As the large bowel with its massive content of germs is approached the counts in the lower ileum increase and assume the composition typical of faeces with its predominant anaerobes and the characteristic enterobacteria. While this huge complex of organisms, singly and in concert, may synthesize and degrade all manner of compounds, it is arguable how well the products will be absorbed from the large bowel. In the rat, in which intestinal bacteria synthesize a useful contribution to its vitamin requirements, the bacterial products are principally absorbed through the small bowel by coprophagy.[3]

If the bowel is obstructed or a segment is sequestrated from the main stream, bacteria accumulate in the affected segment, and their metabolic activities have been thought to play a part in the " blind-loop syndrome."[6]

It may in fact turn out to be very difficult to analyse the metabolic activities of the bacteria in the gut. Bacteriologists have, understandably, looked on the complete systematic analysis of the extraordinarily complex flora of the gut as a daunting task. With increasing familiarity it is beginning to appear as though the difficulties foreseen are as nothing compared with the difficulties unforeseen. Perhaps the most important realization is that the accepted stability of the gut flora, which evidently plays a major part in resisting the incursion of harmful species,[7] may in one important respect be more apparent than real. Even where the total representation of species remains the same, important changes in metabolic activity may occur within species. Though the count of a particular organism may remain the same, the strain intially present may be replaced by another[8] with new activities which can affect the well-being of the host in a different way. To understand fully what the bacteria are doing in the gut it may be necessary to produce not only a complete map of bacterial species but, within each species, a map of metabolic activity.

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Living on the Moon

Twelve years ago a leading article in this journal,[1] stimulated by the then recent launch of the first Russian sputnik, and entitled "Man on the Moon," discussed the medical problems of living on that inhospitable body if ever the occasion should arise. How far has the outlook on these problems changed since then ?

One of the biggest difficulties was the seeming impossibility of producing a pressurized space suit which would allow the limbs to be fully mobile. In fact, at that time the only solution seemed to be a self-propelling cylinder with artificial limb-like projections operated by the astronaut inside. Now the engineers have managed to solve the problem within limits, helped by the presence of a pure oxygen atmosphere inside the suit, which allows normal pressure to be reduced to about one-fifth of an atmosphere. But evidently there is still the problem of moving the head on the neck, because each astronaut needed verbal guidance from the other to climb back up the ladder into the lunar module. Furthermore, one had to ask the other whether the pocket above his knee was open, and he needed guidance to put anything into it.

The art of walking on the moon had already been practised on earth with a " simulator " which relieved the walker of five-sixths of his weight. It had been found difficult to get a proper grip on the ground when trying to go forward, and in fact, as was seen on television, the moonwalkers adopted a kind of slow, slightly prancing motion such as one uses on earth when walking on ice or loose sand. As Edwin Aldrin said: " You do have to be rather careful to keep track of where your centre of mass is. Sometimes it takes about two or three paces to make sure you've got your feet underneath you." But at least neither they nor their module sank into a kilometre-deep sea of dust, as one astronomer had prophesied some years back. Their feet sank in only an eighth of an inch (3 mm.) and the module's " foot pads " an inch or two (2–5 cm.).

Vision in the vacuum of space, with a brilliant sun but no haze to diffuse its light, so that every surface is either dazzlingly bright or virtually invisible, can present problems which were already foreseen 12 years ago.[2] Assembling structures in orbit might be particularly difficult on this account ; but even on the moon, where much reflected light can penetrate the shadows, Aldrin said: " It's quite dark here in the shadow " (of the module) " and a little hard for me to see if I have good footing."

Little was known of radiation dangers 12 years ago. Cosmic rays alone were being investigated, as the radiation belts were not discovered till 1958, and the damaging power of solar flares was not yet realized. Unfortunately information about methods of protection seems to be receding more and more into the " classified " category. We know that before an Apollo flight a satellite is sent up in a highly eccentric orbit, stretching more than half-way to the moon, to detect and report changes in the strength of the " solar wind." We are allowed to know that Armstrong and Aldrin received " no serious dose " of radiation owing to the protection of their suits. However, for longer stays on the moon it will be necessary either to live underground or to build a shelter of moon material, not only to keep off radiation but as a protection against meteorites, whose past activities are shown by the great number of tiny craters seen by the astronauts, some only a foot or so (30 cm.) in diameter. The only attempt to dig into the surface this time was by

1 *British Medical Journal*, 1957, **2**, 1165.
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Neil Armstrong, who threw up some dust with the toe of his boot, but a future Apollo mission is to bring back a core of moon material several feet deep.

Although an orbiting scientific station has been promised for 1972, no date has been fixed for a proposed "lunar international laboratory" on the moon's surface, on which a working party of the International Academy of Astronautics has been at work since 1966. This is to be a research station for astronomical and geological (strictly "selenological") research as well as for many kinds of fundamental research into physics and physical chemistry which can be done only in a vacuum.

Finally, the very strict anti-contamination precautions, both for the astronauts and for the moon samples, will still be in action when these words are published, so believers in life on the moon have still a few days of hope remaining to them.

How to Kill Moon Germs

The admiration which must have been felt throughout the world at the United States's achievement in placing men on the moon and bringing them back to earth will not have been diminished by the somewhat theatrical precautions taken on their return. We are told that the temperature on the moon varies from day to night between intolerable heat and extreme cold. It is certain that there is no atmosphere and thus neither oxygen nor carbon dioxide, on the presence of which all animal and plant life as we know them depend. There is also no water, unless it is well beneath the surface, and this again is necessary to all life as we know it. It was nevertheless considered necessary to defend the inhabitants of this planet from the depredations of micro-organisms brought back from the moon. Stringent as these precautions were, it is far from certain that they will prove to have succeeded if in fact any germs accompanied the astronauts on their return flight.

It seemed from one television picture that actual fragments of the moon surface were to be submitted to high-energy irradiation before being distributed for analysis, but contamination of the persons of the astronauts themselves cannot have been entirely eliminated by anything that was done. The total exclusion of micro-organisms from the immediate environment of a human being is an almost impossible task, and it would be interesting to know what tests are to be applied during the long period of quarantine to verify that it has succeeded.

On the assumption that such contamination occurred, and without any knowledge of the properties of the micro-organisms concerned (in particular, their resistance to physical and chemical agents), what methods should be chosen to destroy them ? So far as the persons of the astronauts are concerned, and the special clothing in which they and their attendants were enveloped, only a superficial chemical method was applicable. The commentators during the televised splash-down on 24 July named three of the solutions actually used. Each of these was evidently chosen because it is capable, at least under certain conditions, of destroying the most resistant form of microbic life known—namely, bacterial spores. Among the conditions governing their use are the concentration employed and the duration of contact, and naturally neither of these was specified, but it may be doubted whether the period of contact, which for sporicidal effect should certainly be not less than 30 minutes and preferably much longer, was adequate. The solutions referred to were, firstly, sodium hypochlorite ; secondly, in connexion with the mutual spraying which took place in the recovery raft, betadine iodine ; and finally glutaraldehyde. Betadine iodine is an "iodophor," a solution of iodine in a detergent which is non-staining and better tolerated by the skin than watery or alcoholic solutions of iodine but decidedly inferior to them in germicidal efficiency. It may be questioned whether this rather bland preparation of one of the halogens was a good choice for its purpose. Glutaraldehyde is chemically related to formaldehyde and germicidally rather more active, though also requiring time to exert its full effect. What these reagents may do to hypothetical forms of microbic life must remain conjectural, but their capacity to ensure complete sterility under the probable conditions of their use is equally so, and it may be fortunate that this was a superfluous precaution.

It is in any case highly improbable that microbic life brought from an uninhabited planet could cause disease in man, though its establishment on earth might possibly have other effects. Television commentators with time to fill both before and after the splash-down instanced the ravages of measles virus in Negro races encountering it for the first time, but that is a false analogy. This virus was already well adapted to parasitic existence in man, or it could not have attacked non-immune people with such vigour. We have no grounds for believing that pathogenicity is a character which can be suddenly acquired or manifested at the first opportunity. Of course Mars, if it proves to be inhabited by creatures anything like ourselves, will be a different matter.

Sympathetic Nervous Overactivity in Tetanus

The best known and understood clinical features of tetanus are the rigidity of skeletal muscle and the progressively more severe and prolonged attacks of spasm, which may lead to death from asphyxia. Treatment of tetanic rigidity with curare was suggested as long ago as 1811 by Benjamin Brodie, but it was only when long-continued intermittent positive pressure ventilation became practicable that the modern treatment by neuromuscular blockade was developed.[1] Since the neurotoxin of *Clostridium tetani* is thought to be specific for the somatic motor system one might expect that treatment with curare, which blocks transmission of excitation at a distal site (the motor end plate), would be the only treatment necessary in severe tetanus. Many patients have continued to die unexpectedly, however, and the present death rate for severe tetanus is between 10% and 40%.

Last year J. H. Kerr and his colleagues[2] analysed the reasons for death in a number of patients who were treated in the United Oxford Hospitals. In almost all the severe cases studied tracheostomy and intermittent positive pressure ventilation were used. In addition most patients were given barbiturates and often phenothiazines and other tranquillizing drugs as well as antibiotics and antitetanus serum. Post-mortem examinations disclosed a number of causes of death which could reasonably have been expected in such patients, such as bronchopneumonia ; but in 4 of the 18 who died no clear cause of death was found. Review of the clinical course