their long bodies high into the air, in an evident effort to see better as the tank approached — an act that separated them from Barlennan's people as effectively as their size. These swayed a trifle from side to side as they watched, somewhat like the snakes Lackland had seen in museums on Earth. Except for this barely perceptible motion they did not stir as the strange metal monster crawled steadily down the channel it had chosen, almost disappeared as the walls which formed the homes of the city dwellers rose gradually to its roof on either side, and finally nosed its way out into the open central space of the town through what had become an alley barely wide enough for its bulk. If they spoke, it was too quietly for either Lackland or Barlennan to hear;

even the gestures of pincer-bearing arms that took the place of so much verbal conversation with the Mesklinites Lackland knew was missing. The creatures simply waited and watched.

The silence continued for a minute or two after the tank came to a halt. Perhaps the natives were readjusting their eyesight after their encounter with the tank's searchlight; the last half of the descent had been made at night.

The sailors edged around the tank through the narrow space left—Lackland had just barely completed emerging from the alley—and stared almost as silently as the natives. Dwellings, to them, consisted of three-inch-high walls with fabric roofs for weather protection; the idea of a covering of solid material was utterly strange to them. If they had not been seeing with their own eyes the giant city dwellers actually inside the weird structures, Barlennan's men would have taken the latter for some new sort of natural formation.

Lackland simply sat at his controls, looked, and speculated. This was a waste of time, really, since he did not have enough data for constructive imagination; but he had the sort of mind that could not remain completely idle. He looked about the city and tried to picture the regular life of its inhabitants, until Barlennan's actions attracted his attention.

The captain did not believe in wasting time; he was going to trade with these people, and, if they wouldn't trade, he would move on. His action, which focused Lackland's attention on him, was to start tossing the packaged trade goods from the roof beside him, and calling to his men to get busy. This they did, once the packages had stopped falling. Barlennan himself leaped to the ground after the last bundle—an act which did not seem to bother in the least the silently watching giants—and joined in the task of preparing the goods for display. The Earthman watched with interest.

There were bolts of what looked like cloth of various colors, bundles that might have been dried roots or pieces of rope, tiny covered jars and larger empty ones—a good, varied display of objects whose purpose, for the most part, he could only guess at.

With the unveiling of this material the natives began to crowd forward; whether in curiosity or menace Lackland could not tell. None of the sailors showed visible apprehension—he had come to have some ability at recognizing this emotion in their kind. By the time their preparations seemed to be complete an almost solid ring of natives surrounded the tank. The way it had come was the only direction unblocked by their long bodies. The silence among the strange beings persisted, and was beginning to bother Lackland; but Barlennan was either indifferent to it or able to conceal his

feelings. He picked an individual out of the crowd, using no particular method of choice that the Earthman could see, and began his selling program.

How he went about it Lackland was utterly unable to understand. The captain had said he did not expect these people to understand his language, yet he spoke; his gestures were meaningless to Lackland, though he used them freely. How any understanding could be transmitted was a complete mystery to the alien watcher; yet apparently Barlennan was having some degree of success. The trouble was, of course, that Lackland in his few months' acquaintance with the strange creatures had not gained more than the tiniest bit of insight into their psychology. He can hardly be blamed; professionals years later were still being puzzled by it. So much of the Mesklinite action and gesticulation is tied in directly with the physical functioning of their bodies that its meaning, seen by another member of the same race, is automatically clear; these giant city-dwellers, though not of Barlennan's precise species, were similar enough in makeup so that communication was not the problem Lackland naturally assumed it would be.

In a fairly short time, a number of the creatures were emerging from their homes with various articles which they apparently wished to trade, and other members of the *Bree's* crew took active part in the bargaining. This continued as the sun swept across the sky, and through the period of darkness — Barlennan asked Lackland to furnish illumination from the tank. If the artificial light bothered or surprised the giants at all, even Barlennan was unable to detect any signs of the fact. They paid perfect attention to the business at hand, and when one had gotten rid of what he had or acquired what he seemed to want, he would retire to his home and leave room for another. The natural result was that a few days later all of Barlennan's remaining trade goods had changed hands, and the new articles were transferred to the roof of the tank.

Most of these things were as strange to Lackland as the original trade materials had been; but two attracted his attention particularly. Both were apparently living animals, though he could not make out their details too well because of their small size. Both appeared to be domesticated; each stayed crouched at the side of the sailor who had purchased it, and evinced no desire to move away. Lackland guessed—correctly, as it turned out—that these were creatures of the sort the sailors had been hoping to raise in order to test possible plant foods.

"Is that all the trading you're going to do?" he called, as the last of the local inhabitants drifted away from the neighborhood of the tank.

"It's all we can do," replied Barlennan. "We have nothing more to trade. Have you any suggestions, or do you want to continue our journey now?"

"I'd like very much to find out what the interiors of those houses are like; but I couldn't possibly get through the doors, even if I could discard my armor. Would you or any of your people be willing to try to get a look inside?"

Barlennan was a trifle hesitant. "I'm not sure whether it would be wise. These people traded peacefully enough, but there's something about them that bothers me, though I can't exactly put a nipper on it. Maybe it's because they didn't argue enough over prices."

"You mean you don't trust them—you think they'll try to get back what they've given, now that you're out of trade goods?"

"I wouldn't say precisely that; as I said, I don't have actual reason for my feeling. I'll put it this way; if the tank gets back to the valley rim and hooked up to the ship so that we're all ready to go, and we've had no trouble from these things in the meantime, I'll come back down and take that look myself. Fair enough?"

Neither Barlennan nor Lackland

had paid any attention to the natives during this conversation; but for the first time, the city dwellers did not share this indifference. The nearer giants turned and eyed, with every indication of curiosity, the small box from which Lackland's voice was coming. As the talk went on, more and more of them drew near and listened; the spectacle of someone talking to a box too small to contain any intelligent creature they knew seemed, for the first time, to break down a wall of reserve that not even the tank had been able to affect. As Lackland's final agreement to Barlennan's suggestion came booming from the tiny speaker, and it became evident that the conversation was over, several of the listeners disappeared hastily into their homes and emerged almost at once with more objects. These they presented, with gestures which the sailors now understood quite well. The giants wanted the radio, and were willing to pay handsomely for it.

Barlennan's refusal seemed to puzzle them. Each in turn offered a higher price than his predecessor. At last, Barlennan made an ultimate refusal in the only way he could; he tossed the set onto the roof of the tank, leaped after it, and ordered his men to begin throwing the newly acquired property up to him. For several seconds the giants seemed nonplussed; then, as though by signal, they turned away and disappeared into their narrow doorways.

Barlennan felt more uneasy than ever, and kept watch on as many portals as his eyes could cover while he stowed the newly bought goods; but it was not from the dwellings that the danger came. It was the great Hars who saw it, as he half reared himself over his fellows in imitation of the natives to toss a particularly bulky package up to his captain. His eye chanced to rove back up the channel they had descended; and as it did so he gave one of the incredibly loud hoots which never failed to amaze—and startle—Lackland. He followed the shriek with a burst of speech which meant nothing to the Earthman; but Barlennan understood, looked, and said enough in English to get the important part across.

"Charles! Look back uphill! *Move!*"

Lackland looked, and in the instant of looking understood completely the reason for the weird layout of the city. One of the giant boulders, fully half the size of the tank, had become dislodged from its position on the valley rim. It had been located just above the wide mouth of the channel down which the tank had come; the slowly rising walls were guiding it squarely along the path the vehicle had followed. It was still half a mile away and far above; but its downward speed was building up each instant as its tons of mass yielded to the tug of a gravity three times as strong as that of the earth!

VIII.

Flesh and blood have their limits as far as speed is concerned, but Lackland came very close to setting new ones. He did not stop to solve any differential equations which would tell him the rock's time of arrival; he threw power into the motors, turned the tank ninety degrees in a distance that threatened to twist off one of its treads, and got out from the mouth of the channel which was guiding the huge projectile toward him. Only then did he really come to appreciate the architecture of the city. The channels did not come straight in to the open space, as he had noticed; instead, they were so arranged that at least two could guide a rock across any portion of the plaza. His action was sufficient to dodge the first, but it had been foreseen; and more rocks were already on their way.

For a moment he looked around in all directions, in a futile search for a position which was not about to be traversed by one of the terrible projectiles; then he deliberately swung the nose of the tank into one of the channels and started uphill. There was a boulder descending this one, too; a boulder which to Barlennan seemed the biggest of the lot—and to be growing bigger each second. The Mesklinite gathered himself for a leap, wondering if the Flyer had lost his senses; then a roar that outdid anything his own vocal apparatus could produce sounded beside him. If his nervous system had reacted like that of most Earthly animals, he would have landed halfway up the hill. The startle reaction of his race, however, was to freeze motionless, so for the next few seconds it would have taken heavy machinery to get him off the tank roof. Four hundred yards away, fifty yards ahead of the plunging rock, a section of the channel erupted into flame and dust—the fuses on Lackland's shells were sensitive enough to react instantly even to such grazing impact.

An instant later the rock hurtled into the dust cloud, and the quick-firer roared again, this time emitting half a dozen barks that blended almost indistinguishably with each other. A fair half of the boulder emerged from the dust cloud, no longer even roughly spherical. The energy of the shells had stopped it almost completely; friction took care of the rest long before it reached the tank. It now had too many flat and concave surfaces to roll very well.

There were other boulders in position to roll down this channel, but they did not come. Apparently the giants were able to analyze a new situation with fair speed, and realized that this method was not going to destroy the tank. Lackland had no means of knowing what else they might do, but the most obvious possibility was a direct personal attack. They could certainly, or almost cer-

tainly, get to the top of the tank as easily as Barlennan and repossess everything they had sold as well as the radio; it was hard to see how the sailors were to stop them. He put this thought to Barlennan.

"They may try that, indeed," was the answer. "However, if they try to climb up we can strike down at them; if they jump we have our clubs, and I do not see how anyone can dodge a blow while sailing through the air."

"But how can you hold off alone an attack from several directions at once?"

"I am not alone." Once again came the pincer gesture that was the Mesklinite equivalent of a smile.

Lackland could only see the roof of his tank by sticking his head up into a tiny, transparent view dome, and he could not do this with the helmet of his armor on. Consequently he had not seen the results of the brief "battle" as they applied to the sailors who had accompanied him into the city.

These unfortunates had been faced with a situation as shocking as had their captain when he first found himself on the roof on the tank. They had seen objects—heavy objects—actually *falling* on them, while they themselves were trapped in an area surrounded by vertical walls which were guiding the fearful missiles inexorably toward them. To climb was unthinkable, though the sucker-feet which served them so well in Mesklin's hurricanes would have served as adequately in this task; to jump as they had now seen their captain do several times was almost as bad—perhaps worse. It was not, however, physically impossible; and when minds fail, bodies are apt to take over.

Every sailor but two jumped; one of the two exceptions climbed—rapidly and well—up the wall of a "house." The other was Hars, who had first seen the danger. Perhaps his superior physical strength made him slower than the others to panic; perhaps he had more than the normal horror of height. Whatever the reason, he was still on the ground when a rock the size of a basketball and almost as perfectly round passed over the spot he was occupying.

For practical purposes, it might as well be considered to have struck an equivalent volume of live rubber; the protective "shell" of the Mesklinites was of a material chemically and physically analogous to the chitin of Earthly insects, and had a toughness and elasticity commensurate with the general qualities of Mesklinite life. The rock bounded twenty-five feet into the air against three gravities, hurtling entirely over the wall which would normally have brought it to a stop, struck at an angle the wall of the channel on the other side, rebounded, and went clattering from wall to wall up the new channel until its energy was expended. By the time it had returned, in more leisurely

fashion, to the open space the main action was over; Hars was the only sailor still in the plaza. The rest had brought some degree of control into their originally frantic jumps and had either already reached the top of the tank beside their captain or were rapidly getting there; even the climber had changed his method of travel to the more rapid leaping.

Hars, unbelievably tough as he was by Terrestrial standards, could not take the sort of punishment he had just received completely without injury. He did not have his breath knocked out, since he lacked lungs—the small size of the natives combined with the physical properties of hydrogen to make diffusion a perfectly adequate method of getting the gas to the tissues that needed it—but he was scraped, bruised, and dazed by the impact. Fully a minute passed before he could control his motions sufficiently to make a co-ordinated attempt to follow the tank; why he was not attacked during that minute neither Lackland, Barlennan, nor Hars himself was ever able to explain satisfactorily.

The Earthman thought that the fact that he was able to move at all after such a blow had frightened any such thoughts out of the minds of the city dwellers; Barlennan, with a more accurate idea of Mesklinite physique, thought that they were more interested in stealing than in killing and simply saw no advantage in attacking the lone sailor. Whatever the reason, Hars was permitted to regain his senses in his own time, and eventually, to regain the company of his fellows. Lackland, finally brought up to date on just what had happened, waited for him; when he finally reached the vehicle two of the crew had to descend and practically throw him to the roof, where the rest promptly undertook first-aid measures.

With all his passengers safely aboard, some of them crowded so close to the edge of the roof that their new-found indifference to height was a trifle strained, Lackland headed uphill once more. He had warned the sailors to keep clear of the gun muzzle, and kept the weapon trained ahead of him; but there was no motion on the ridge, and no more rocks fell. Apparently the natives who had launched them had retreated to the tunnels which evidently led up from their city. This, however, was no assurance that they would not come out again; and everyone on and in the tank kept a sharp lookout for any sort of motion.

The channel they were climbing was not the same as the one they had descended, and consequently did not lead directly to the sled; but the *Bree* became visible some distance before they reached the top, owing to the tank's height. The crew members who had been left behind were still there, all looking with evident anxiety down into the city. Dondragmer muttered something in his own language con-

cerning the stupidity of not keeping an all-around watch, which Barlennan repeated in amplified form in English. Lackland was not enough of an artillerist to control the muzzle velocity of his projectiles, and in any case would have hesitated to play with any but the flattest of trajectories under this gravity, or he would have been tempted to lob a shell to the other side of the slope to attract their attention.

However, the worry proved fruitless; the tank reached the stranded sled, turned, and was hitched up to its load without further interference. Lackland, once more under way, decided that the giants had overestimated the effectiveness of the gun; an attack from close quarters—emerging, for example, from the concealed tunnel mouths which must shelter the individuals who started the rocks downhill—would leave the weapon completely helpless, since neither high explosive nor thermite shells could be used close to the *Bree* or her crew. Lackland had no hand weapons with him, and in any case would have been more than reluctant to emerge from the tank to use them. The giants were, presumably, fully as strong as Barlennan's people, and he had seen the latter do things to metal that had seriously undermined his trust in personal armor.

There was no point, however, in worrying over what might have happened. He could, of course, use such thought as the basis for plans to insure that nothing of the sort did happen later; and with great reluctance he decided that there could be no more exploration until the *Bree* had reached the waters of the eastern ocean. Barlennan, when this conclusion was offered for his consideration, agreed, though he made some reservations in his own mind. Certainly while the Flyer slept his own crew was going to keep working. They now had two *ternees* which could be used to check new plants for edibility, and Barlennan was shrewd enough to realize that he might create a market for a new foodstuff strictly on the basis of its rarity, even though it had no particular virtue as regarded taste. Lackland had already remarked that the Mesklinites were similar in many ways to his own people, though he had not mentioned caviar to the captain.

With the expedition once more under way and the tangible results of the interruption rapidly being transferred from tank roof to ship by leaping Mesklinites, Lackland made a call to Toorey, listened humbly to the expected blast when Rosten learned what he had been doing, and silenced him as before with the report that much plant tissue was now available if Rosten would send down containers for it.

By the time the rocket had landed far enough ahead of them to preserve the Mesklinite nervous systems, had waited for their arrival, picked up the

new specimens—to which Barlennan had generously added a large number of the eggs they no longer wanted to hatch—and waited once more until the tank had traveled safely out of range of its take-off blast, many more days had passed. These, except for the rocket's visit, were relatively uneventful. Every few miles a boulder-rimmed hilltop was sighted, but they carefully avoided these, and none of the giant natives were seen outside their cities. This fact rather worried Lackland, who could not imagine where or how they obtained food.

With nothing but the relatively boring job of driving to occupy his mind, he naturally formed many hypotheses about the strange creatures. These he occasionally outlined to Barlennan, but that worthy was of little help in deciding among them. It was not that he was completely uninterested, since he did have some share of normal curiosity; but his mind was of the sort which could not deal with problematical matters when there were practical ones immediately at hand. He had such problems, or felt that he had, in the investigation of the food resources of the country they were traversing, and Lackland got little of value from their conversations.

One of his own ideas, however, bothered him. He had been wondering just why the giants built their cities in such a fashion. They could hardly have been expecting either the tank or the *Bree*. It seemed a rather impractical way to repel invasion by others of their own kind who evidently, from the commonness of the custom, could hardly be taken by surprise.

Still, there was a possible reason. It was just a hypothesis; but it would account for the city design, and for the lack of natives in the country outside, and for the absence of anything resembling farm lands in the neighborhood of the cities. It involved a lot of "if-ing" on Lackland's part even to think of such an idea in the first place, and he did not mention it to Barlennan.

For one thing, it left unexplained the fact that they had come this far unmolested—if the idea were sound, they should by this time have used up a great deal more of the quick-firer's ammunition. He said nothing, therefore, and merely kept his own eyes open; but he was not too surprised, one sunrise when they had come perhaps two hundred miles from the city where Hars received his injuries, to see a small hillock ahead of the cavalcade suddenly rear up on a score of stubby, elephantine legs, lift as far as possible a head mounted on a twenty-foot neck, stare for a long moment out of a battery of eyes, and then come lumbering to meet the oncoming tank.

Barlennan for once was not riding in his usual station on the roof, but he responded at once to Lackland's call. The Earthman had stopped the tank, and there were several minutes

to decide on a course of action before the beast would reach them at its present rate of speed.

"Barl, I'm willing to bet you've never seen anything like that. Even with tissue as tough as your planet produces, it could never carry its own weight very far from the equator."

"You are quite right; I haven't. I have never heard of it, either, and don't know whether or not it's likely to be dangerous. I'm not sure I want to find out, either. Still, it's meat; maybe—"

"If you mean you don't know whether it eats meat or vegetables, I'll bet on the former," replied Lackland. "It would be a very unusual plant-eater that would come toward something even larger than itself immediately upon sighting it—unless it's stupid enough to think the tank is a female of its own species, which I very much doubt. Also, I was thinking that a large flesh-eater was the easiest way to explain why the giants never seem to come out of their cities, and have them built into such efficient traps. They probably lure any of these things that come to their hilltops by showing themselves at the bottom, as they did with us, and then kill them with rocks as they tried on the tank. It's one way of having meat delivered to your front door."

"All that may be true, but is not of present concern," Barlennan replied with some impatience. "Just what should we do with this one? That weapon of yours that broke up the rock would probably kill it, but might not leave enough meat worth collecting; while if we go out with the nets we'll be too close for you to use it safely should we get in trouble."

"You mean you'd consider using your nets on a thing that size?"

"Certainly. They would hold it, I'm sure, if only we could get it into them. The trouble is that its feet are too big to go through the meshes, and our usual method of maneuvering them into its path wouldn't do much good. We'd have to get the nets around its body and limbs somehow, and then pull them tight."

"Have you a method in mind?"

"No—and we wouldn't have time to do much of the sort anyway; he'll be here in a moment."

"Jump down and unhitch the sled. I'll take the tank forward and keep him occupied for a while, if you want. If you decide to take him on, and get in trouble later, you and your crew should be able to jump clear before I use the gun."

Barlennan followed the first part of the suggestion without hesitation or argument, slipping off the rear of the deck and undoing with a single deft motion the hitch which held the tow cable to the tank. Giving a hoot to let Lackland know the job was done, he sprang aboard the *Bree* and quickly gave his crew the details of the new situation. They would see for themselves by the time he had finished, for

the Flyer had moved the tank forward and to one side, clearing their line of sight to the great animal. For a short time they watched with much interest, some astonishment, but no fear to speak of as the tank maneuvered with its living counterpart.

The creature stopped as the machine resumed its forward motion. Its head dropped down to a yard or so from the ground, and the long neck swung as far as possible first to one side and then the other, while the multiple eyes took in the situation from all possible angles. It paid no attention to the *Bree;* either it failed to notice the small movements of the crew, or regarded the tank as a more pressing problem. As Lackland moved toward one flank, it slewed its gigantic body around to keep facing it squarely. For a moment the Earthman thought of driving it into a full hundred and eighty degree turn, so that it would be facing directly away from the ship; then he remembered that this would put the *Bree* in his line of fire should he have to use the gun, and stopped the circling maneuver when the stranded sled was at the monster's right. With that eye arrangement, it would be as likely to see the sailors moving behind it as in front, anyway, he reflected.

Once more he moved toward the animal. It had settled down, belly to the ground, when he had stopped circling; now it rose once more to its many legs and drew its head back almost into its great trunk, in what was apparently a protective gesture. Lackland stopped once more, seized a camera, and took several photographs of the creature; then, since it seemed in no mood to press an attack, he simply looked it over for a minute or two.

Its body was a trifle larger than that of an Earthly elephant; on Earth, it might have weighed eight or ten tons. The weight was distributed about evenly among the ten pairs of legs, which were short and enormously thick. Lackland doubted that the creature could move much faster than it had already. That fact would have cast some doubt upon the theory that it was a flesh-eater, since it was hard to imagine how it could catch anything to eat; but the head left little question.

It was some four feet long, and enough of the teeth protruded past the lips to show that it would have had a hard time chewing vegetables. One pair of tusks projected upward from the lower jaw for a distance of some eighteen inches, and gave some clue to their owner's method of combat. Behind the long snout the head was almost globular; at first glance the creature might have been assumed to possess considerable brain capacity, but in fact the lower part of the head was occupied by the giant jaw muscles and the upper half by a crown of half a dozen eyes. None of these were actually in the back of the head, but they extended far enough around the sides to give their owner practically full-circle vision. The coloration, on top at least, was a mixture of irregular black and white stripes which blended rather well with the present landscape, in which the ropy black vegetation extended everywhere through the snow which had not melted.

After a minute or two of waiting, the creature began to grow restless; its head protruded a little and began to swing back and forth as though looking for other enemies. Lackland, fearing that its attention would become focused on the now helpless *Bree* and her crew, moved the tank forward another couple of feet; his adversary promptly resumed its defensive attitude. This was repeated several times, at intervals which grew progressively shorter. The feinting lasted until the sun sank behind the hill to the west; as the sky grew dark Lackland, not knowing whether the beast would be willing or able to carry on a battle at night, modified the situation by turning on all the tank's lights. This, at least, would presumably prevent the creature from seeing anything in the darkness beyond, even if it were willing to face what to it must be a new and strange situation.

Quite plainly, it did not like the

lights. It blinked several times as the main spotlight burned into its eyes, and Lackland could see the great pupils contract; then, with a wailing hiss that was picked up by the roof speaker and clearly transmitted to the man inside, it lumbered a few feet forward and struck.

Lackland had not realized that he was so close — or, more correctly, that the thing could reach so far. The neck, even longer than he had at first estimated, snapped to full length, carrying the massive head forward and a trifle to one side. As it reached full travel, the head tipped a trifle and came slashing sideways. One of the great tusks clanged resoundingly against the tank's armor, and the main light went out in the same instant. Another, shriller hiss suggested to Lackland that the current feeding the light had grounded into the armor through some portion of the monster's head; but he was not taking time out to analyze the possibility. He backed away hastily, cutting the cabin lights as he did so. He did not want one of those tusks striking a cabin port with the force it had just expended on the upper armor. Now only the running lights, mounted low in the front of the vehicle and set well into the armor, were illuminating the scene. The animal, encouraged by Lackland's retreat, lurched forward again and struck at one of these.

The Earthman did not dare extinguish it, since it would have left him effectively blind; but he sent a frantic call on the radio.

"Barl! Are you doing anything about your nets? If you're not about ready for action, I'm going to have to use the gun on this thing, meat or no meat. You'll have to stay away if I do; he's so close that high explosive would endanger the tank, and I'll have to use thermite."

"The nets are not ready, but if you'll lead him back a few more yards he'll be downwind of the ship, and we can take care of him another way."

"All right." Lackland did not know what the other way could be, and was more than a little doubtful of its effectiveness whatever it was; but as long as retreat would suit the captain he was prepared to co-operate. It did not for an instant occur to him that Barlennan's weapon might endanger the tank; and, in all fairness, it probably did not occur to Barlennan either.

The Earthman, by dint of repeated and hasty withdrawals, kept the tusks from his plating most of the time; the monster did not seem to have the intelligence to anticipate motion on his part. Actually it probably did not need that much brain, since its own head motions were so rapid that very few creatures were probably able to dodge it successfully. Lackland avoided trouble principally by remaining near the limit of its reach; the motion of the bulky body, of course, was slow, clumsy, and easy to anticipate. Two

or three minutes of this dodging satisfied Barlennan.

He, too, had been busy in those minutes. On the leeward rafts, toward the dueling monster and machine, were four devices closely resembling bellows, with hoppers mounted above their nozzles. Two sailors were now at each bellows, and at their captain's signal began pumping for all they were worth. At the same time a third operator manipulated the hopper and sent a stream of fine dust flowing into the current from the nozzle. This was picked up by the wind and carried toward the combatants. The darkness made it difficult to estimate its progress; but Barlennan was a good judge of wind, and after a few moments of pumping suddenly snapped out another order.

The hopper crews promptly did something at the nozzle of the bellows each was tending; and as they did so, a roaring sheet of flame spread downwind from the *Bree* to envelope both of the fighters. The ship's crew were already sheltered behind their tarpaulins, even the "gunners" being protected by flaps of fabric that formed part of their weapons; but the vegetation that sprouted through the snow was neither tall nor dense enough to shelter the fighters.

Lackland, using words that he had never taught Barlennan, hurled the tank backward out of the flame cloud with a prayer for the quartz in his portholes. His adversary, though evidently as anxious to dodge, seemed to lack the necessary control. It lurched first one way, then the other, seeking escape. The flame died out in seconds, leaving a cloud of dense white smoke which gleamed in the tank's running lights; but either the brief fire had been sufficient or the smoke was equally deadly, for the monster's disorganization grew steadily worse. Its aimless steps grew shorter and feebler as the legs gradually lost the power to support its vast bulk, and presently it stumbled and rolled on one side. The legs kicked frantically for a time, while the long neck alternately retracted and stretched to full length, lashing the fanged head frantically through the air and against the ground.

By sunrise the only remaining motion was an occasional twitch of head or leg; within a minute or two thereafter all activity of the giant creature ceased. The crew of the *Bree* had already swarmed overboard and across the dark patch where the snow had boiled from the ground, bent on acquiring meat. The deadly white cloud was farther downwind now, and gradually settling. Lackland was surprised to note traces of *black* dust on the snow where the cloud had passed.

"Barl, what on Earth—or rather, on Mesklin—was the stuff you used for that fire cloud? And didn't it occur to you that it might crack the windows in this tank?" The captain, who had remained on the ship and was near one of his radios, answered promptly.

"I'm sorry, Charles; I didn't know what your windows are made of, and never thought of our flame cloud as a danger to your great machine. I will be more careful next time. The fuel is simply a dust which we obtain from certain plants—it is found as fairly large crystals, which we have to pulverize very carefully and away from all light."

Lackland nodded slowly, digesting this information. His chemical knowledge was slight, but it was sufficient to make a good guess at the fuel's nature. Ignited by light—burned in hydrogen with a white cloud—black specks on the snow—it could, as far as he knew, be only one thing. Chlorine is solid at Mesklin's temperature; it combines violently with hydrogen, and hydrogen chloride is white when in fine powder form; methane snow boiled from the ground would also give up its hydrogen to the voracious element and leave carbon. Interesting plant life this world sported! He must make another report to Toorey—or perhaps he had better save this tidbit in case he annoyed Rosten again.

"I am very sorry I endangered your tank." Barlennan still seemed to feel apologetic. "Perhaps we had better let you deal with such creatures with your gun; or perhaps you could teach us to use it. Is it, like the radios, especially built to work on Mesklin?" The captain wondered if he had gone too far with this suggestion, but decided it had been worth it. He could neither see nor interpret Lackland's answering smile.

"No, the gun was not remade or changed for this world, Barl. It works fairly well here, but I'm afraid it would be pretty useless in your country. Let's see—it's mounted about eight feet off the ground, and its muzzle velocity is about fifteen hundred feet per second—nothing wonderful as firearms go. If I fired it horizontally at the south pole, the shell would strike the ground about thirty of your lengths, less than fifty feet, from the muzzle. That's better than anything else you'd be likely to have, I admit, but I'm afraid projectile weapons will always be pretty useless to you and your people." He picked up a slide rule, and added one more sentence after employing it for a moment. "The farthest this thing could possibly shoot at your pole would be just about three times the distance I mentioned—one hundred fifty feet."

Barlennan, disappointed, said nothing further. Several days were spent in butchering the dead monster. Lackland salvaged the skull as a further protection from Rosten's ire, and the cavalcade resumed its journey.

Mile after mile, day after day, the tank and its tow inched onward. Still they sighted occasional cities of the rock-rollers; two or three times they picked up food for Lackland which had been left in their path by the

rocket; quite frequently they encountered large animals, some like the one Barlennan's fire had slain, others very different in size and build. Enough of them were carnivorous to explain the habits of the rock-rollers and apparently justify Lackland's ideas about these people; enough herbivorous forms existed to support the flesh-eaters in luxury.

The country grew hillier as they progressed, and the larger animals seemed to prefer the hills, so their encounters increased in frequency. Usually the tank outran the carnivores, but sometimes it could not. When this happened the gun was used, unless the position permitted the use of fire without endangering ship or tank. Twice specimens of the giant herbivores were netted and killed by the crew to furnish meat, much to Lackland's admiration. The discrepancy in size was far greater than that existing between Earthly elephants and the African pygmies who sometimes hunted them.

With the rising ground the river, which they had followed intermittently for hundreds of miles, shrank and split into numerous smaller streams. Two of these tributaries had been rather difficult to cross, requiring that the *Bree* be unlashed from the sled and floated across at the end of a towrope while tank and sled drove below the surface on the river bed. Now, however, the streams had become so narrow that the sled actually bridged them and no such delays occurred.

At long last, fully twelve hundred miles from where the *Bree* had wintered and some three hundred south of the equator, with Lackland bowing under an additional half gravity, the streams began to bear definitely in the general direction of their travel. Both Lackland and Barlennan let several days pass before mentioning it, wishing to be sure, but at last there was no more doubt that they were in the watershed leading to the eastern ocean. Morale, which had never been low, nevertheless improved noticeably; and several sailors could now always be found on the tank's roof hoping for the first glimpse of the sea as they reached each hilltop. Even Lackland, tired sometimes to the point of nausea, brightened up; and as his relief was the greater, so proportionately greater was his shock and dismay when they came, with practically no warning, to the edge of an escarpment; an almost sheer drop of over sixty feet, stretching as far as the eye could see at right angles to their course.

IX.

For long moments nothing was said. Both Lackland and Barlennan, who had worked so carefully over the photographs from which the map of their journey had been prepared, were far too astonished to speak. The crew, though by no means devoid of initiative, decided collectively and at the

first glance to leave this problem to their captain and his alien friend.

"How could it have been there?" Barlennan was first to speak. "I can see it's not high, compared to the vessel from which your pictures were taken, but should it not have cast a shadow far across the country below, in the minutes before sunset?"

"It should, Barl, and I can think of only one reason it escaped us. Each picture, you recall, covered many square miles; one alone would include all the land we can see from here, and much more. The picture that does cover this area must have been made between sunrise and noon, when there would have been no shadow."

"Then this cliff does not extend past the boundary of that one picture?"

"Possibly; or, just as possibly, it chanced that two or three adjacent shots were all made in the morning—I don't know just what course the photo rocket flew. If, as I should imagine, it went east and west, it wouldn't be too great a coincidence for it to pass the cliff several times running at about the same time of day.

"Still, there's little point in going through that question. The real problem, since the cliff obviously *does* exist, is how to continue our journey." That question produced another silence, which lasted for some time. It was broken, to the surprise of at least two people, by the first mate.

"Would it not be advisable to have the Flyer's friends far above learn for us just how far this cliff extends to either side? It may be possible to descend an easier slope without too great a detour. It should not be hard for them to make new maps, if this cliff was missed on the first." Barlennan translated this remark, which was made in the mate's own language. Lackland raised his eyebrows.

"Your friend may as well speak English himself, Barl—he appears to know enough to understand our last conversation. Or do you have some means of communicating it to him that I don't know about?"

Barlennan whirled on his mate, startled and, after a moment, confused. He had not reported the conversation to Dondragmer; evidently the Flyer was right—his mate had learned some English. Unfortunately, however, the second guess had also some truth; Barlennan had long been sure that many of the sounds his vocal apparatus could produce were not audible to the Earthman, though he could not guess at the reason. For several seconds he was confused, trying to decide whether it would be better to reveal Dondragmer's ability, the secret of their communication, both together, or, if he could talk fast enough, neither.

Barlennan had nothing against the Earthman; but he wanted something from him that he suspected the alien would not give willingly. Any secrets which might later be used in tricking him should, for that reason, be pre-

served. On the other hand, if he tried to talk his way out of revealing a fact and were detected, Lackland could hardly fail to become both suspicious and distrustful. Too much time spent in reaching a decision could have this effect, too; some answer must be made at once. Barlennan did the best he could.

"Apparently Dondragmer is sharper than I realized. Is it true that you have learned some of the Flyer's language, Don?" This he asked in English, and in a pitch that Lackland could hear. In the shriller tones that his own language employed so much he added, "Tell the truth — I want to cover up as long as possible the fact that we can talk without his hearing. Answer in his own language, if you can." The mate obeyed, though not even his captain could have guessed at his thoughts.

"I have learned much of your language, Charles Lackland. I did not realize you would object."

"I don't mind at all, Don; I am very pleased, and, I admit, surprised. I would gladly have taught you as well as Barl if you had come to my station. Since you have learned on your own—I suppose from comparing our conversations and your captain's resultant activities—please enter our discussion. The suggestion you made a moment ago was sound; I will call the Toorey station at once."

The operator on the moon answered immediately, since a constant guard was now being maintained on the tank's main transmitter frequency through several relay stations drifting in Mesklin's outer ring. He indicated understanding of the problem, and promised that a survey would be made as quickly as possible. Lackland, knowing the expense of operating even a hydrogen-iron rocket near Mesklin, suspected that his mission was now the only hope the expedition leader retained of recovering the gravity data in the downed rocket.

"As quickly as possible," however, meant quite a number of Mesklin's days; and while waiting the trio endeavored to formulate other plans in case the cliff could not be rounded within a reasonable distance.

Physically, of course, the rocket was perfectly capable of lifting the weight of the *Bree* and its crew. If that had been practical, however, it would have been done long since; unfortunately, there was no method of slinging a load outside the craft, and the crew could not tolerate for an instant either the temperature or the atmosphere inside. If the pilot wore armor and the rocket were opened to Mesklinite conditions, it was more than likely that drastic results would occur to the internal mechanism of the ship. Also the *Bree*, like the sled she was now riding, would have to be disassembled to get through even the cargo lock, though her construction made that fact merely a nuisance

rather than an impossibility. All these difficulties had been considered before Rosten had approved construction of the sled.

One or two of the sailors expressed a willingness to jump down the cliff, to Barlennan's anxiety—he felt that the natural fear of height should not be replaced with *complete* contempt, even though the entire crew now shared his willingness to climb and jump. Lackland was called upon to help dissuade these foolhardy individuals, which he managed to do by computing that the sixty-foot drop of the cliff was about equal to a one-foot fall at the latitude of their home country. This revived enough memory of childhood experience to put a stop to the idea. The captain, thinking over this event afterward, realized that by his own lifelong standards he had a crew composed entirely of lunatics, with himself well to the front in degree of aberration; but he was fairly sure that this particular form of insanity was going to be useful.

Ideas more practical than these were not forthcoming for some time; and Lackland took the opportunity to catch up on his sleep, which he badly needed. He had had two long sessions in his bunk, interrupted by a hearty meal, when the report of the surveying rocket came in. It was brief and discouraging. The cliff ran into the sea some six hundred miles northeast of their present location, almost exactly on the equator. In the opposite direction it ran for some twelve hundred miles, growing very gradually lower, and disappearing completely at about the five-gravity latitude. It was not perfectly straight, showing a deep bend away from the ocean at one point; the tank had struck it at this point.

Two rivers fell over its edge within the limits of the bay, and the tank was neatly caught between them, since in the interests of common sanity the *Bree* could never be towed across either without first going many miles upstream from the tremendous waterfalls. One of the falls was about thirty miles away, almost due south; the other, approximately a hundred miles distant to the north and east around the curve of the cliff. The rocket had not, of course, been able to examine the entire stretch of escarpment in complete detail from the altitude it had had to maintain, but the interpreter was very doubtful that the tank could scale it at any point. The best bet, however, would be near one of the waterfalls, where erosion was visible and might conceivably have created negotiable paths.

"How can a cliff like this form?" Lackland asked resentfully when he had heard all this. "Eighteen hundred miles of ridge just high enough to be a nuisance, and we have to run right into it. I bet it's the only thing of its kind on the planet."

"Don't bet too much," the surveyor

retorted. "The physiography boys just nodded in pleasure when I told them about it. One of them said he was surprised you hadn't hit one earlier; then another piped up and said actually you'd expect most of them farther from the equator, so it wasn't surprising at all. They were still at it when I left them. I guess you're lucky that your small friend is going to do most of the traveling for you."

"That's a thought." Lackland paused as another idea struck him. "If these faults are so common, you might tell me whether there are any more between here and the sea. Will you have to run another survey?"

"No. I saw the geologists before I started on this one, and looked. If you can get down this step, you're all right—in fact, you could launch your friend's ship in the river at the foot and he could make it alone. The river narrows in some places and the current is probably swift, but there don't seem to be any rapids or falls in either stream between the cliff and the ocean. Your only remaining problem is to get that sailboat hoisted over the edge."

"To get . . . hm-m-m. I know you meant that figuratively, Hank, but you may have something there. Thanks for everything; I may want to talk to you later."

Lackland turned away from the set and lay back on his bunk, thinking furiously. He had never seen the *Bree* afloat; she had been beached before he encountered Barlennan, and on the recent occasions when he had towed her across rivers he had himself been below the surface most of the time in the tank. Therefore, he did not know how high the vessel floated. Still, to float at all on an ocean of liquid methane she must be extremely light, since methane is less than half as dense as water. Also she was not hollow—did not float, that is, by virtue of a large central air space which lowered her average density, as does a steel ship on Earth. The "wood" of which the *Bree* was made was light enough to float on methane and support the ship's crew and a substantial cargo as well.

An individual raft, therefore, could not weigh more than a few ounces—perhaps a couple of pounds, on this world at this point. At that rate, Lackland himself could stand on the edge of the cliff and let down several rafts at a time; any two sailors could probably lift the ship bodily, if they could be persuaded to get under it. Lackland himself had no rope or cable other than what he was using to tow the sled; but that was one commodity of which the *Bree* herself had an ample supply. The sailors should certainly be able to rig hoisting gear that would take care of the situation—or could they?

On Earth it would be elementary seamanship; on Mesklin, with these startling but understandable preju-

dices against lifting and jumping and throwing and everything else involving any height, the situation might be different. Well, Barlennan's sailors could at least tie knots, and the idea of towing should not be too strange to them now; so undoubtedly the matter could be straightened out.

The real, final problem was whether or not the sailors would object to being lowered over the cliff along with their ship. Some men might have laid that question aside as strictly a problem for the ship's captain, but Lackland more than suspected that he would have to contribute to its solution.

Barlennan's opinion, however, was certainly needed at this point; and reaching out a heavy arm, Lackland energized his smaller transmitter and called his tiny friend.

"Barl, I've been wondering. Why couldn't your people lower the ship over the cliff on cables, one raft at a time, and reassemble it at the bottom?"

"How would you get down?"

"I wouldn't. There is a large river about thirty miles south of here that should be navigable all the way to the sea, if Hank Stearman's report is accurate. What I'm suggesting is that I tow you over to the fall, help you any way I can in getting the *Bree* over the edge, watch you launch her in the river, and wish you the best of luck—all we can do for you from then

on is give weather and navigation information, as we agreed. You have ropes, do you not, which will hold the weight of a raft?"

"Of course; ordinary cordage would take the weight of the entire ship in this neighborhood. We'd have to snub the lines against trees or your tank or something like that; the whole crew together couldn't furnish traction enough for the job. Still, that's no problem. I'd say you had the answer, Charles."

"How about the personnel? Will they like the idea of being lowered down that way?"

Barlennan thought for a moment. "I think it will be all right. I'll send them down on the rafts, with a job to do like fending off from the cliff. That will keep them from looking straight down, and sufficiently occupied so they shouldn't be thinking of the height. Anyway, with this light feeling everyone has"—Lackland groaned silently—"no one's much afraid of a fall anyway; not even as much as they should be. We'll make that part, all right. Had we better start for that waterfall right away?"

"All right." Lackland hauled himself to his controls, suddenly very weary. His part of the job was nearly over, sooner than he had expected, and his body shrieked for relief from the endless weight it had dragged around for the last seven months. Perhaps he shouldn't have stayed through the winter, but tired as he was he could not regret it.

The tank swung to the right and started moving once more, parallel to the cliff edge two hundred yards away. The Mesklinites might be getting over their horror of heights, but Lackland was developing one. Besides, he had never attempted to repair the main spotlight since their first battle with Mesklin's animal life, and he had no intention of driving close to that edge at night with only the running lights to guide him. They pointed too nearly straight ahead for comfort—the edge of their beams might be confused with the rim of the escarpment until it was too late to rectify the error. Even at this distance Lackland was uneasy after sunset; and he finally asked Barlennan to have either himself or Dondragmer ride on the tank to give warning if he began to slant to the left. He had learned long since that the natives, while not in a class with Terrestrial cats or owls, could see at night rather better than a man.

They made the waterfall in a single lap of about twenty days. Both natives and Earthman heard it long before they arrived, at first a vague trembling in the air that gradually rose through a muted thunder to a roar that put even the Mesklinite vocal equipment to shame. It was day when they came in sight of it, and Lackland stopped involuntarily as they did so. The river was half a mile wide where it reached the brink,

and smooth as glass—no rocks or other irregularities appeared to exist in its bed. It simply curled over the edge and spilled downward.

The fall had eroded its way for a full mile back from the cliff line; and they had a splendid view of the gorge. The lack of ripple marks gave no clue to the liquid's speed of fall, but the violence with which the spray erupted from the bottom did. Even in this gravity and atmosphere a permanent cloud of mist hid the lower half of the curved sheet, thinning gradually away from its foot to reveal the roiled, eddied surface of the lower river. There was no wind except that created by the fall itself, and the stream grew rapidly calmer as it moved smoothly away toward the ocean.

Lackland looked for a rainbow in the spray with something like a tinge of homesickness; but the sun was in the wrong position, and he wasn't sure that methane drops would produce one anyway. He must ask one of the physicists, he decided.

The crew of the *Bree* had gone overboard the moment the tank had stopped; and the way they were strung out along the rim of the gorge indicated that there would not be much morale difficulty during the descent. Now Barlennan called them back to the ship, and work commenced at once. Lackland relaxed once more while cordage was dragged forth and a plumb line dropped over the edge to secure a more precise measure of the cliff's height.

Some of the sailors began securing all loose gear about the rafts, though preparations for the original journey had left little to do in this respect; others reached down between the rafts and began unfastening the lashings which held them together and checking at the same time the buffers that held them safely apart. They were fast workers, and raft after raft was dragged away from the main body of the ship.

Barlennan and his first mate, once this work was well under way, went over to the edge to determine the best place for the lowering operation. The gorge itself was rejected at once; the river within its walls was too rough, even if they had wanted to do their reassembling while afloat. It turned out, however, that almost any point on the cliff face would be suitable, so the officers quickly chose one as close as possible to the mouth of the gorge. The reassembled ship or its separate parts would have to be dragged to the river without the tank's help, and there was no point in making the journey any longer than necessary.

A scaffold of masts was arranged at the edge to give a point of suspension far enough out to prevent rope friction, though the masts were not long enough to hold a raft completely away from the cliff face; a block and tackle, which Lackland observed with

interest, was attached to the scaffold, and the first raft dragged into position. All this was improvised, though the man did not realize it; the natives were not used to lifting objects any distance. It was adjusted in a rope sling that would carry it horizontally, the main cable attached to the sling and hitched around a tree, several sailors seized the cable, and the raft was pushed over the edge.

Everything held up, but Dondragmer and his captain inspected each part very, very carefully before the mate and one of the crew crawled aboard the platform that hung somewhat slanted against the rock an inch or so below the edge. For a moment after they had gone aboard everyone watched expectantly; but again nothing happened, and Dondragmer finally gave the signal to lower away.

All the crew members who were not on the cable rushed to the edge to watch the descent. Lackland would have liked to watch it himself, but had no intention of venturing either the tank or his armored person close enough to do so. Beside his own uneasiness at the height, the sight of the cordage the Mesklinites were using made him unhappy; it looked as though an Earthly clerk would scorn it for tying a two-pound bag of sugar, and knowing the qualities of Mesklinite animal and plant tissues didn't make it look any better. Still, no one seemed to worry, and sailors should certainly know ropes.

An excited hooting and general withdrawal from the edge indicated that safe arrival of the first raft, and Lackland blinked as the sailors proceeded to stack several more on top of each other while the cable was being drawn up. Apparently no more time than could be helped was to be wasted. Confident as he was in Barlennan's judgment, the Earthman suddenly decided he wanted to watch the stack of rafts make the descent. He was on the point of donning his armor when he remembered that it was not necessary; he relaxed again, called Barlennan, and asked him to arrange one or more of the little communicators so that their "eyes" could cover the desired activity. The captain complied immediately, having a sailor lash one of the set to the scaffold so that it looked almost straight down and placing another on top of the pile of rafts which had just been secured in their rope sling.

Lackland switched from one to the other as the operation proceeded. The first was a trifle more disconcerting than he had expected, since the supporting cable was visible for only a few feet from the pickup lens and the load seemed to be floating down without support; the other gave him a view of the cliff face that would undoubtedly have been highly interesting to a geologist. With the descent half completed it occurred to him to call Toorey to invite the interested parties to watch. The geology depart-

ment responded and commented freely during the rest of the process, but as far as Lackland could tell their remarks were mostly of the "it's obvious that" and "I told you so" variety. None of them bothered to tune in any of the "eyes" which were still with the *Bree's* gear, to get a look at the natives.

Load after load went down, with little variety to make the operation more interesting. Toward the end a longer cable was installed and the lowering was done from below, since the greater part of the crew had now descended; and Lackland had a suspicion of the reason when Barlennan finally turned away from the scene of action and leaped toward the tank. The radio which had been used from that position was permanently mounted, and had not been taken down with the others.

"We have only about two more loads, Charles," the captain said. "There will be a slight problem in connection with the last one. We'd like to keep all our gear if possible, which means dismantling and sending down the masts used for our lowering tackle. We don't want to throw them down because we're not sure they'd take it—the soil below is very rocky. Would you be willing to get into your armor and lower the final load by hand? I will arrange for it to consist of one raft, those few masts and the associated tackle, and myself."

Lackland was startled by the last item. "You mean you would trust yourself to my strength, knowing that I'm already under three and a half times my normal gravity and will have the weight of my armor as well?"

"Certainly. The armor will easily be heavy enough to serve as anchor, and if you take a turn of the rope about your own body you can pay it out gradually. I don't see any difficulty; the load will be only a few of your pounds."

"Not that way, perhaps, but there's another point. Your rope is very thin indeed, and the handling clamps of my armor are somewhat clumsy when it comes to managing small objects. What if the cord slips out of my grip?"

That silenced Barlennan for a moment.

"What is the smallest object you could handle with reasonable security?"

"Oh—one of your masts, I should say."

"There is no trouble, then. We will wind the rope about a mast, and you can use that as a windlass. You can toss mast and rope over afterwards; if the stick is broken the loss will not be too great." Lackland shrugged.

"It's your health and property, Barl. I don't have to say I'll be careful; I wouldn't want anything to happen to you, especially through my negligence. I'll be out shortly."

The Mesklinite, satisfied, leaped back to the ground and began to give the necessary orders to the few remaining sailors. The second last load went down with all of these; and a few moments later the Earthman emerged from his conveyance.

Barlennan was waiting for him. A single raft now lay at the cliff edge, tied in its sling and ready to go. A radio and the bundled remains of the scaffolding lay upon it, and the captain was dragging the mast which had the line wrapped about it toward Lackland. The man's approach was slow, for the terrible fatigue seemed to grow with every instant; but he finally reached a point about ten feet from the edge, reached over as far as his clumsy garment would permit, and took the mast from the tiny being who had reared up to meet him. Without a word of caution or any other suggestion of doubt in his big friend, Barlennan turned back to the raft, made sure its cargo was lashed securely, pushed it until it was teetering on the edge of the cliff, and climbed aboard.

He turned for a last look at Lackland, and the man could have sworn that he winked. Then, "Hang on, Charles," came the voice over the radio; and the captain stepped deliberately to the outer edge of the precariously balanced raft. His pincers were securely caught in the lashings, which was all that kept him aboard as the platform teetered once and slipped over the rim.

There was enough slack in the line Lackland was holding to permit a couple of feet of fall; and raft and passenger vanished instantly. A sharp jerk told the man that at least the line was still holding, and an instant later Barlennan's voice cheerfully conveyed the same information. "Lower away!" was the concluding phrase; and Lackland obeyed.

It was rather like handling a kite, at least in the form of windlass he was using—simply a cord wound on a stick. It revived childhood memories; but if he lost this kite he would, he knew, be much longer in getting over it. He did not have the best possible grip on the mast, and he slowly pivoted so as to wind the cord about his body before he tried to change holds. Then, satisfied, he paid out slowly.

Barlennan's voice came at intervals, always with something encouraging; it was as though the midget had an idea of the anxiety in Lackland's mind. "Halfway now." "Smooth going." "You know, I don't mind looking down even this far, now." "Almost there—just a little more—that's it; I'm down. Hold on to the tackle for a little, please; I'll tell you when the area is clear and it's all right to throw it down."

Lackland continued to obey. For a keepsake, he tried to break off a foot or two from the end of the cable, but

found it impossible even with armored hands. However, the edge of one of the locking snaps on his armor proved sharp enough to cut the stuff, and he wound the souvenir around his arm before starting to carry out the remaining requests of his ally.

"We have things out from underneath, Charles; you can let go of your end of the rope and toss the mast over whenever you want." The fine cord slithered instantly out of sight, and the ten-inch twig that was one of the *Bree's* main booms followed. *Seeing* things fall free in triple gravity, Lackland found, was even worse than thinking about it. Maybe it would be better at the poles—then you couldn't see them at all. Not where an object falls some two miles in the first second! But perhaps the abrupt vanishing would be just as hard on the nerves. Lackland shrugged off these thoughts, and turned back to the tank.

For the couple of hours the process took he watched the *Bree's* reassembly through the vision sets. With just the traces of a wish that he might go along, he saw the cluster of rafts pushed out into the broad stream, and listened to the farewells of Barlennan, Dondragmer, and the crew—he could guess at the meaning of the sounds uttered even by the sailors who spoke no English. Presently the current bore the vessel far enough from the cliff to be seen from the tank's position. Lackland raised a hand silently in farewell, and watched her as she shrank slowly and finally vanished toward the distant sea.

For long minutes he sat silently; then roused himself to call the Toorey base.

"You may as well come and pick me up. I've done all I can on the surface."

X.

The river, once away from the vicinity of the great fall, was broad and slow. At first the air trapped by the descending water furnished a breeze toward the sea, and Barlennan ordered the sails set to take advantage of it; but this presently died out and left the ship at the mercy of the current. This was going in the right direction, however, and no one complained. The land adventure had been interesting and profitable, for several of the plant products collected could certainly be sold at high prices once they reached home; but no one was sorry to be afloat again. Some looked back at the waterfall as long as it could be seen, and once everyone stared into the west to catch a glimpse of the rocket as the muted thunder of its approach reached them; but in general the feeling was one of anticipation.

A new sea lay ahead—one that no member of their nation had ever ridden. There would be new and strange people to meet, certainly to

trade, perhaps to fight as well. Captain Cook sailing into the South Seas for the first time must have felt much as these beings felt—sailors as well as officers, for any who were so lacking in imagination as to go wherever Barlennan ordered without thought or interest had long since dropped away from his crew.

There were no present worries; the Flyers far above had said that river had no falls or rapids all the way to the sea. There were none for the immediate future, either; there was so much food aboard that most of the sailors did not even bother to fish, much as they normally preferred fresh food. For the moment, there was practically nothing to do except speculate on what the future might hold; and morale was so high that not even Dondragmer felt there was any need of inventing work to stop talk.

The banks on either side began to draw more and more attention as they proceeded. During their overland journey they had become accustomed to the sight of an occasional upright growth of the sort that the Flyer had called a "tree," usually seeing one every few days. They had been fascinating objects at first, and had, indeed, proved a source of one of the foods they planned to sell at home.

Now the trees were becoming more and more numerous, threatening to replace the more familiar sprawling, rope-branched plants entirely, and Barlennan began to wonder if even a colony planted here might not be able to support itself by trade in what the Flyer had called fir-cones—he had said the fruit closely resembled an object that went by that name on his own world. Of course, if they proved too common the price would go down—but no, they would never be common on the shores of *his* ocean while travel between the seas was this difficult. It was a project worth considering. Of course, some of the giant natives they had met above the cliff might be here too, and that could be either good or bad. Depending. The last thought was a cryptic one, and Barlennan shifted his speculation to other directions.

For a long time, fully fifty miles, no intelligent life was sighted, though animals in fair numbers were seen along the banks. The river itself teemed with fish, though none appeared large enough to constitute a danger to the *Bree*. Eventually the river on either side became lined with trees, which extended no one could tell how far inland; and Barlennan, spurred by curiosity, ordered the ship steered closer to shore to see what a forest—he had no such word for it, of course—looked like.

It was fairly bright even in the depths of the woods, since the trees did not spread out at the top nearly as much as is common on Earth, but it was strange enough. Drifting along almost in the shadow of the weird

plants, many of the crew felt a resurgence of their old terror of having solid objects overhead; and there was a general feeling of relief when the captain silently gestured the helmsman to steer away from the bank once more.

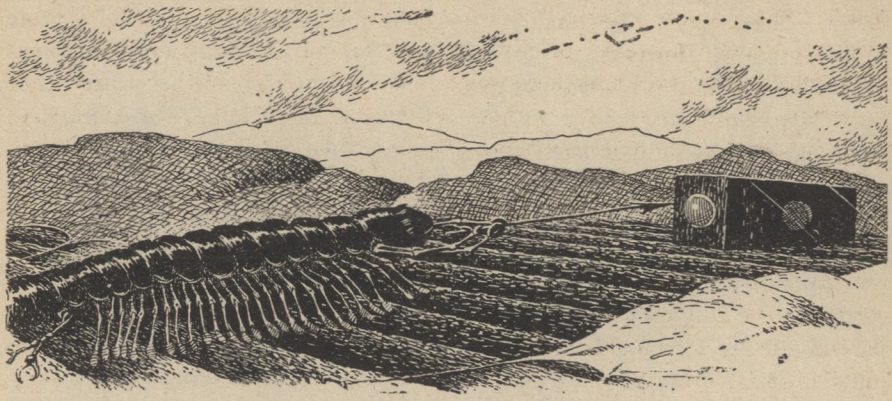
If anyone lived there they were welcome to it. Dondragmer expressed this opinion aloud, and was answered by a general mutter of approval. Unfortunately, his words were either not heard or not understood by listeners on the bank. Perhaps they were not actually afraid that the *Bree's* crew meant to take their forest away from them, but they decided to take no chances; and once more the visitors from high-weight suffered an experience with projectile weapons.

The armory this time consisted entirely of spears. Six of them flew silently from the top of the bank and stuck quivering in the *Bree's* deck; two more glanced from the protective shells of sailors and clattered about on the rafts before coming to rest. The sailors who had been hit leaped convulsively from pure reflex, and both landed yards away in the river. They swam back and clambered aboard without assistance, for all eyes were directed toward the source of the mysterious attack. Without orders the helmsman angled more sharply toward the center of the river.

"I wonder who sent those—and if they used a machine like the Flyer's. There wasn't the same noise." Barlennan spoke half aloud, not caring whether he were answered. Terblannen wrenched one of the spears out of the deck and examined its hardwood point; then experimentally, he threw it back at the receding shore. Since throwing was a completely new art to him, except for experiments such as he had made in getting objects to the top of the tank in the stone-rollers' city, he threw it as a child throws a stick, and it went spinning end over end back to the woods. Barlennan's question was partly answered; short as his crewman's arms were, the weapon reached the bank easily.

The invisible attackers at least didn't *need* anything like Lackland's gun, if they were anything like ordinary people physically. They might, of course, be giants such as they had met already; Barlennan suddenly realized that he had no idea of the physical strength of those beings, since none of his crew had become involved hand-to-hand with them in that fight. There seemed no way to tell what the present attackers were, and the captain had no intention of finding out by direct examination.

The *Bree* kept on downstream, while an account of the affair went winging up to Lackland on distant Toorey. It was a comfort, felt even by the sailors who could not understand his language, to be able to talk to this mysterious and powerful being even though he was no longer with them. His answer in the present case was a



little mysterious, even to Barlennan.

"For a planet that should be dead and in cold storage, Mesklin can certainly keep a person hopping." Nothing more came of the incident.

For fully a hundred miles the forest continued while the river widened gradually. The *Bree* kept out in midstream for a time after her single encounter with the forest dwellers, but even that did not keep her completely out of trouble. Only a few days after the arrival of the spears, a small clearing was sighted on the left bank. His view point only a few inches off the surface prevented Barlennan from seeing as well as he would have liked, but there were certainly objects in that clearing worthy of examination.

After some hesitation he ordered the ship a little closer to that bank. The objects looked a little like trees, but were shorter and thicker. Had he been a little higher he would have seen small openings in them just above ground level which might have been informative; Lackland, watching through one of the vision sets, compared the things at once to pictures he had seen of the huts of African natives, but he said nothing yet.

Actually he was more interested in a number of other items lying partly in and partly out of the river in front of what he already assumed to be a village. They might have been logs or crocodiles, for they were not too clearly visible at this distance, but he rather suspected they were canoes. It would be interesting to see how Barlennan reacted to a boat so radically different from his own.

It was quite a while, however, before anyone on the *Bree* realized that the "logs" were canoes or the other mysterious objects dwellings. For a time, in fact, Lackland feared that they would drift on downstream without ever finding out; their recent ex-

perience had made Barlennan very cautious indeed. However, there were others besides Lackland who did not want the ship to drift by without stopping, and as she approached the point on her course opposite the village a red-and-black flood of bodies poured over the bank and proved that the Earthman's conjecture had been correct. The loglike objects were pushed into the stream, each carrying fully a dozen creatures who apparently belonged to the identical species as the *Bree's* crew. They were certainly alike in shape, size, and coloring; and as they approached the ship they uttered ear-splitting hoots precisely like those Lackland had heard on occasion from his small friends.

The canoes were apparently dugouts, hollowed out sufficiently so that only the head end of each crew member could be seen; from their distribution, Lackland suspected that they lay herringbone fashion inside, with the paddles operated by the foremost sets of pincer-equipped arms. Actually they sculled rather than paddled; the blades were not lifted from the water at any time, and there seemed to be little back-and-forth movement.

None of Barlennan's crew analyzed these points; what interested them was the fact that the canoes were approaching far more rapidly than the *Bree* had ever moved except in a full gale. If their paddlers should prove hostile, as recent incidents made probable, there was nothing that could be done to avoid a fight; there was practically no wind, and what there was blew straight toward the left bank from which the canoes had come.

The crew unobtrusively took up their stations on the outer rafts, weapons beside them. The leeward flamethrowers were manned, though Barlennan doubted that they would be useful under these conditions. Krendoranic, the munitions officer, was working furiously at one of his storage bins, but no one knew what he was up to; there was no standard procedure for his department in such a situation. Actually, the entire defense routine of the ship was being upset by the lack of wind, something that almost never occurred on the open sea.

Any chance there might have been to make effective use of the flame dust vanished as the fleet of canoes opened out to surround the *Bree*. Two or three yards from her on all sides they glided to a stop, and for a minute or two there was silence. To Lackland's intense annoyance, the sun set at this point and he was no longer able to see what went on. The next eight minutes he had to spend trying to attach meaning to the weird sounds that came over the set, which was not a very profitable effort since none of them formed words in any language he knew. There was nothing that denoted any violent activity; apparently the two crews were simply speaking to each other in experimental fashion.

He judged, however, that they could find no common language, since there appeared to be nothing like a sustained conversation.

With sunrise, however, he discovered that the night had not been wholly uneventful. By rights, the *Bree* should have drifted some distance downstream during the darkness; actually, she was still opposite the village. Furthermore she was no longer far out in the river, but only a few yards from the bank.

Lackland was about to ask Barlennan what he meant by taking such a risk, and also how he had managed to maneuver the *Bree*, when it became evident that the captain was just as surprised as he at this turn of events. His voice could be heard issuing a steady stream of comment, orders, and, Lackland suspected, invective in his own language, rising steadily in pitch until he finally seemed to lose his voice entirely. The Earthman could have learned much from that fact if he had been able to interpret it correctly.

Instead, he failed even to notice it particularly. Wearing a slightly annoyed expression, he turned to one of the men sitting beside him—the receiving screens for Barlennan's vision sets had been set up in a small auditorium in the station on Toorey, and expedition members who had nothing else to do could usually be found there—with the remark:

"Barl has let himself get into trouble already. I know he's a smart fellow, but with over thirty thousand miles to go I don't like to see him getting held up in the first hundred."

"Aren't you going to help him? There are a couple of billion dollars, not to mention a lot of reputations, riding with him."

"What can I do? All I could give would be advice, and he can size up the situation better than I can. He can see it better, and is dealing with his own sort of people."

"From what I can see, they're about as much his sort as the South Sea Islanders were Captain Cook's. I grant they appear to be the same species, but if they're, say, cannibals, your friend may really be in hot water."

"I still couldn't help him, could I? How do you talk a cannibal out of a square meal when you don't know his language and aren't even facing him in person? What attention would he pay to a little square box that talked to him in a strange language?"

The other raised his eyebrows a trifle. "While I'm not mind reader enough to predict that one in detail, I would suggest that in such a case he might just possibly be scared enough to do almost anything. As an ethnologist I can assure you that there are primitive races on a lot of planets, including our own Earth, who would bow down, hold square dances, and even make sacrifices to a box that

talked to them."

Lackland digested that remark in silence for a few moments, nodded thoughtfully, and turned back to the screens.

A number of sailors had seized spare masts and were trying to pole back toward the center of the river, but were having no success. Dondragmer, after a brief investigation around the outer rafts, reported that they were in a cage formed of piles driven into the river bed; only the upstream side was open. It might or might not be coincidence that the cage was just large enough to accommodate the *Bree*—no one had noticed sounds during the night that might have betokened its construction.

As this report was made, the canoes drifted away from the three closed sides of the cage and congregated on the fourth; and the sailors, who had heard the mate's report and prepared to pole in the upstream direction, looked to Barlennan for instructions. After a moment's thought, he motioned the crew to the far end of the ship and crawled alone to the end facing the assembled canoes. He had long since figured out how his ship had been moved; with the coming of darkness some of the paddlers must have gone quietly overboard, swum beneath the *Bree*, and pushed her where they wanted. There was nothing too surprising in that; he himself could exist for some time beneath the surface of river or ocean, which normally carried a good deal of dissolved hydrogen. What bothered him was just why these people wanted the ship.

As he passed one of the provision lockers he pulled back its cover and extracted a piece of meat. This he carried to the edge of the ship and held out toward the crowd of now silent captors. Presently some unintelligible gabbling sounded among them; then this ceased, as one of the canoes eased slowly forward and a native in the bow reared up and forward toward the offering. Barlennan let him take it. It was tested, and commented upon; then the chief, if that was his position, tore off a generous fragment, passed the rest back to his companions, and thoughtfully consumed what he had kept.

Barlennan was encouraged; the fact that he hadn't kept it all suggested that these people had some degree of social development. Obtaining another piece, the captain held it out as before; but this time, when the other reached for it, it was withheld. Barlennan put it firmly behind him, crawled to the nearest of the piles that were imprisoning his ship, indicated it, gestured to the *Bree*, and pointed out into the river. He was sure his meaning was plain, as undoubtedly it was; certainly the human watchers far above understood him, though no word of their language had been used. The chief, however, made no move. Bar-

lennan repeated the gestures, and finished by holding out the meat once more.

Any social consciousness the chief possessed must have been strictly in connection with his own society; for as the captain held out the meat a second time a spear licked out like the tongue of a chameleon, impaled the food, jerked it out of Barlennan's grasp, and was withdrawn before any one of the startled sailors could move. An instant later the chief gave a single barking order; and as he did so half the crew of each of the canoes behind him leaped forward.

The sailors were completely unused to aerial assault, and had also relaxed a trifle when their captain began his negotiation; in consequence, there was nothing resembling a fight. The *Bree* was captured in something less than five seconds, with two husky natives equipped with knives stationed, quite evidently ready for action, beside each member of the crew.

A committee headed by the chief began at once to investigate the food lockers, and their satisfaction was evident even through the language barrier. Barlennan watched with dismay as the meat was dragged out on deck in obvious preparation for transferral to a canoe, and for the first time it occurred to him that there was a possible source of advice which he had not yet used.

"Charles!" he called, speaking English for the first time since the incident had begun. "Have you been watching?"

Lackland, with mixed anxiety and amusement answered at once. "Yes, Barl; I know what's been going on."

He watched the *Bree's* captors for reaction as he spoke, and had no reason to feel disappointed. The chief, who had been facing away from the point where the radios were lashed in the center of the ship, switched ends like a startled rattlesnake and then began looking around for the source of the voice with an unbelievably human air of bewilderment. One of his men who had been facing the radios indicated to him the one whose speaker Lackland had used, but after poking around the impenetrable box with knife and lance the chief obviously rejected this suggestion. This was the moment the Earthman chose for speaking again.

"Do you think there's any chance of getting them scared of the radios, Barl?"

The chief's head was about two inches from the speaker this time, and Lackland had made no effort to reduce the volume. Consequently there was no question where the sound had come from; and the chief began backing away from the noisy box. He was evidently trying to go slowly enough to satisfy his self-respect and fast enough to suit his other emotions, and once again Lackland had trouble in not laughing aloud.

Before Barlennan had a chance to reply Dondragmer, who Lackland was beginning to think must be some kind of mind reader, moved over to the pile of meat, selected a choice piece, and laid it in front of the radio set with every indication of humility. He had taken a chance on having a pair of knives meet in his body, and knew it; but his guards were too absorbed by the new situation to take offense at his motion. Lackland, understanding how the mate had interpreted his own lead, followed on; he reduced the volume in the hope that his next utterance would seem less like anger to the canoeists, and heartily approved the mate's action.

"Good work, Don. Every time one of you does something like that I'll try to show approval; and I'll bark like nobody's business at anything I don't want our new acquaintances to be doing. You know the appropriate actions better than I, so just do everything in your power to make 'em think these radio boxes are high-powered beings who'll deliver lightning if properly annoyed."

"I understand; we can hold our end," replied the mate. "I gathered that was what you had in mind."

The chief, gathering his courage once more, suddenly lunged at the nearest radio with his spear. Lackland remained silent, feeling that the natural result on the wooden point would be impressive enough; the sailors entered with a will into the game outlined by the Flyer. With what Lackland supposed were the equivalent of gasps of pious horror, they turned away from the scene and covered their eyes with their pincers.

After a moment, seeing that nothing further was happening, Barlennan offered another piece of meat, at the same time gesturing in a way meant to convey the impression that he was begging for the life of the ignorant stranger. The river people were quite evidently impressed, and the chief drew back a little, gathered his committee, and began to discuss the whole situation with them.

One of the guards reached slyly for a piece of the food that had been offered to the radio, and the sailor beside him went to the length of holding him back, giving every indication he could of horror. The similarity in natural gesture between all of these people, that had helped so much in trading with the giants, was in full play here as well; and the people of the river were becoming convinced more thoroughly every moment that the radio boxes were objects with which it would be wise to remain on friendly terms.

Finally one of the chief's counselors, in what was evidently an experiment, picked up a piece of meat and gave it to the nearest radio. Lackland was about to express gentle thanks when Dondragmer's voice came, "Refuse it!" Not knowing why but willing to trust the mate's judgment, Lackland

turned up the volume and emitted a lionlike roar. The donor leaped back in genuine and unmistakable terror; then, at a sharp order from the chief, he crawled forward, retrieved the offending bit of food, selected another from the pile on the deck, and presented that.

"All right." It was the mate's voice again, and the Earthman lowered the volume of the speaker.

"What was wrong the other time?" he asked quietly.

"I wouldn't have given that piece to a *ternee* belonging to my worst enemy," replied Dondragmer. "I don't know what attributes a being like you would be expected to have, but in my experience the higher-up an individual is placed the choosier he gets."

"I keep finding resemblances between your people and mine in the darnedest situations," Lackland remarked. "I hope this business is suspended for the night; I can't see what's going on in the dark. If anything happens that I should react to, be sure to tell me."

This remark was prompted by the arrival of sunset once more, and Barlennan assured him that he would be kept informed. The captain had recovered his poise, and was once again more or less in control of the situation—as far as a prisoner could be.

The night was spent by the chief in discussion; his voice, interrupted occasionally by others which must belong to his counselors, came clearly to the Earthmen far above. The ethnologist sitting by Lackland had cut in a recorder, in the hope of making something of the language later on. Ethnology and philology had overlapped so thoroughly since the beginning of interstellar travel that it was no longer easy to distinguish between them. Lackland's opinion of his chances of interpreting the weird gabble was extremely low, but he realized his own lack of training in that direction might be giving him a false impression of the task's difficulty. He himself was listening for sounds that might indicate activity, and was more than glad when the sun reappeared without his having heard any. As nearly as he could tell from the screens—which did not, of course, give really complete coverage—everything was as it had been the evening before. Perhaps the warriors guarding the sailors were a little less attentive to their jobs, and the sailors themselves less tense; Lackland could not be sure, familiar as he had now become with their various bodily attitudes and "facial" expressions.

The chief had apparently reached a decision. He had drawn a little apart from his counselors and laid down his weapons; now, as sunlight slanted once more across the deck, he advanced toward Barlennan, waving the latter's guards away as he approached.

The captain, already fairly sure in his mind what the other wanted, waited calmly. The chief halted with his head a few inches from Barlennan's, paused impressively for a moment, and began to speak.

His words were still unintelligible to the sailors, naturally enough; but the gestures accompanying them were clear enough to give the speech meaning even to the distant human watchers. He waved repeatedly first at the nearest of the radios and then toward the bank; tapped the deck of the *Bree* with a pincer, and then pointed downstream. After each repetition of these signals with their accompanying verbal plea he would pause expectantly.

Quite plainly, he wanted a radio. Lackland found himself speculating idly on just what supernatural powers the chief supposed the device to possess. Perhaps he wanted it to protect the village from enemies, or to bring luck to his hunters. It was unlikely to be a much more complicated wish; these people seemed to be on about the cultural plane of the nineteenth-century Fans or Bushmen. That was not really an important question, however; what mattered would be his attitude when the request was refused. That might possibly be rather antisocial, and Lackland was still worrying a trifle.

Barlennan, showing what his human friend felt was rather more courage than sense, answered the speech briefly; a single word and a gesture which Lackland had long since come to recognize comprised the reply. "No" was the first Mesklinite word which Lackland learned beyond doubt, and he learned it for the first time now. Barlennan was very definite.

The chief, to the relief of at least one watcher, did not take a belligerent attitude. Instead, he gave a brief order to his men. Several of these at once laid aside their weapons and began restoring the looted food to the lockers from which it had been taken. If freedom were not enough for one of the magic boxes, he was willing to pay more. Both Barlennan and Lackland more than suspected that the fellow was now afraid to use force, badly as his possessive instincts were aroused.

With half the food returned, the chief repeated his request; when it was refused as before, he gave an amazingly human gesture of resignation and ordered his men to restore the rest. Lackland was getting uneasy.

"What do you think he'll do when you refuse him now, Barl?" he asked softly. The chief looked at the box hopefully; perhaps it was arguing with its owner, ordering him to give his captor what he wanted.

"I'm not sure enough to venture a prediction," the Mesklinite replied. "With luck, he'll bring us more stuff from the village to add to the price; but I'm not sure luck goes that far. If the radio were less important, I'd give it to him now."

The ethnologist sitting beside Lackland practically exploded at this point: "Have you been going through all this rigmarole and risking your life and those of your men just to hang onto a cheap vision set?"

"Hardly cheap," muttered Lackland. "They were designed to hold up at Mesklin's poles, under Mesklinite atmosphere, and through the handling of Mesklinite natives."

"Don't quibble!" snapped the student of cultures. "What are those sets down there for if not to get information? Give one to that savage! Where could it be better placed? And how could we observe the everyday life of a completely strange race better than through that eye? Charles, sometimes I wonder at you!"

"That will leave three in Barlennan's possession, of which one absolutely *must* get to the south pole. I see your point, Don, but I think we'd better get Rosten's approval before we actually leave one this early on the way."

"Why? What does he have to do with it? He's not risking anything like Barlennan, and doesn't care about watching that society like some of the rest of us. I say leave it; I'm sure Barlennan wants to leave it; and it seems to me that Barlennan has the final say in any case."

The captain, who had, of course, overheard this, cut in.

"You forget, friend of Charles, that the radios are not my property. Charles let me take them, at my suggestion to be sure, as a safety measure, so that at least one would reach its goal even though unavoidable incidents deprived me of the others. It seems to me that he, not I, is the one whose word should be final." Lackland answered instantly.

"Do as you think best, Barl. You are on the spot; you know your world and its people better than any of us can hope to; and if you do decide to leave one with these people, even that will do some good to my friends, as you have heard."

"Thank you, Charles." The captain's mind was made up in the instant the Flyer finished speaking. Fortunately the chief had listened enthralled to the conversation, making no attempt to further his own interests while it was going on; now Barlennan, keeping up the play to the end, called some of his crew and gave swift orders. Their recipients, as well as the other crew members who heard, had difficulty suppressing their mirth, but they succeeded.

Moving very circumspectly and never touching a radio at any time, the sailors prepared a rope sling. Then they pried the set up from a "safe" distance with spears, and poked and pushed until the sling was in position under and around it. This accomplished, one of the sling handles was given very respectfully to Barlennan. He in turn gestured the chief closer, and with an air of handling something

precious and fragile, handed the loop of rope to him. Then he gestured toward the counselors, and indicated that they should take the other handles. Several of them moved forward, rather gingerly; the chief hastily designated three for the honor, and the others fell back.

"I thought he might assign four, and give himself the honor of lead-off man," Professor Don McKnight whispered in Lackland's ear. "I wonder whether they have different ideas of what constitutes the position of honor, or if the chief thinks he'll derive some mystical benefit from carrying the thing himself?"

Lackland shrugged his shoulders, having no means of answering this question. His interest was in Barlennan's activities, anyway.

Very slowly and carefully the bearers moved the radio to the edge of the *Bree's* outermost raft. The chief's canoe glided up—a long, narrow vessel evidently hollowed to a paper-thin shell from the trunk of one of the forest trees. McKnight looked it over with interest, as well as the single "eye" now pointing in the right direction would permit him; Barlennan viewed it with distrust. He himself had never sailed anything but a raft; hollow vessels of any kind were strange to him. He felt certain that the canoe was too small to carry the weight of the radio; and when the chief ordered the greater part of the crew out of it he barely suppressed the equivalent of a negative headshake. He felt that the lightening thus obtained would be insufficient. He was more than startled when the canoe, upon receiving its new freight, merely settled a trifle. For a few seconds he watched, expecting vessel and cargo to pop suddenly below the surface; but nothing of the sort happened, and it became evident that nothing would.

Barlennan was an opportunist, as had been proved months ago by his unhesitating decision to associate with the visitor from Earth and learn his language. This was something new, and obviously worth learning about; if ships could be made that would carry so much more weight for their size, the knowledge was obviously vastly important to a maritime nation. The logical thing to do was to acquire one of the canoes.

As the chief and his three co-workers entered the craft, Barlennan followed. They delayed shoving off as they saw his approach, wondering what he might want. Barlennan himself knew what he wanted, but was not sure he could get away with what he planned to try. His people, however, had a proverb substantially identical in meaning with Earth's "Nothing ventured, nothing gained," and he was no coward.

Very carefully and respectfully he touched the radio, leaning across the half inch of open river surface between ship and canoe to do so. Then he

spoke.

"Charles, I'm going to get this little ship if I have to come back and steal it. When I've finished talking, please answer—it doesn't matter what you say. I'm going to give these people the idea that the boat which carried the radio is too changed for ordinary use, and must take the radio's place on my deck. All right?"

"I was brought up to disapprove of racketeers—I'll translate that word for you some time—but I admire your nerve. Get away with it if you can, Barl, but please don't stick the neck you don't have out too far." He fell silent and watched the Mesklinite turn his few sentences to good account.

As before, he employed practically no spoken language; but his actions were reasonably intelligible even to the human beings, and clear as crystal to his erstwhile captors. First he inspected the canoe thoroughly, and plainly if reluctantly found it worthy. Then he waved away another canoe which had drifted close, and gestured several members of the river tribe who were still on the *Bree's* deck away to a safe distance. He picked up a spear which one of the counselors had discarded to take up his new position, and made it clear that no one was to come within its length of the canoe.

Then he measured the canoe itself in spear lengths, took the weapon over to where the radio had been, and ostentatiously cleared away a spot large enough to take the craft; at his order, several of his own crew gently rearranged the remaining radios to make room for their new property. More persuasion might have been attempted, but sunset cut the activity short. The river dwellers did not wait out th night; when the sun returned, the ca oe with the radio was yards away, already drawn up on shore.

Barlennan watched it with anxiety. Many of the other canoes had also landed, and only a few still drifted near the *Bree*. Many more natives had come to the edge of the bank and were looking over; but to Barlennan's intense satisfaction, none came any closer to the loaded canoe. He had apparently made some impression.

The chief and his helpers carefully unloaded their prize, the tribe maintaining its original distance. This was, incidentally, several times the spear's length demanded by Barlennan. Up the bank the radio went, the crowd opening wide to let it through and disappearing after it; and for long minutes there was no more activity. The *Bree* could easily have pushed out of her cage at this time, the crews of the few canoes remaining on the river showing little interest in what she did, but her captain did not give up that easily. He waited, eyes on the shore; and at long last a number of long black-and-red bodies appeared over the bank.

One of these proceeded toward the canoe; but Barlennan realized it was not the chief, and uttered a warning hoot. The native paused, and a brief discussion ensued, which terminated in a series of modulated calls fully as loud as any that Lackland had heard Barlennan utter. Moments later the chief appeared and went straight to the canoe; it was pushed off by two of the counselors who had helped carry the radio, and started at once toward the *Bree*. Another followed it at a respectful distance.

The chief brought up against the outer rafts at the point where the radio had been loaded, and immediately disembarked. Barlennan had given his orders as soon as the canoe had left the bank, and now another set of slings went about the bow and stern of the little vessel. It was hauled aboard and dragged to the space reserved for it, still with every evidence of respect. The chief did not wait for this operation to be finished; he embarked on the other canoe and returned to shore, looking back from time to time. Darkness swallowed up the scene as he climbed the bank.

"You win, Barl. I wish I had some of your ability; I'd be a good deal richer than I am now, if I were still alive by some odd chance. Are you going to wait around to get more out of them tomorrow?"

"We are leaving now!" the captain replied without hesitation. "I want to get where I can learn about this little ship without having to play-act all the time I'm about it. We'll be out in the current in two minutes."

Sounds of scraping wood as the *Bree* was poled from her cage confirmed his statement; and moments later the sound was replaced with utter silence as the ship slipped free into the slow stream. There was a little wind, and some sails were hoisted until they reached a point well out in the river; then they were dropped once more, and the banks began to slip silently westward as the current took over. Lackland left his dark screen and went to his quarters for his first sleep in many hours. Sixty-five minutes—rather less than four of Mesklin's days—had passed since the village was sighted.

To Be Continued

Epitaph for a second-rater:

He thought he had a call to genius.

THE REFERENCE LIBRARY

BY P. SCHUYLER MILLER

FIRST READER

It is an open secret that the fundamental work in science and engineering which can—and we believe one day will—lift Man into space, is now being done. The record of this work, or of that part of it that is not classified as a state secret by our own nation and others, is scattered through a score or more of technical journals, monographs and research records where only the trained professional worker, aware of the literature and able to lay hands on it, can find out what is being done.

Now the time has come when in popular journals, newspaper science columns, and in books, this research is being pulled together, generalized, and fitted into a picture which the average man can comprehend. Actually the pioneering—the pre-primers of space—was done in science fiction long before serious scientists dared toy with so unorthodox a field. But we are reasonably well provided with the primers of rocket flight: the succeeding editions of Willy Ley's "Rockets," Arthur C. Clarke's "Interplanetary Flight" and "The Exploration of Space," the Ley-Bonestell "Conquest of Space," the *Collier's* symposium, "Across the Space Frontier," the sev-

eral excellent books for children, especially those by Jack Coggins and Fletcher Pratt.

We do not have a primer for the effects of space on Man. "Space Medicine," two years ago, promised to be, but left whole areas untouched. Chapters in the rocketry books have played a bit with the problems involved. Now, from the University of New Mexico Press, comes a weighty and exhaustive volume of six hundred eleven packed pages, "Physics and Medicine of the Upper Atmosphere" —$10.00—which turns out to be, not the expected primer but a first reader.

This is the expanded report of the Symposium on the Physics and Medicine of the Upper Atmosphere, held in San Antonio, Texas, in November 1951 under the sponsorship of the Air University School of Aviation Medicine at Randolph Field and the Lovelace Foundation for Medical Education and Research of Albuquerque, New Mexico. Among the thirty-eight contributors are most of the men who took part in the previous year's symposium at the University of Illinois—but this time, in place of educated guesses about the prospects of plumbing interplanetary space and conditions there, we have hard, factual scientific papers about what we are already doing to reach and explore the top of the atmosphere—the "aeropause," where the physiology of flight becomes all-important as we pause on the threshold of emptiness.

Except that it very self-consciously limits itself to the upper atmosphere, this is the book which really deserves the title, "Space Medicine." As such it is a basic reference for the writer and serious reader of science fiction. Yet it has already passed by certain fundamentals of human reaction which would be useful to readers like ourselves. For them, it appears, we must go directly to the technical papers listed in the voluminous bibliographies or wait until Willy Ley ferrets them out for the next edition of his "Rockets" or *Collier's* schedules them as part of another round-table.

The first ten chapters of the book deal with the basic physical circumstances known to exist in the high atmosphere. With scattered later chapters in the same vein, these make up perhaps half the volume. Another meaty section uses approximately eighty-five pages for a discussion of the methods and engineering of reaching high altitudes by balloon and rocket, and of how one measures what is found there.

The rest of the book—nearly half—is devoted to serious reports of what can only be called space medicine: the effects of flight at high altitudes on human beings. These center around a relatively few themes or problems: maintaining life under reduced atmospheric pressures, effects of high and low temperatures, effects of cosmic radiation, and effects of weightlessness. Linked with these, because of

the danger of a puncture, is the question of meteorites.

And here, it seems, there is still a head-on collision of opinion between experts. As a participant in the San Antonio symposium, Dr. Fred L. Whipple of Harvard proposed his now famous "space bumper"—a paper-thin outer skin against which small meteors will explode without reaching or damaging seriously the inner casing of a rocket or space station. He advocates, among other things, the good old science-fiction practice of jumping over the asteroid belt and avoiding the orbits of comets and meteor swarms. He warns of the possible sandblasting of ports by micro-meteors —which are already pitting our experimental rockets.

According to Whipple, the dangers of a fatal or even serious penetration are relatively slight: a fifteenth magnitude meteoroid, which will penetrate one millimeter of aluminum, is not likely to hit a sphere of three-meter diameter oftener than once every hundred days, while one of zero magnitude, which will batter through eleven centimeters of aluminum plate, may be expected in collision only once—actually 1.2 times—in a hundred *million* days.

But as I have said, there is by no means wholehearted agreement among the experts on the dangers of meteors. The basic disagreement seems to lie in Whipple's belief that meteors are all members of the solar family, and hence limited to relatively low orbital velocities and energies. Dr. Lincoln LaPaz of the Institute of Meteoritics at the University of New Mexico, on the other hand, cites seemingly sound evidence that there is a family of meteors of parabolic and hyperbolic velocities which come from outer space at terrific speeds. There is considerable difference between collision with a smallish meteor traveling at, say, 40 to 50 km/sec and one of La Paz's space wanderers which zips in from the far reaches of nowhere with twice or three times that speed and four to nine times the energy.

A meteor strike which opens the inner skin of a ship—or high-altitude plane—will, of course, lead to rapid loss of air and what the space-medicos call explosive decompression. Several chapters are devoted to the question of how great and how fast a drop in pressure a man can stand—and the time is alarmingly short. Stanley G. Weinbaum's hero in "The Red Peri" could *not* have survived his unprotected dash through the vacuum—not because he would freeze, but because his lungs would rupture and his blood boil, his eyeballs pop, and other unpleasantries occur—such as one phenomenal "burrrrrrrrp!".

The several reports show that loss of oxygen begins to cause psychophysiological effects above thirteen thousand feet (of course, many mountain climbers have gone up to twice that height without special protection

—but you may be sure they do not belittle the effects of altitude). The so-called "hypoxic zone" runs from thirteen thousand to fifty-two thousand feet (16 km), when oxygen pressure in the lungs has dropped to 30 mm of mercury, consciousness is lost almost immediately, and the "zone of anoxia" begins. A man has *only from eleven to twenty seconds of consciousness* if he is tossed from normal pressure into that at forty-six thousand, with his lungs full of air. He can last fifteen seconds at fifty-two thousand feet with oxygen.

Even though there is oxygen in the atmosphere up to 90 km (295,000 ft), above 16 to 18 km (52,000–59,000 feet) water vapor and CO_2 crowd all oxygen out of the lungs, and the spaceman drowns in his own moisture—unless he can somehow save himself in fifteen seconds. At this altitude a candle flame also smothers in its own wastes.

Nor is anoxia the whole danger: from about twenty-three thousand feet up there is danger of aeroembolism—the diver's "bends" as dissolved nitrogen in the blood and tissues comes out of solution in tiny bubbles. Above 19 km (62,000 ft) the body fluids "boil"—vaporize—at body temperature.

Later chapters go over this picture again and again, with the same result. An oxygen mask alone will not help much. Breathing under forced pressure will rupture the lungs unless some sort of chest protection is used—but with anything short of a full spacesuit a man can last only for a matter of minutes, his blood being forced out into his arms and legs and plasma lost from the blood itself.

In another area there is a brighter picture. The appraisal of what cosmic rays are like and what effect they will have on human beings is quite complete. One major point emerges: the genetic dangers of creating mutations through destruction or alteration of genes are negligible compared with the dangers of radiation sickness from the effects of heavy nuclei in the primary "rays."

These heavy, electron-stripped metallic nuclei, blocked off by the atmosphere, smash their way through the cells, causing scores of ionizations and hashing the chromosomes, which will then recombine in strange, nonhuman mixtures of genes. As the damaged cell divides, the alien chromosome pattern is carried with it—and in effect a little nucleus of nonhuman flesh begins to grow where each cosmic ray has passed.

But these heavy primaries will be stopped by any kind of ship wall. The cosmic ray picture seems less serious than we have been led to believe—*if* you stay under cover.

One less optimistic bit of evidence: at Oak Ridge it has been found that mice are more sensitive to the mutation-producing effects of X rays than are the standard laboratory fruit flies—nine to fourteen times more sensitive. And what about men?

There is much, much more in this massive storehouse of space information: a detailed discussion of our orientation mechanism, which will be thrown out of functioning by weightlessness—the very strange effects on vision which are produced in a centrifuge when the direction of seeming "weight" is changed—the extreme durability of the human animal when faced by extreme heat or (better) cold —experiments have been run up to 250° C.

Incidentally, the experts aren't very happy about the pumpkin-leaf oxygen supply for spaceships. Or catalpas. Or algae. Too much heavy kit to keep it growing *and* lighted. And they don't do much about the impressive number of components making up the ordinary "odor-of-living" of all of us, which can build up to toxic proportions in a closed space without convection. B.O. —plus!

In books like this and Kuiper's "Atmospheres of the Earth and Planets," and in the other books like them which will be coming along now, are the raw materials which writers of the Heinlein caliber and school must now use to bring the thrill of reality into their stories of space. There is information in them that will not be of much interest to the casual reader. But, for the sake of your own curiosity, you can do much worse than call them to the attention of the technical department in your local public library.

DROME, by John Martin Leahy. Fantasy Publishing Company, Inc., Los Angeles. 1952. 295 pp. Ill. $3.00

It seems impossible that twenty-eight years have passed since I first read "Drome" as a serial in *Weird Tales*. I have always remembered the illustrations of the ape-bat "demons" —far better, as I recall, than the ones the author has done himself for this book—but have suspected that the story itself was probably pretty primitive.

It is—and it isn't. "Drome" is in the late Victorian tradition of H. Rider Haggard, full of allusions to nineteenth century science and of discursive chatter among the characters, but it is surprisingly good chatter and the author seems to have done some rewriting—at least the "Prolegomenon" refers to August Derleth. I think "Drome" is one of the best books FPCI has published, and I'm looking forward to their edition of Leahy's "Zandara," which I've never seen.

In "Drome" Scientist Milton Rhodes and his muscular pal William Barrington Carter, who tells the story, set out to investigate the appearances of a mysterious "angel" accompanied by a ravening "demon," somewhere on the slopes of Mount Ranier. They were seen, with bloody results, in 1858 and appeared again in 19??.

Plunging through a crevice which is uncovered by the Cowlitz Glacier only on rare occasions, Rhodes and Carter

encounter the "angel" Drorathusa, have to kill her ferocious watchdog ape-bat, and accompany her and her party to the subterranean realm of Drome.

Here is one of the most oddly convincing of worlds inside the Earth—principally because the author never tries to explain it as most writers have done, in tiresome detail and endless paradox. The underworld of Drome is there, with its monsters and its strange people, but it is never argued away. The people have Greek-sounding names and a certain Greek character to their architecture, but their language, religion, and customs are certainly not Greek nor is it ever suggested what they are. More monsters are suggested in the gloom that surrounds the inhabited caverns than are ever shown—and Drome is just a world of huge caverns under Ranier, not the hollow Earth of such yarns as Burroughs' Pellucidar series.

To add to the unorthodoxy, it takes the explorers two hundred fifty-eight pages to reach the first of the Droman cities—and thirty-seven pages later they've licked the diabolical high priest, married the queen, and returned to Seattle to leave the manuscript of their adventure before going back to Drome for good! Any other writer of that era or this would have completely reversed the proportion, and piled on tiresome details of the Droman civilization, its history, plot and counterplot foiled by the twentieth century science of the intruders, bloodshed and mayhem *ad nauseam.*

Quaint though it may be by modern fashions in science fiction, I like "Drome" with all its classical quotations, bolstering allusions to dubious science, and real warmth and humor. Since its author is apparently still alive and kicking, I'd like to see him get back at the typewriter with the added mellowness which twenty-eight years must have added.

SPACE HAWK, by Anthony Gilmore. Greenberg: Publisher, New York. 1952. 274 pp. $2.75

It's hard to accept the undeniable fact that Hawk Carse burst on an eager young flock of science-fiction fans—they weren't yet "fen"—more than twenty years ago, in the November 1931 issue of—then—Astounding Stories. The Hawk was a little more than a cardboard hero—plywood, let's say. This was the result of some expert writing by Mr. Gilmore, who—later report and the definitive Donald Day "Index to the Science Fiction Magazines" have it—was two men: Editor Harry Bates, remembered longest for his "Alas, All Thinking," and Desmond W. Hall.

Referring again to the Day "Index" rather than to memory or the ASF files, it appears that Hawk Carse bludgeoned his way through four very popular stories between November '31 and November '32, when he appar-

ently incinerated his implacable enemy, Dr. Ku Sui, and vanished from these and other pages. He returned ten years ago, in *Amazing Stories*, under Mr. Bates' sole sponsorship, but that is another story.

In "Space Hawk" the four original Hawk Carse novelettes have been assembled into a book-length account of what can be called—as it was in the second of the series—"The Affair of the Brains." This is space opera of the old, raw, gloves-off school, out of an era when subtlety was a waste of good writing. Every cliché of the period—and this one—is there: the utterly righteous, utterly powerful, utterly muscular hero—with a few mechanical advantages over Conan, but none of Conan's barbaric humor—the faithful black servitor—and the utterly vicious, suave, and intellectual Eurasian villain—Dr. Ku Sui instead of Dr. Fu Manchu. There's the Master Scientist—that's his literal equivalent of a Ph.D.—whose brain Dr. Ku would like to embalm alive in a vat of something with the cerebra of five of his former colleagues—whom the M.S. is accused of having murdered. There's the Hawk's dogged campaign to avenge whatever mysterious indignity is hidden behind his blond bangs and poker face—never revealed by the time the halves of Anthony Gilmore separated. There is fortunately no pure young heroine who looks like Yvonne De Carlo and is found lashed to an asteroid for BEM's to lap—though there are plenty of BEM's in bit parts. This was man stuff!

Hawk Carse was so bad that he was almost good. He made all lesser space-heroes look silly until Kinnison and his Lens appeared five years later. He looks silly himself, in view of present-day writing. If, as the critics insist, science-fiction characters are still two-dimensional, the Hawk was one-dimensional—but mighty tall. If that's what you like—if you'd like a sample of the old days, a "classic," even—if you can't lay hands on that year of Astounding, maybe "Space Hawk" is your book.

THE CURRENTS OF SPACE, by Isaac Asimov. Doubleday & Company, Garden City. 1952. 217 pp. $2.75

Doubleday's science-fiction library, which has been thinning out during 1952—C. M. Kornbluth's "Takeoff" has been the outstanding title of the year—has snatched up "The Currents of Space" from these pages almost before the last installment was off the newsstands.

What needs to be said about a story so fresh in your memories? It's a good yarn—mystery, intrigue—a picture of the future of galactic civilization which fits into Isaac Asimov's private future somewhere before the formation of the Empire whose aftermath we saw in "Foundation" and "Foundation and Empire." Earth is not yet forgotten—Rik, the psychoprobed hero

comes from there, and it is a world much like the haunted planet of "Pebble in the Sky." Trantor, home-world of the later Emperors, is a monstrous political force behind the scenes, probing, juggling men and planets, consolidating her power.

How many generations or centuries lie between "The Currents of Space" and "Foundation"? Perhaps their creator will tell us some day—if he knows yet. As of now, the hard-cover reincarnation of his untouted "future history" is a couple of laps ahead of Heinlein's.

998, by Edward Hyams. Pantheon Books, New York. 1952. 208 pp. $2.75

This book is not science fiction. Only by a long stretch of a limber imagination can it be classed as a borderliner. But some of you who relish borderliners may find it amusing.

"998" isn't science fiction because Type 998 is a phony. It was generated in the brain of one Sylvester Green, Radar Officer in His Majesty's Navy, who under other circumstances might have turned out to be an ancestor of our old friend Gallegher. Incited—not to say inspired—by alcohol, Sylvester, abetted by a small group of friends, assembled the remains of a forsaken perambulator—baby carriage to the U.S.A.—and the three brass balls off a pawnshop—in London *and* Pittsburgh—and welded them to the mast of a corvette belonging to the Republic of Agraria.

To the Radar Officer of H.M.S. *Ross and Cromarty*, berthed next to the *Agraria*, this unique assembly appeared to be the antenna of a new and super radar. He wanted one. He set about getting one. And when it presently appeared—to him, to a roving journalist, to an admiral, to a newspaper publisher—that "Type 998" was not a radar, it became obvious that it must be a new and terrific secret weapon which Britain must possess for the salvation of the world.

Thus is launched a howling farce of blunders in high places, the general puddin'-headedness of humanity, the indelible quality of official memoranda, and a floundering move to end all war by surrounding the civilized nations of the world—the United States and Russia will have none of it—with an impenetrable wall of 998 rays. If 998 had succumbed to some Gallegherian, Padgettian miracle and been transformed into the Weapon-To-End-All-Weapons, Mr. Hyams' spoof would be science fiction. Since it is, and remains, a baby carriage and three hock-shop balls, this is only a farce with some telling cracks at bureaucratic and military psychology, which crumples up on itself in the latter third when Sylvester Green—"executed" for the record and turned loose under an alias to grub for himself—bobs up and down through a series of outra-

geous coincidences which not even Gilbert, Sullivan, and Shakespeare would tolerate, is threatened with brain-surgery, thwarts a plot to sabotage Post 998/102, and goes all serious.

All this you would never learn from the jacket blurb—which considers 998 "a gadget as terrible as the H-bomb" —or any review I have seen to date. Since I've sampled the book for you, you know what to expect. Maybe you collect books and stories about world-shaking gadgets that don't work along with yarns about gimmicks that do. If so, by all means collect "998".

THE ROLLING STONES, by Robert A. Heinlein. Charles Scribner's Sons, New York. 1952. 276 pp. Ill. $2.50

"The Rolling Stones" stands out from the field in two chief respects: its people are likable and human, and it is utterly unpretentious—and, in the Heinlein manner, utterly real. In a year marked largely by resurrections of old "classics" and hard-shell publication of some ponderously social-minded current serials, it stands way, way out for freshness and simplicity.

The Stones are a family you'll want to meet again, but their creator will probably be smart if he lets them sail off into space and forgets them. Sequels are seldom anything but an anticlimax. At any rate, here are the fifteen-year old twins, Castor and Pollux, smart and intelligent but by no means paragons, their older sister, their little brother, their space-opera-writer father, their physician-plus-sculptor mother, and their unforgettable grandmother, one of the Founding Fathers of the Moon settlement and an individualist in a family of individualists.

Bored with life on the Moon, the Stones roll off to Mars in a rickety old spaceship which they have patched together with spit and know-how from a junkyard wreck. Clifford Geary has been adding a very essential element to these Heinlein books with his clean and striking black-and-white illustrations, and his portrait of the old ship in mid-space, strung with broken-down bicycles like a Christmas tree, strikes the spirit of the book perfectly.

Arrived on Mars—not without events en route—the twins find that their corner on bicycles may be a white elephant—to spin a suitably twisted metaphor. They wriggle adroitly out of that and into another scrape; Grandma Hazel comes to their rescue and presently they are all off for the asteroids on another money-making venture, joined now by a pleasant companion, a Martian flat-cat known as Fuzzy Britches.

There may be more ambitious, more cerebrally stimulating books in the 1952 stock, but for one which is the essence of good science fiction—a life-size portrait-gallery of real people living in a real world of the future, every detail of which fits in place with top-tolerance precision—try "The

Rolling Stones." There hasn't been a family like this since the Swiss Family Robinson—and the Stones are full of humor and the joy of life.

THE TITAN, by P. Schuyler Miller. Fantasy Press, Reading. 1952. 252 pp. $3.00

What's to be said in a department like this when your own book shows up in the mail? Praise it and you're accused—justly—of trying to boost royalties. Pan it, and you're a hypocrite. All that's left is a simple description of what's there.

These are old stories, originally published in this and four other magazines between 1931 and 1944. Only two—. . . "As Never Was" and "Forgotten"—have been in other anthologies: other stories which were have been deliberately excluded, even though Lloyd Eshbach and I both agreed they were better than some he did include.

The original of the title story was apparently just about my first attempt at a "novel" length story. Internal evidence in the first draft, which I found while switching it over from the first into the third person, indicates that it was written in 1932. It began to appear in one of the "little" science-fiction magazines of the time, *Marvel Tales*, in Winter 1935, ran for three parts and was never finished: in fact, the original manuscript was lost, and the present version has been resurrected from a

longhand draft with considerable, though perhaps not enough, revision. Since the jacket blurb gives the "startling" plot-gimmick away, I can say that the story's hero and heroine are Martians, helped out of their difficulties by a caged Earthman, the "Star Beast."

Two stories deal with the Arrhenius hypothesis that life is carried through space in the form of impalpable spores which can be propelled from planet to planet and galaxy to galaxy by light pressure. "The Arrhenius Horror"—*Amazing Stories*, 1931—still keeps its original skeleton: however, the old story contained large lumps of erudition in the form of a description—right out of Mellor's "Inorganic Chemistry"—of the process for extracting radium from its ores. Radium is out of the picture now, so that's been replaced by some discussion of what might have to be done to get at uranium and its heavier relatives—without treading on the toes of the A.E.C. It's third-person now, too.

"Spawn" uses the life-spore theme for a sort of parody on the peculiar style of the late Charles Fort. Probably the parody got itself lost in the shuffle. Please believe that no communistic or other subversive leanings, then or now, are indicated by the fact that a character is a more or less paternalistic Middle European dictator named Svadin. (This was in *Weird Tales*, 1939.)

"Forgotten," which closes the book, dates from *Wonder Stories* of 1933 and is another in which radium had to be converted into uranium to avoid obsolescence. As a pre-BEM yarn, it suggested that extraterrestrials could be good guys—maybe even better than some of us.

The others are from this magazine. In order of appearance they are: "In the Good Old Summertime"—1940—which has the anthropological moral that when you're on Venus it pays to look under the surface of Venusian customs; "Old Man Mulligan"—1940—whose namesake claims to be roughly one hundred thousand years old; "Gleeps"—1943—lifted from a teenage expression of those lost years and otherwise just an antic; and ". . . As Never Was"—1944—a time paradox item with an archeological atmosphere.

I've done better stories, but they've been in other books. I still hanker to do better ones. But for good measure Hannes Bok has dressed this lot up with one of his handsomest jackets, and a Bok jacket is always worth the price of the book. Isn't it?

THE RED PERI, by Stanley G. Weinbaum. Fantasy Press, Reading, Pa. 1952. 270 pp. $3.00

With this collection of eight stories, Fantasy Press has completed the publication of the science fiction written by the late Stanley G. Weinbaum. FPCI has recently brought out his un-

published novel, "The Dark Other," which I have not seen, but reports indicate that it was a minor work.

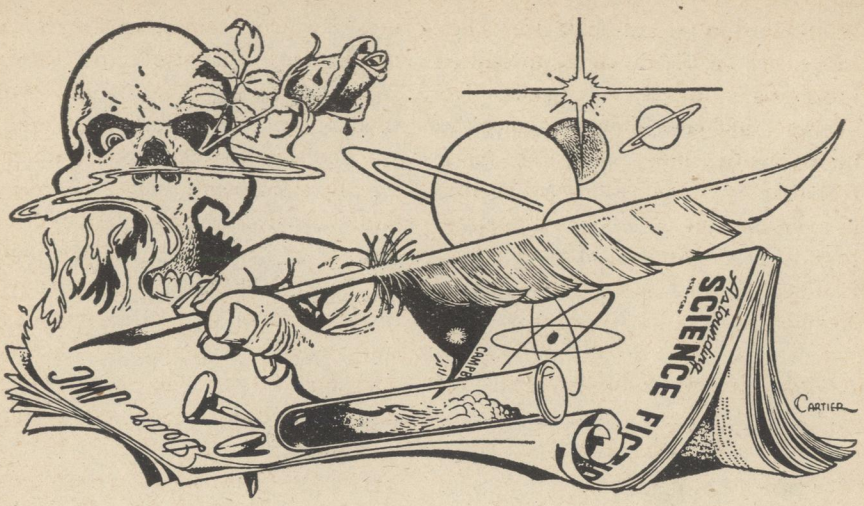
For that matter, these also are minor stories compared with "A Martian Odyssey" and some of the other tales in the first Fantasy Press selection. Two—"Smothered Seas" and "Revolution of 1960"—were collaborations with Ralph Milne Farley. Five of the eight first appeared here in 1935 and 1936.

One thing which emerges from reading this collection is the diligence with which Stanley G. Weinbaum, no scientist and still relatively a beginner as a writer, was searching for new scientific facets on which to base his stories. The title story, "The Red Peri," is a typical space-adventure yarn of the period—which might have developed into a series if Weinbaum had lived—which introduced the radical and still-argued idea that one can survive for some time in a vacuum, without insulation, because at low temperatures radiation is a far less effective cooler than convection or conduction. "Proteus Island" is a sort of variation on Wells' "Island of Dr. Moreau," but uses chromosome variation instead of Wells' crude plastic surgery. "Brink of Infinity" is a very short exercise—a puzzle-story, really—in elementary mathematics, "Shifting Seas" deals with concepts of world climate, and "Revolution of 1960" antedates the recent furor over cortisone by nearly twenty years. "Smothered Seas" draws upon knowledge of the algae.

The remaining two tales, "Flight on Titan" and "Redemption Cairn," are slight adventure tales which, however, utilize the bizarre conditions on other worlds as essential elements in the plot, instead of setting them up for window-dressing alone. And throughout—in the ice-ants and balloon-birds of these two stories, in the element-eaters of "The Red Peri" and the Protean monsters of "Proteus Island"—Weinbaum's genius for creating strange flora and fauna and making them convincing is readily evident.

If Weinbaum had lived to develop his talent, as Jack Williamson, John Campbell, and other starters of the period developed theirs, present-day science fiction would certainly have been the richer for it. Any of these stories would stand up today, but Stanley Weinbaum would be writing better ones.

☆ ☆ ☆ ☆ ☆



BRASS TACKS

Dear Sir:

While reading the December issue, I began to get mad at myself and the book industry at the same time. I didn't get too mad but was disturbed because I don't have the science background that I should have; or rather, that I would like to have. I have a degree in business and economics with a few years in engineering. But it is not enough. I want more education without going to a place of higher learning.

Just recently I read an article in the *Nation's Business* concerning the pocket-book editions. In that article it was pointed out that an amazing number of people read books now because of the formerly prohibitive price of hard backs has been undercut by the pocket book.

I believe that the trend in reading is more to informative now than ever and the pendulum is swinging faster on the downgrade. Many people would like to learn or read about the sciences. Also many of them would like to start from the bottom and work up in their chosen field but they cannot afford to pay anywhere from five to ten dollars for just a basic book such as the books on the college level. Result, a frustrated public that nibbles and bites wherever they can, not knowing right from wrong.

Why cannot college textbooks be

reproduced in pocket-book size? They can easily be cut down to an edition appropriate for pocket books. The average first-year physics books can be cut into three parts and made readable by showing how it is used in everyday life. The same can apply to most of the other fields.—Marshall E. Parry, 1245 Charles Drive, Reno, Nevada.

I think this idea extremely cogent—but it probably hasn't been carried out partly because of scholastic traditionalism.

Dear Mr. Campbell:

The December cover moves me to write to you. It strikes me as by long odds the finest that ASF has ever had, and I am grateful for the new cover set-up that does not mutilate the painting with extraneous matter.

In looking back over back numbers, some other covers deserve a word: two portraits, by Rogers and van Dongen, for "That Share Of Glory" and "Blood's A Rover" respectively; two spaceships by Rogers, for "Outward Bound" and "Now You See It;" and van Dongen's covers for "Firewater" and "The Specter General," these latter being rather less impressive than the others.

The admirable thing about all these is that they do not discard fine craftsmanship in detail while searching for an over-all power, also that they do not fall into the trap of pretentiousness, which somewhat mars for me Pattee's "Choice" and Rogers' "Achievement," handsome work though they are. None leave one in any doubt as to whether the painter is a really subtle workman or a slovenly bluffer, as I am always left in doubt before, for instance, a Pollack painting. I do not like to be confronted with the old reaction of "if this very singularly deep young man is much too deep for me, why what a very singularly deep young man this deep young man must be."

The December cover, besides being wonderfully beautiful from a visual point of view, can be read as a couple of issues worth of first-class short stories. One question, raised purely out of curiosity, and in no sense as a criticism: Would smoke rise in Martian atmosphere?—Philip C. Bolger, Gloucester, Massachusetts.

Wish we could score bull's eyes every time—but there are a lot of complex factors in art!

Dear Mr. Campbell:

In answer to your request for information on what we want in the line of articles. I have been quite happy with the articles you have been publishing, particularly in the lines of computing machines and psychology. I hope we can have more articles by computermen both on mechanical and organic computers. Math, logic, semantics, nuclear physics, astronomy,

and one that you have completely ignored—if my memory is right—astrogation, would all be welcomed by Yours Truly as subjects for articles. How about a series on present and planned digital and analogue computers? Would the Theory of Games make material for an article? I would be happy to see one on it.

Your articles are the first thing I read when I get the magazine—right after I read the editorial and Brass Tacks. The editorials, together with your fine articles, form almost a pocket education.

Your editorial on "The Laws of Speculation" will probably start a lot of speculation so why not start a department of—or for—the practice and advancement of speculation? Call it the Spec Dept.—John Gilson, 1710 Jefferson Street N.E., Minneapolis 13, Minnesota.

The Spec Dept. is called "Astounding Science Fiction."

Dear Mr. Campbell:

Nough we knough hough to translate, however that first spelling lesson had me buffaloed for a while. (October '51 issue of ASF.) If all obtained the same impression I did, they expected either *More* in the same issue, or *More* in a future issue, but to my knowledge *More* was not forthcoming and hence I presume no comment from the readers.

A bit of material like that thrust suddenly upon the readers of a magazine with no explanation could have but a few uses:

(1) to start a discussion.

(2) to start a discussion.

(3) to start a discussion.

There may be other reasons but they are a little obscure. Possibly it was intended to elicit a story from some bold and venturous writer—it may do just that. Food for thought? Yes. Spelling difficulties, however, tend to be the least of the difficulties involved in the English language. People who use a language continuously seem to overlook the fact that it is difficult. They see the overlying results of the "inability to communicate" but fail to realize the reasons for the failure.

A certain percentage of people see as a partial or even complete solution, the establishment of a "world language." This language to be simple, utilizes as few words as possible and has one word for each meaning???? This is fine except for a few minor?? things.

First, one of the biggest reasons for the breakdown of communications is the difference in meaning of a word, when defined by two individuals. A good example of this may be the latest discussion on the definition of Science Fiction. In the individual mind one man may be visualizing some fantasy story—complete with a beautiful goddess—and another, *thinking he has the same thing in mind*, the control panel and associated equipment necessary to operate an interstellar space liner.

Now, both men are certain they know what science fiction is but *neither* man actually knows what the other means when he says "science fiction." Such is the case with many words—multi-ordinal in meaning—such as *many*, 100, 1000 or 10^{15}; *much*, 1″, 1′ or 15 lbs. and they are not helped measurably by putting them in context. "A lot of rain fell yesterday." The multi-ordinal is obviously *lot*. Let's suppose one man lives in India and one in the Sahara Desert. A lot of rain to the man from India means a cloudburst or drenching rain. To the man from the Sahara Desert, a lot represents enough to just wet the ground. This is all right except that when discussing important subjects this multiordinality creeps in even more subtly and with much more disastrous consequences.

This has strayed far from the field of spelling but only serves to illustrate one of the many linguistic failures which occur in a language, spelling being—except for initially learning the language—one of the least troublesome. You say "but what if someone wanted to translate the language wouldn't consistent spelling help." Sure, but communication will still breakdown because Ogg from Mercury sees the word earth used to designate our planet and translates it to "Puglwhip," a cold, gaseous planet located at a "great" distance from the sun.—Brice L. Ward, Jr., 212 Spruce Street, NE, Albuquerque, New Mexico.

Another use for such material: That a thing doesn't have to have a use; it can just be fun!

Dear Mr. Campbell:

We are requesting ideas from your readers on a medical research problem

we are considering. We are investigating the tremor rate of the tongue during moments of stuttering. The way the problem was handled before was to insert a pneumatic pressure bulb in the mouth and have changes in pressure actuate a recording device to obtain amplitude and frequency. The size of the bulb, its mechanical inertia, distracting tubes, et cetera, limited the usefulness of this system. However, information of definite clinical and therapeutic value was obtained.

It has been suggested that a drop of paint containing iron filings could be placed on the tongue and by magnetic or electronic means movements could be recorded. Metal in the teeth would have to be accounted for. Amplitudes of 0.01 to 2 or 3 inches and frequencies of 1 to 100 per second seem to be about the necessary range of the instrumentation.

We are requesting suggestions from your readers on possible systems and procedures and other possible methods that may come to mind. Full credit upon publication.—Julius Lucoff, Professional Engineer, 4905 East 68th Street, Seattle 5, Washington.

That sounds like a real, Grade A, tough problem. About equal to sticking a pin in a scared rabbit without his noticing it. But a very worth-doing job. Any suggestions?

Dear Mr. Campbell:

The January issue forced several thoughts to the fore that I'd like to put down on paper. Their rank of importance is open to question, but no sequence is intended.

"Un-Man:" I rather blushingly admit that the type of science fiction published in ASF is exactly my dish. By that I mean that I don't go in so much for the more technical side of stf. Still, every now and then, I run across a story that I like.

Poul Anderson has, for me, spun a story so intriguing that it has been hard for me to do my homework. I read the story through in as short a time as was possible. Poul didn't try to use too complex a plot. His was simple, direct, and to the point. His descriptive phrases were word paintings of striking beauty.

I'd like to nominate this story for *The Best Science Fiction Novels*—what would the date be? . . . 1953 or 1954.

Of this Anderson, I think we'd all like to see more.

Then there's this. "Needle" was very good. I liked "Iceworld," too. The news of an eighty-five thousand word serial by Hal Clement was very well received.

In the same breath you mentioned this bonus plan. There's a point or two that is unclear.

Now, as a fellow who plans to start contributing in a year or so, how does a bonus work for a serial novel? If "we," the readers, vote for Story X as being best in the Y 1953 issue, the author gets a bonus of one cent per

word. For a serial, does the author have to rank first once, twice, or all three times? It would be hard for *any* story to ring the bell three times in a row.

I feel that my issue of ASF is incomplete without "In Times To Come." I like those advance blurbs that make my mouth water for a month to come. —Henry Moskowitz, Three Bridges, New Jersey.

A serial will be given a bonus payment of one cent a word on each installment that ranks tops. If it earns it on Parts I and III, but misses on Part II, it would earn its author about $600 extra, instead of $900 extra.

Dear Mr. Campbell:

During the last two weeks, while invalided with a broken leg, I have read fourteen back numbers of ASF from cover to cover. It was my maiden experience with your magazine, or any like it, although I have read a quantity of hard-cover stf previously. Like Mr. Keats perusing Chapman's Homer, I felt like "some watcher of the skys when a new planet (in this case, several dozen planets) swims into his ken."

At any rate, after much intensive travel through the realms of space, and having seen many goodly World Governments and Galactic Federations, I've come up with a few observations anent your publication. I have decided to speak out loud and bold. Here then, are my shallow-browed reactions:

Fiction: The best to be found between soft covers. But I am in consistent disagreement with the Analytical Lab. For me, the short stories pack the biggest punch, say most with least verbiage, are more thought-provoking than the longer pieces. I think

the readership often votes for quantity instead of quality. I think your format is well-balanced, however, and I enjoy the novelettes and serials; I am merely stating a preference.

Articles: Most of them are excellent for the layman, and no one should resent the stimulus provided when he has to "dig" for the meaning of a more technical piece occasionally. I, for one, would like a little more basic astronomy — but then I've read no issues prior to late 1950, where this may have been dealt with extensively.

Editorial and Critical Material: This is what really puts ASF head and shoulders above the competition. One has to seek out the literary journals to find comparable intellectual pay-dirt, and do a lot more panning to get at the mother lode. (I did a double-take when I found an article entitled "Aristotelian Thinking" on page two of ASF; now I am an aficionado, and my surprise is replaced by avid application to the Editor's Page.)

But my paean is getting prolix; I'll get to my personal point.

ASF publishes just about every literary form except drama and verse. Drama is out of the question for a number of reasons, but why not an occasional poem to occupy one of those half-page fillers? I mean stf verse, of course, and if there isn't much in existence, there soon would be if an outlet were provided. Many readers wouldn't care for it, but then, one of the nicest things about ASF is that it doesn't try to be all things to all men. From the editorial standpoint, verse doesn't cost much: many a lay laureate would contribute free, just to see his work in print.

Just in case this argument carries any weight, I will knock the props out from under it in perverse fashion by enclosing an example of what I mean by science-fiction verse.

I would like to see some reader reaction, if not to the poem, at least to the idea.

CELESTIAL MECHANICS

Nebulae, Nebulae,
Man is the square-root of infinity,
Your only integer for cosmic calculations.

What if the stars revolve for endless eons,
While Man drifts vaporized across the void,
The radiant remnant of Atomageddon?

Nebulae, Nebulae,
Yours will be a blind participation—
Galactic factors in a dead equation.

See what I mean? The theme is anthropocentric, but ASF readers should interpret "man" as all forms of sentient life, anywhere in the universe.—Herbert Taylor, 2115 East Fifth Street, Duluth, Minnesota.

How about it, readers? I haven't used verse in the past because there was

little demand for it. If the situation has changed—if you do want verse—let me know.

Dear Mr. Campbell:

The Gegenschein article in the January 1953 issue was interesting, but I failed to agree with Moulton's explanation. According to Richardson's article, the experimental facts are: A round or oval patch of light is observed directly opposite the sun, about the sun's apparent size or larger. No parallax is observed. It appears to be an atmospheric effect, for a sky not overly transparent is just as good.

There are two objections to assuming it is light reflected from meteors a million miles away. It is hard to imagine that there are so many meteors there; a conservative estimate of the mass of these meteors would be one thousandth of the moon's mass, which would produce a noticeable gravitational effect on the earth and moon. The other objection is that it fails to explain why a sky not overly transparent is just as good. The theory's strongest argument—no parallax—is not valid, unless it is a definite object that is seen; by a similar argument one can prove the rainbow is halfway to the moon, whereas it is actually much closer.

The correct explanation seems to be that the light comes directly from the sun, but is diffracted around the earth. The effect is somewhat similar to observing a disk with a light behind it, which under certain conditions appears to have a bright center. If light is a wave, it is reasonable that some vibrations will appear behind the earth. Due to symmetry, one would expect the spot directly opposite the sun to be either a maximum, or a minimum; the gegenschein indicates it's a maximum, although only a mathe-

matical analysis—by another ASF reader—can prove it. Each point on the sun's surface produces a small patch of light opposite, so the gegenschein should be equal to the sun's apparent size, or larger. The ratio of the earth's radius to the wave-length of light is the thirteenth power of ten, so the intensity of light would probably be cut down at least by this factor. When directly overhead, the gegenschein should be perfectly round; when away from the zenith, it might appear oval. Mathematically, the effect of the atmosphere would be most difficult, but qualitatively, one might expect that a heavy atmosphere would help in bending the light around the earth, if it didn't absorb too much light. This theory seems to explain the facts better, but the acid test will be when that spaceship goes crashing into that churning mass of meteors, or doesn't!—Gary D. Gordon, 49 Irving Street, Cambridge, Massachusetts.

I take it you feel that the amount of meteoric material involved would lead to "When the Mountain Comes over the Moon!"

Dear Mr. Campbell:

For the Analytical Lab:

1. "Un-Man," Poul Anderson.
2. "The Captives," Julian Chain.
3. "Secret," Lee Cahn.
4. "Stamp from Moscow," Steve Benedict.
5. "These Shall not be Lost," E. B. Cole.

Of the two articles I found Richardson's the more interesting. So we have to wait till April for another serial! I'd kick if the prospect of a novel by Clement didn't make me so happy. Can't wait to see if the next "Brass Tacks" contains any of those howls of anguish concerning "Frontier of the Dark." I thought it was an excellent story. If van Vogt, Kornbluth, and others can get away with vampires, why can't Chandler work with werewolves?

With "The Basic Science Fiction Library" Miller has done something more worthwhile than any book review column of science fiction anywhere. And those of us—I wonder how many—who find the reviews in some of the newspapers intolerable because of their snobbishness are glad to read reviews in which the critic doesn't try to completely demolish a book's reputation because of some personal and often unjustified prejudice.

The January issue has a high average of quality. There is only one bad story.—R. Hodgers, 74 Willow Street, Glen Ridge, New Jersey.

It will take time for those not familiar with science-fiction to learn to enjoy it as we do.

[Continued from page 8]

reduced to a perfectly congruent system.

The GG unit is proposed for the following reason: if purely random postulates are thrown into the logic computer, the device can circle endlessly, randomly, simply churning without advance. But if the GG unit gives even a tiny fractional advantage, we have an "Oak Ridge situation." That is, we have a recycling filter system; just as Oak Ridge purifies U-235 because U-235 has a slight—very slight—advantage over U-238 in passing the filter membranes, so the GG Unit would purify valid answers. Oak Ridge can produce U-235 of any desired degree of purity; it's simply a matter of how many times you recycle the U-235-U-238 mixture through the filter membranes.

The logic unit is specified as Aristotelian for a reason: it must have absolutely no judgment whatever. If judgment is introduced at the Logic step, it makes it non-rigid, and would then allow a false postulate to stand because it would form a non-rigid link between theory and observation. It would amount to a scientist who gave himself the benefit of the doubt in all his measurements. He'd wind up with a pleasing, but not accurate. answer.

Let's say that judgment is the X in the equation of thinking. In solving for X, the first step required is to collect your terms, and concentrate X on one side of the equation. You can't solve for X, if X remains distributed throughout all terms of the equation.

Ideally, then, perceptive devices will exercise no judgment; logic will exercise no judgment; actuators will have zero judgment, et cetera. Only then, can the machine determine that failure to achieve coincidence of logical conclusion and observed data is due to faulty postulate.

Now an essentially infallible logic computer is not at all impossible to devise. Logic is a very simple process, actually—if you use Aristotelian logic. A pair of binary digital computers running as a logic machine will have to check exactly, at every step, if they are functioning correctly. Mere lack of total agreement will immediately indicate mechanical failure. Within Aristotelian logic itself, there can be no difference of opinion that is valid—opinion, that is judgment, has no place whatever in Aristotelian logic. The very simplicity of the system makes it ideal for an application demanding absolute rigidity.

All that's needed to give the required effective non-rigidity is to establish an adequate number of postulates differing minutely between each other. Thus the modern scientist recognizes the nearly infinite differences between the substances of which the world is made, yet does so by saying "All material substance is made up of atoms. All atoms are made up of electrons, and nuclei. All nuclei are—" and so on. That system of thinking does *not* deny the infinite resultant differences, and yet does allow Aristotelian thinking.

Such a thinking mechanism can solve all the problems of the total Universe, given time enough to operate—*provided*

1. No postulate is allowed to be immune to reconsideration and recycling.
2. Data from the external world, and data from the data-storage are *always* given priority over any postulates.
3. No area of the Universe may be barred from investigation.

Now if human minds operated on such a basis, postulates leading to unsane behavior would involve, at the root, concepts such as "I can't think about that" or "I mustn't even think about that," since that bars a segment of Totality from inspection. Blockage of memory-scan would prevent checking a conclusion against data, as effectively as blockage of sight would prevent seeing the present situation does not correspond with the individual's belief. "Whosh shdrunk? I'm no' shdrunk!" can only be uttered by a thoroughly soused individual who refuses to compare data on present behavior with data on his own earlier behavior.

And all of these would come down to failure to recycle the problem—some postulate that "This is a final answer which must never be questioned."

So far as the computer design engineer goes—the problem is, "What's the mechanism in the GG Unit?" Given that wonderful gadget, we could really get somewhere!

Do human minds have such a Unit?

I don't know. How do people get scores perceptibly above chance on Dr. Rhine's card-guessing game?

THE EDITOR.

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