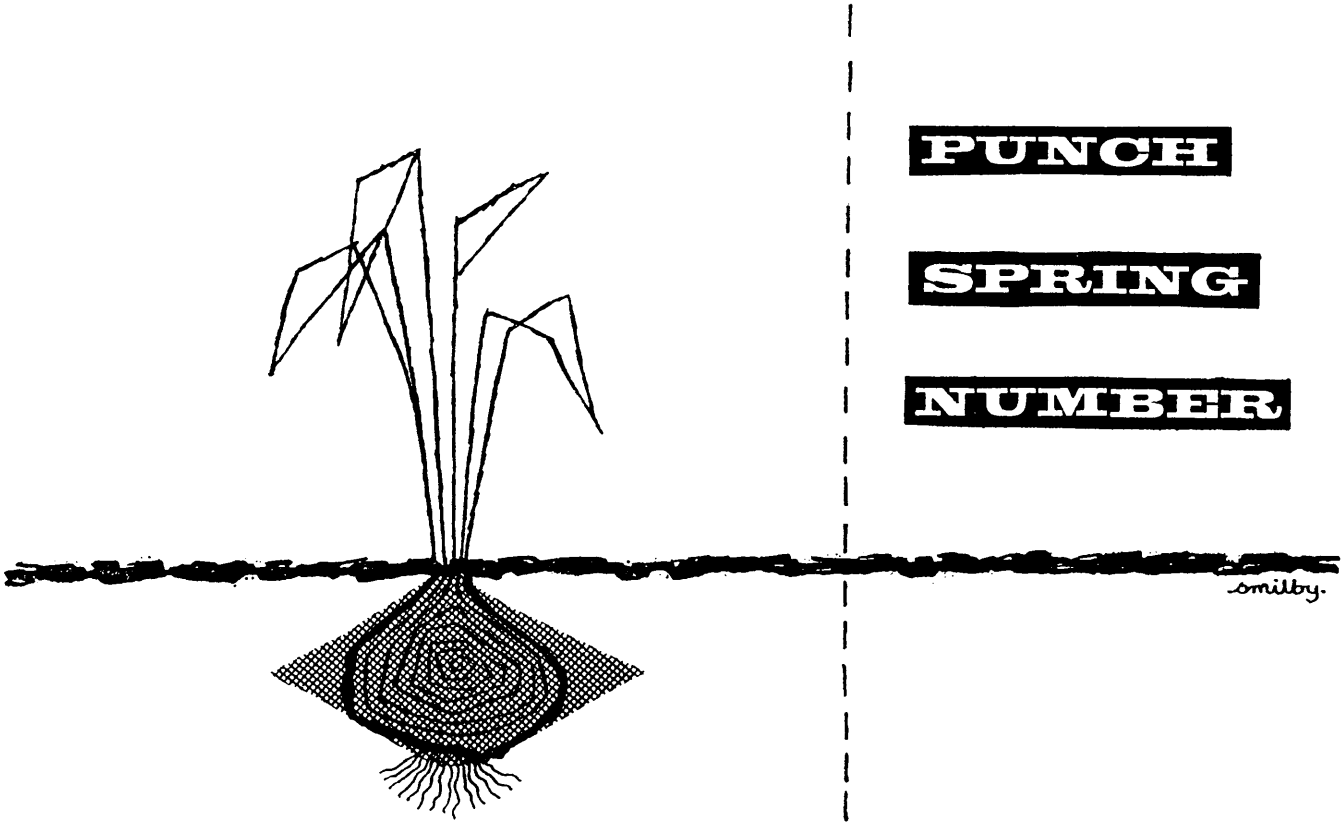
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AT LAST! IN EIGHT EASY PAGES

SPACE FOR BEGINNERS

LESSON 1: History

THE Universe began about four and a half billion years ago. This means that we shall have to get on in a series of short sharp sentences if we are to cover the ground in a thousand words. Gibbonian balance and periphrasis have no place in a history of this kind.

The above estimate of the age of the Universe is based on the so-called radioactive clock and is taken from a paper by Donald H. Menzel, Director of Harvard Observatory. A moment's reflection will tell us that Professor Menzel would be using the word "billion" in the American sense of a thousand millions, not a million millions, so that we can at once re-estimate the age of the Universe at only four thousand five hundred million years, or 4,495,500,000,000 years *less* than the number we first thought of. This represents a considerable saving of time. Our task already has been reduced to comparatively cosy limits.

Modern astrophysicists tend to agree that at about the time it began, or perhaps a little earlier, all the matter in the Universe was concentrated in a kind of lump which was nowhere in particular. All around it, of course, was empty space, which was probably very much older, but we cannot go into that now. The history of Space, as opposed to the matter in it, is unrelievedly dull and much too curved for beginners.

To get things started, the concentrated lump flew apart. Aggregations of gas and radiation sped off in all directions, cooled, and became the innumerable universes which now comprise the Universe. Then came a disappointment. Nothing much more happened. The history of the Universe practically ceases at the point at which it got itself sorted out. Now and again a star blew up, a satellite was captured here and there; but by and large the Universe just went on receding from itself with increasing velocity for millions and millions of years. A Table of Dates, giving events at intervals of say fifty million years, would consist of a monotonous series of entries reading "Everything that much older and that much further away," with an occasional "Moon cooled off 10 deg. F." to brighten it. Anything more detailed would be either Physics or Geology.

However, although in one sense space is somewhat short of history, in another it is full of it. This is because of the nature of light, which goes on and on at a finite speed. Far from being instantaneous, light is now much too slow to be a satisfactory means of communication between the different parts of the Universe. It takes this sluggish stuff about four thousand million years to reach us from the most distant objects we are able to photograph through telescopes; in other words, as those who are still attending will realize, we are seeing these objects not as they are now but as they were almost before they began.

Since we all started together in a lump, how can these distant objects have got so far away and still be sending back pictures of themselves as they began? Or, to put it another way, if the pictures we are getting now took so long to arrive, ought they not to be older than they look?

This is probably a foolish question. It must not be forgotten that there are in all probability still more distant objects, way out beyond the ones we can see, so many light-years away that if we *could* see them we should see them as they were before they existed. Happily, however, these outer objects are receding with the speed of light, so that their pictures cannot, as it were, get started. We are spared the embarrassment of observing them in a state of nonentity.

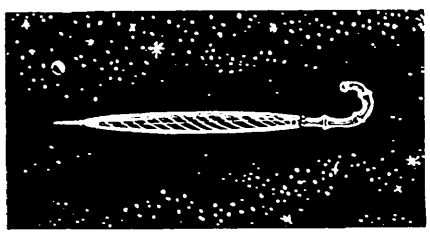
But what about the pictures of them *before* they reached the speed of light? Ought not these to be arriving at Mount Palomar obseryatory any time now?

No, no. The question shows a confusion of thought. They *have* arrived. They are the pictures we mistakenly referred to just now as those of the most distant objects we *can* see. As a matter of brute fact, they've gone.

It should be clear by this time that space is full of pictures of things as they used to be—in other words, of history. The images of everything that has ever happened travel eternally onwards and outwards. Seen from the Sun, the Earth appears as it was eight minutes ago. An observer on *Proxima Centauri*, the nearest star some four light-years

away, looking at this moment through a suitable telescope, might well see the Proclamation of Queen Elizabeth II from the steps of the Royal Exchange. Henry VIII, with his six satellites, is now about midway between *Kappa Orionis* and *Zeta Orionis*. Somewhere in the cold immensities of the constellation of Scorpio the battle of Agincourt is still being fought with undiminished fury. If some benign intelligence were to erect for our benefit a non-U mirror on *Gamma Andromedae* (150 light-years away) and equip us with patent double-million magnifying gas telescopes of hextra power, television would really come into its own. We should be able to watch the younger Pitt in person rolling up the—— But stay. There is a flaw here. One cannot expect light, with the pictures it carries, to come back faster than it went. We should have to wait another hundred and fifty years before the mirror reflected anything at all. It is, at best, a long-term project.

Nevertheless it is a compelling, perhaps a rather chilling thought that whatever is done—whatever, at any rate, is done out of doors—is for ever imprinted on Space, a kind of undeveloped negative rippling outwards to the uttermost limits of the Universe. Out there in the void Gladstone still stumps the country on his Midlothian campaign; Xerxes, immensely further, endlessly flogs the Hellespont with chains; closer at hand, but doing the full hundred and eighty-six thousand miles a second, Chamberlain waves his deathless umbrella. It is nonsense to say that Space is empty. It is full to the



brim with History: history on the move, history in full colour, the history of the stars and of the earth, the actions of every man and woman that ever drew breath, from Neanderthal Man down to you and me.

This fact, if it does nothing else, should make us careful what we get up to when we step outside for a breath of fresh air.

H. F. Ellis

LESSON 2: Geography

General

SPACE-cartographers labour under the handicap that space is finite but unbounded, a concept easier to express in words than in Mercator's projection. To make things more difficult still, space is also constantly expanding; some of the more distant galaxies are receding from the earth at speeds comparable with the speed of light. It may be, as has been suggested in the History Lesson, that there are even galaxies somewhere that actually are receding with the speed of light itself, but if so, we shall never know about them unless they throw messages out into space in bottles. Even then it seems likely that the messages would be in a language we did not understand.

If there are galaxies that are in fact exceeding the speed of light, they are liable to appear at the opposite side of space and begin to catch up with themselves. Fortunately they have a very long way to go. The problem for the maker of space-maps, however, is to decide which galaxies are actually approaching from one side of space, and which are the same galaxies retreating on the other side.

With so many galaxies mobile in finite space, it may be wondered how it is that the galaxies avoid running into one another. An ingenious answer has been given by Sir James Jeans. Jeans calculated that on an average any star should expect to pass dangerously close by another star once in every 5×10^{15} years. As none of the galaxies has yet existed for anything like that period of time, collisions have been reduced retrospectively to a very small figure.

Exploration of Space

Exploration of our own solar system, about which a good deal is known, is not a difficult problem. It is only necessary to design a rocket-ship capable of attaining a velocity of seven miles a second; to invent a suit in which a man is comfortable in a complete vacuum with temperatures of 270° F on his face and −40° F on his back simultaneously; to achieve immunity from cosmic rays; to devise a method of living under zero gravity; to learn how to avoid meteors, asteroids and incoming flying-saucers; and the job is done.

Similar methods will not serve for outer space. Sir George Thomson tells us that it is theoretically possible to attain half the speed of light if a mere eighty-third part of one's space-ship is payload and the rest fuel. We shall then be able to fly to *Proxima Centauri*. The return trip will take about seventeen years and three months, though on account of the strange behaviour of time at high speed the crew will only have been away fourteen years and seven months, and will thus be in the curious position of returning to earth two years and eight months before they actually do so. What is more, there is no guarantee that there will be anyone on *Proxima Centauri* when they get there.

More adventurous astronauts will propel their ships by warp drive. The principle of the warp drive is easily demonstrated by means of a simple analogy involving bookworms (the non-humanoid variety) eating their way through a sheet of paper, but space is unfortunately not available to go into it here. How to navigate when deprived of the familiar surroundings of our own space-time continuum is a problem that will be dealt with in the next section.

Navigation

Astronautics is a simple science as long as the stars maintain the same relative positions. There is no reason why a space-navigator should not set a course on a star and fly to Venus on it. Come to that, he could set a course on *Proxima Centauri* and fly to *Proxima Centauri* on it. But he would be well

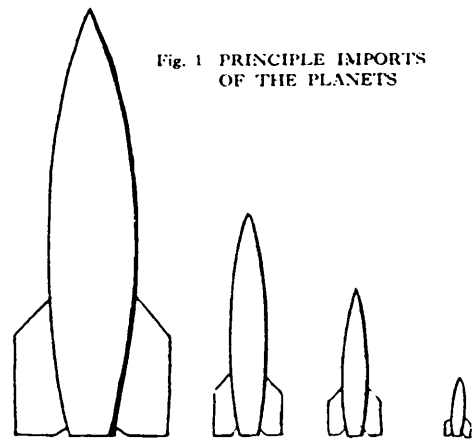


Fig. 1 PRINCIPLE IMPORTS OF THE PLANETS

advised to detail a member of his crew to keep an eye on our own Sun, for by the time he arrived the appearance of the heavens would have changed considerably and the constellations as such would have disintegrated. He should also pray fervently that the Sun will be visible at a distance of 4·3 light-years. If he thinks there will be any doubt about this he should include a powerful telescope as part of his equipment.

The problems of navigating under warp drive, which involves quitting our own space-time continuum and passing through another, are too complex to be discussed here.

Fig. II PRINCIPAL EXPORTS OF THE PLANETS

Political Considerations

It is not possible, in the present state of man's knowledge, to be dogmatic about the ownership of space, or the rights space-travellers may claim when travelling it. It is easy for the nations of a world to demarcate those parts of the sky above their territory as their own skies, and to lay down which aircraft may, or may not, fly through them. But every world is completely surrounded by space, and if an analogous procedure were followed every inhabited planet would necessarily claim the whole of space. No doubt when communication between worlds becomes easier spheres of influence will be laid down and interplanetary visitors warned not to violate the three-light-year limits of territorial space, under pain of being seized by spaceguards and fined; but the difficulties to be met before such a system can be inaugurated are considerable, and for many years yet we may be forced to witness the humiliating spectacle of flying saucers flying in and out of our territorial airs as they please without penalty.

The Solar System

The principal planets of the solar system are Pluto, Neptune, Uranus, Saturn, Jupiter, Mars, the Earth, Venus and Mercury. Only the Earth, Mars and Venus are known to be inhabited, though it should be mentioned that a theory of inhabitants on the Moon, first put forward in fictional form by the British scientist Wells, has recently received unexpected confirmation in various quarters. A notion advanced by one observer after conversation with a flying-saucer pilot from Mars is that the inhabitants all live on the side remote from Earth. His explanation is that they are preparing some vast operation which they wish to keep secret; it seems at least equally likely, however, that it is the operations that they have observed in preparation on Earth that have driven them so resolutely to the distant hemisphere.

The Moon, being a mere quarter-million miles from the Earth, does not really count as space, however, and any further discussion must be reserved for another place.

Mars

By far the most widely-explored of the planets is Mars.

The earliest reports of Martian exploration are contained in a massive work by the American adventurer John Carter, which has been edited by Edgar Rice Burroughs and published in at least seven volumes by Methuen and Co. Carter, whose origins are mysterious but who hailed from Virginia, first visited Mars in 1866, and wrote his account of his adventures there in 1885–6. His highly-coloured style, and the fantastic nature of his report, have earned him the name of "the Sir John Mandeville of Mars."

Recent discoveries, however, have unexpectedly tended to confirm John Carter's stories. For example, a prominent double feature at Ismenii Luci (at the junction of the Djihoun and Protonilus Canals) is exactly in the position where Carter described the "twin cities" of Helium.

Later visits were made by C. S. Lewis, who has written a valuable account of the language and religious beliefs of the Martians, and by Jet Morgan, who found the place full of zombies, but with only one Martian left. A scientific expedition led by Arthur C. Clarke on behalf of the British Interplanetary Society has also landed on the planet. Their main achievement was to set one of the moons on fire.

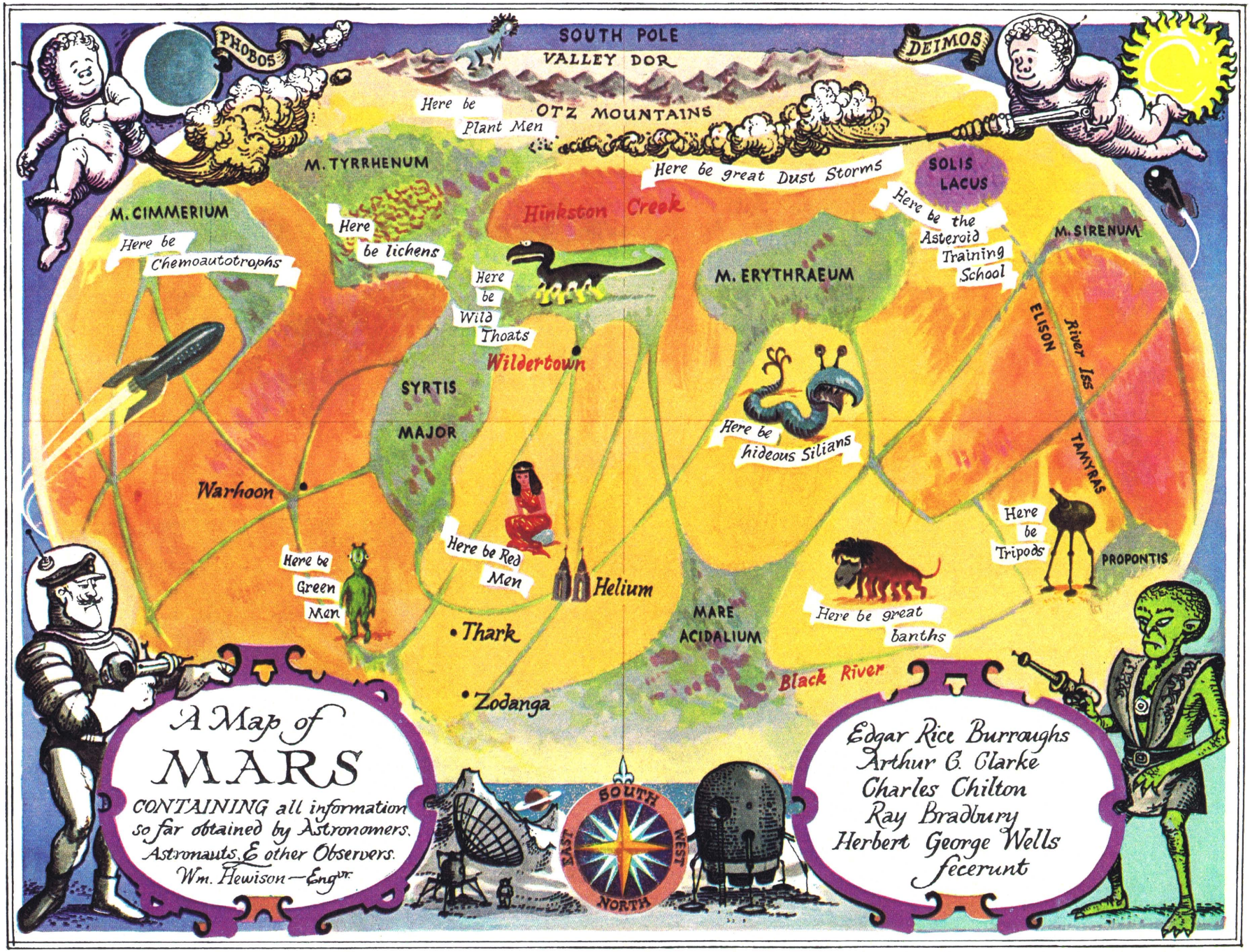
Mars, as can be seen with a telescope of quite moderate power, has the south pole at the top. The north pole lies correspondingly at the bottom, the east in the west and the west in the east. Oddly enough this arrangement is favoured by all the planets except Earth and Uranus. Uranus has an east pole and a west pole. But that is another story.

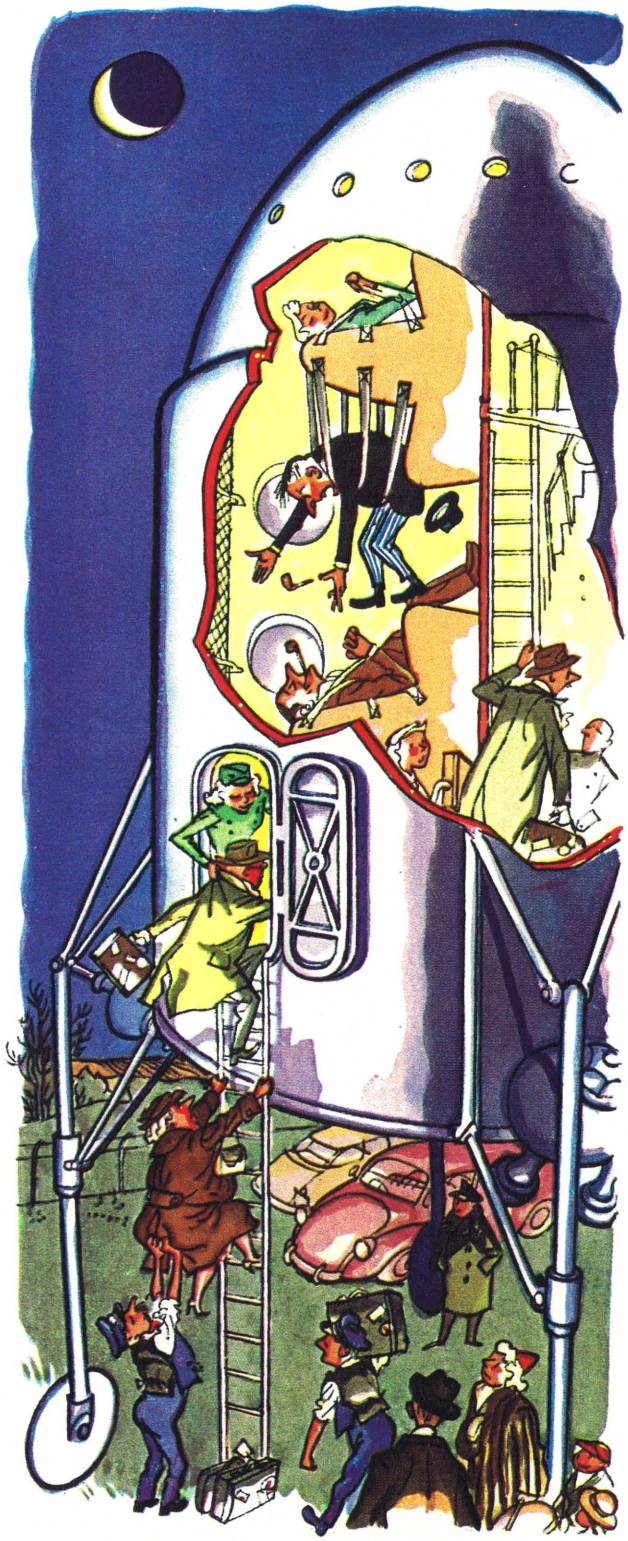
The climate of Mars is equable but cold; not so cold, however, as to discourage John Carter from wearing Martian dress at all times. This consists of jewelled trappings or harness during the day and fur rugs at night. Later Martian explorers, finding the thinness of the air unpleasant, stuck to their space-suits.

Little is known about Martian industry, though John Carter has given a fairly detailed description of the air factory near Zodanga. The manufacture of flying-machines and submarines is well developed, but automobiles have not yet made their appearance, possibly because there are no roads. Wireless and television are unknown. Agriculture seems on the whole to be neglected, though we know that there is a plant yielding milk (Carter) and one yielding air (Clarke), and that the plants observed by H. G. Wells during the Martian invasion earlier this century were red in colour.

Venus

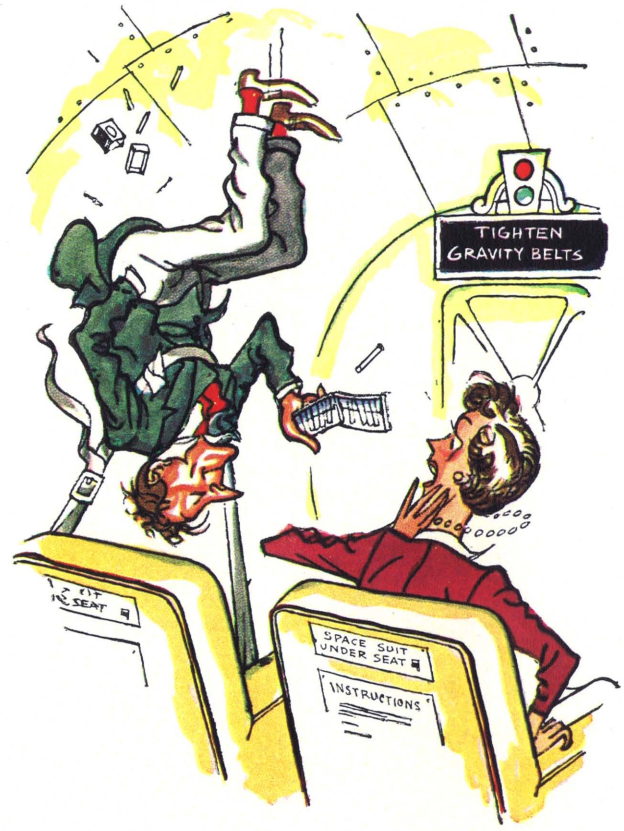
Venus is a very boring planet. It has been thoroughly described by C. S. Lewis, whose friend Ransom flew there in a coffin in the manner of the mediæval saints. According to his account, the greater part of the surface is covered with water; small flexible islands float on the surface of it, and on these dwell the inhabitants, who are forbidden, on religious grounds, to live on the comparatively small land masses known as the Fixed Lands. The sky is permanently covered in clouds and the general pattern of existence closely follows the events of the Garden of Eden, only with more introspection all round. There were only two humanoid inhabitants at the time of Ransom's


PHOBOS
DEIMOS
SOUTH POLE
VALLEY DOR
OTZ MOUNTAINS
Here be Plant Men
M. TYRRHENUM
Here be great Dust Storms
SOLIS LACUS
Here be the Asteroid Training School
M. CIMMERIUM
Here be Chemoautotrophs
Here be lichens
Hinkston Creek
M. SIRENUM
M. ERYTHRAEUM
Here be Wild Thoats
Wildertown
ELISON
River Iss
SYRTIS MAJOR
Here be hideous Silians
TANYRAS
Warhoon
Here be Tripods
PROPONTIS
Here be Green Men
Here be Red Men
Helium
MARE ACIDALIUM
Here be great banths
• Thark
Black River
• Zodanga
A Map of MARS
CONTAINING all information so far obtained by Astronomers, Astronauts & other Observers.
Wm. Hewison—Engr.
SOUTH
EAST
WEST
NORTH
Edgar Rice Burroughs
Arthur C. Clarke
Charles Chilton
Ray Bradbury
Herbert George Wells
fecerunt



Don't make a fuss, before take-off, about wanting to sit with your back to the engine.

As soon as the early effects of gravitation have worn off, see that your personal belongings are neatly stowed.



Always make sure you are the same way up before addressing a lady.

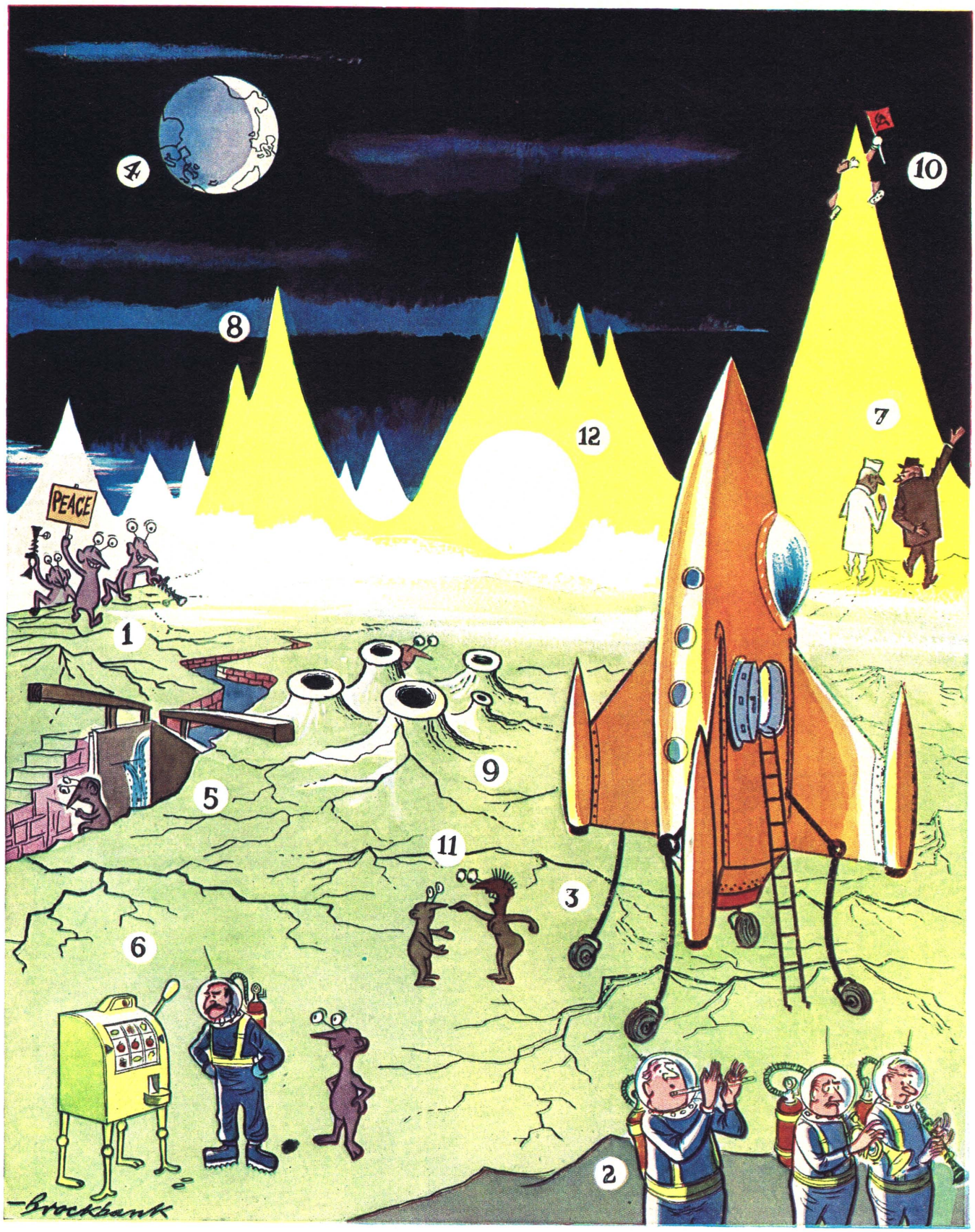
THE ETIQUETTE

Don't go into the control cabin except by invitation. They may be busy.

If in doubt or difficulty, consult the Space Hostess.

Above all, avoid shipboard entanglements. The journey may last some time.

OF SPACE TRAVEL



FOR 11-PLUS CANDIDATES (*See opposite page*)

journey, one of each sex, and they were married, if so coarse a word can be employed of creatures so spiritual.

John Carter visited Venus as well as Mars and has left an account of it very different from Lewis's, but it is possible that he was not in a state of grace at the time of his observations. At any rate he agrees with Lewis about the cloud envelope, the existence of which is independently confirmed by Ray Bradbury, who draws the perfectly fair deduction that on Venus it is always raining. (Ransom appears to have been there during an unusually dry spell.) Yet another account has come from Maurice Baring, of all people; his description, based on three very brief visits by a man nearing a nervous breakdown, seems to tally to some extent with Lewis's. Baring's Venus contains enormous butterflies and an indefinable sense of dread, both of which would fit into Lewis's world very well.

A curious description of life on Venus was given by the French writer Maurice Leblanc. Leblanc's knowledge was based on a kind of long-distance telepathic cinematography, and is not considered reliable. According to him the Venusians have three eyes and live in a vertical, instead of a horizontal, plane. This last observation is not borne out by any other Venerographer. A possible explanation is that the scenes he was shown were not taking place on Venus, as he supposed, but on Uranus, where the unusual arrangement of the poles might produce this effect. Other evidence, however, is conclusively against the existence of life on Uranus, any way up, and Leblanc's theories are now discounted.

None of these observers has anything to say about anything so mundane as principal rivers, mountain ranges, imports and exports or ethnographical distribution, and the Venusian who came thirty million miles in a flying saucer to speak to George Adamski had nothing to say about them either, or possibly found them too complex to discuss telepathically.

OTHER HABITABLE PLANETS

There are no other habitable planets.

B. A. YOUNG

TEST PAPER

For 11-plus Candidates

Look carefully at the picture on the opposite page, and then say:

1. Whether you would be inclined to trust the party advancing over the ridge at left?
2. What action should be taken by the Ensa Concert Party (wind section) in right foreground?
3. Who invented the ludicrous legs on which the rocket-ship, just arrived from Earth, is trying to support itself?
4. Assuming the landscape to be Venusian in character, would you say the apparent diameter of the Earth is about right? (Rough working may be shown.)
5. Assuming, on the other hand, that this is Mars, what has happened to this derelict canal? Nationalized?
6. What *is* that thing Sir Mortimer Wheeler is trying to identify down there in the bottom left-hand corner?
7. See if you can find (*a*) Mr. Dulles (*b*) Pandit Nehru, (*c*) any other fabulous characters likely to be nosing around doing good.
8. Do you know of any reason why mountains in drawings of other planets should always be more spiky than ours?
9. Could these be ventilating shafts for underground railways, would you say?
10. Is this Tensing—and, if so, is he likely to be invited to join future expeditions financed by *The Times*?
11. If all these odd Martians (or Venusians?) can live in this place, why —as usual—no animals or birds?
12. Draw in a Venusian sparrow, with its eyes on stalks, just for the hell of it.

LESSON 3: General

Memorize the following:

The Moons of Saturn

Saturni: Phoebe Mimas Iapetusque
Dione
Enceladus Tethys Rhea Titan atque
Hyperion.

The Moons of Jupiter

Count of my dozen moons or so
Callisto, Ganymede, Io,
And add Europa to the score,
It only leaves me eight* moons more.

*With Latin names too: V ,VI, VII, VIII, IX, X and, last, XI.

Heavenly Bodies

The path of a planet or satellite
Is nearly circular but not quite.
The figure the average comet trips is
Either parabola or ellipsis.
But that common object, the asteroid,
Just blunders about the measureless
void.

Time

Time past and present are both perhaps
Present in future time.
T. S. Eliot says so, chaps,
In a solidly rhymeless rhyme.
Neither the sentiment nor the pun
Is, in time-travel circles, precisely
Dunne.

Further Research

Many stars in "—us" we find
To the galaxy assigned.
To memorize them do not fuss:
They are too far away for us.

Space-Shanty

To be sung in Schools.

Farewell, Venusian maiden,
From your pretty green arms I must
go, must go,
For with Pluto-bound cargo we're laden
CHORUS:
And $E = mc^2$, Yo ho!
But carry this curl in your locket
And I will come back to you, to you,
In the same old rocket
CHORUS: And $ds^2 = \sum_{\mu=1}^{4} \sum_{\nu=1}^{4} g_{\mu\nu} dx_\mu dx_\nu$

Yo ho!

Exercise

Complete the following semi-quatrain:

Sing a song of spaceships,
A rocket full of π . . .

PETER DICKINSON