BIOLOGY

Friendly Germs Aid Man

Bacteria, not all of which are disease-causing or harmful, will soon be used for electric power, food, mining and many other purposes, William E. Small reports.

➤ BACTERIA, usually associated only with disease and decay, may soon be harnessed to produce electric power for space probes and cities, mine metals and oil, and be grown commercially for food.

Although microbes have been used by man for centuries in many processes, scientists have found only recently that bacteria could be used in cells, similar to car batteries, for powering submarines and spaceships, and possibly for supplying power for the world's largest cities.

Scientists predict bacteria will be the backbone of the food supply of future generations. This is based on discoveries since World War II that yeasts and bacteria can be substituted for meat and dairy products.

Already bacteriologists are applying the tiny organisms to the extraction of petroleum products from rock, and sulfuric acid and minerals from low grade ores.

Since the initial function of bacteria is decomposition of matter, whether animal, vegetable or mineral, bacteria can live on diverse diets and produce useful products with a minimum amount of care, giving off energy during the process. Many bacteria can even decompose rock, metal or concrete.

Their diets vary from iron to blood or garbage. And since billions of the minute plants can be found in a teaspoon of dirt, and they cover every unsterile surface, every substance is selected and attacked by the organisms which can eat it.

Studies of rock-loving bacteria, for example, show that ores can be "mined" by appropriate species. Oil, gas and tar can be produced by "cultivated" bacteria, and leather, linen, nylon and many acids require bacterial processing.

Bacteria Are Valuable Tools

Because bacteria reproduce at very rapid rates, they are valuable tools of the geneticist. They are presently eaten as vitamin pills and injected as vaccines.

Bacteria are also being studied as radiation shields for humans.

But present research indicates that the largest jobs for the tiny organisms lie in the field of power. Work on fuel cells for space power and electrical studies for harnessing the plants to power huge cities hold great promise for our ever-expanding, ever-demanding population.

The main uses of bacteria, of course, are still in agriculture and waste disposal, but many new adaptations are increasing their efficiency in both fields.

Bacterial spores are being sprayed on fields to kill insects and weeds. Special bacteria are added to seeds to improve fertility. Fertilizers produced from wastes by bacterial action are in wide use.

And without these germs, sewage disposal plants would be overflowing. Sewage would not be destroyed. Rivers would become greatly polluted. And the land would be piled high with dead organisms and wastes.

Government agencies, universities and private industries are studying bacteria for nearly as many reasons as there are species of bacteria. Hundreds of defense contracts have been awarded for the study of these organisms.

Organizations like the American Type Culture Collection in Washington, D. C., deal with the growth, preservation and distribution of microorganisms. This one group distributes more than 12,000 cultures each year for scientific and industrial uses.

Scientists have found that microbes can be trained to attack compounds which did not exist before man. Insecticides and many medicinal substances intended for destroying some bacteria are the main diet of others. Bacteria can even be trained to flourish on a diet of pure cyanide.

Some bacteria eat 1,000 times their weight each hour, and most eat at least twice their weight in that time. They can be trained to eat waste products of ores or petroleum to purify the product.

Many bacteria are grown only for their waste products. Sulfur bacteria, for example, were found by the U.S. Bureau of Mines to give off precious sulfuric acid after eating sulfur found in ore wastes.

The standard process of extracting acid from ores requires large investments in equipment. The Bureau's new process, using *Thiobacillus thiooxidans* in beds of sulfur under controlled temperatures, may enable small mine owners to compete economically with large operations.

Since bacteria can survive varied and unusual conditions, scientists are able to use them. Wide ranges of temperature have little effect on their existence. They live underwater or on mountains, in strong acids or poisons.

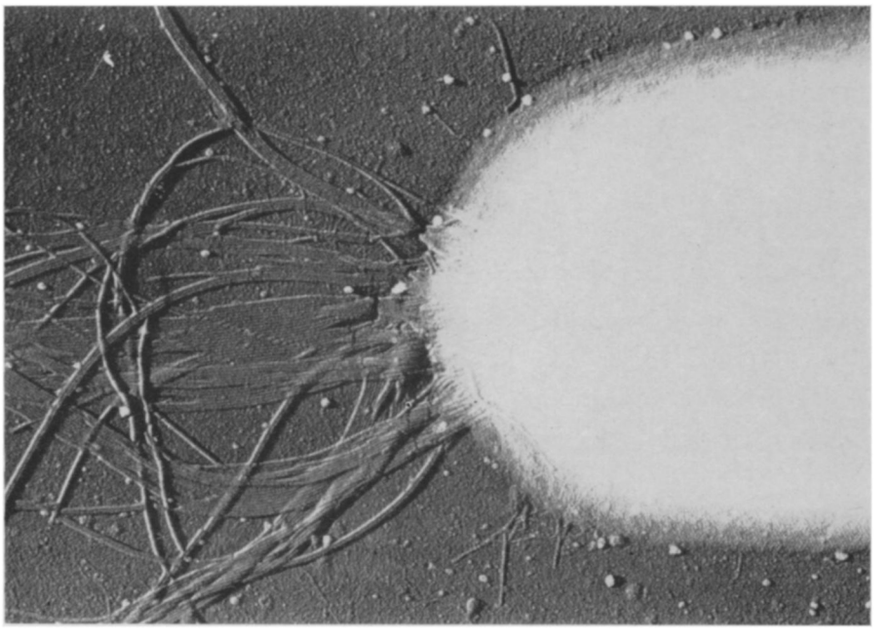
Survive Under "Mars" Conditions

Two kinds of bacteria have even survived under conditions like those on Mars. Still others make their homes in an atomic reactor, enduring 2,000 times the radiation which would kill man.

What may be even more important to their use is they multiply when they divide. That is, they double in numbers by splitting in two. Their growth and multiplication rate may be as short as 15 minutes; or, 100 bacteria can become 1,600 in a single hour.

Useful or harmless bacteria far outnumber the harmful ones.

During a 1941 "census" of bacteria in the United States, Dr. Otto Rahn, formerly a professor of bacteriology at Cornell University, "counted" 10 trillion trillion harm-



MICROSCOPIC MONSTER—This dangerous-looking monster is actually a tiny, harmless bacterium **(Spirillum volutans)** ***enlarged 33,500 times with an electron microscope by Dr. Marion A. Williams while at Harvard University.***

less or necessaary bacteria, as opposed to only 308 thousand trillion harmful ones.

These staggering figures may be compared with good and bad people. One out of every 17,000 humans is detrimental to the public welfare, whereas only one out of 30,000 bacteria is harmful in this country.

For centuries bacteria have aided man in the preparation of foods, such as cheese, beer, wine, sauerkraut, pickles and many others. New applications have increased productivity of many industries.

Cocoa and chocolate, tobacco, leathers, vinegar and acids are all produced by bacterial action. Coffee berries are fermented to set the beans free. Linen, hemp and jute are produced using these helpers.

In fact, much of the basic existence of life is affected by these tiny plants. Yet, only about 2,000 species have been identified, and even these are being reduced by reclassification.

Bacteria must be magnified nearly 1,000 times to be seen. Only with the advent of the electron microscope have their tiny features been recognized.

These organisms have three general shapes: balls, or cocci; rods, known as bacilli; and corkscrews, called spirilla. The cocci may form grapelike bunches, or staphylococci, or they may appear as strands, called streptococci.

Some have hair-like flagella, as the harmless *Spirillum volutans* found in stagnant water. These flagella aid the organism to swim or move.

Bacteria often have diseases, caused by the tiny viruses which attach themselves by their tails.

Not all bacteria are helpful or harmless. Some cause diseases ranging from pneumonia to bubonic plague, including syphilis, scarlet fever and dysentery.

But it should be remembered that good and useful bacteria far outnumber the bad ones. All germs and all bacteria are not harmful. In fact, without them, all life would cease to exist.

Scientists are now finding more and better ways to put microorganisms to work and benefit mankind. Thus, these microbes of merit will continue to serve men and nature.

• Science News Letter, 81:234 April 14, 1962

MEDICINE

Doctors Are Reading—

➤ IF CANCER cannot be cured, many cases can be prevented, physicians read in their official Journal of the American Medical Association, 179:1001, 1962.

More than 1,400 physicians, mostly in Wisconsin, have been asked their opinions about 40 possible measures to prevent cancer. The majority agreed that preventive measures such as surgery on polyps, nodules and premalignant lesions would be best method.

Laboratory or experimental discoveries about causes of cancer were rated lower. These experimental findings include studies on air pollution, food additives, industrial causes and tobacco.

Less acceptable to the doctors were other measures suggested, such as circumcision and protection from sunlight.

The originator of the poll, Dr. Robert J. Samp of the University of Wisconsin Medical Center, Madison, reports that much work on reform of present practice would have to begin with the doctors themselves.

Personal considerations entered into the answers, Dr. Samp says. About two-thirds of the doctors questioned in four county medical societies were estimated to be regular smokers.

Simple Cancer Test

Another article describes a simple test that may enable doctors to solve the difficult problem of differentiating benign from malignant stomach disorders.

The test is based on a recent finding that administration of the drug tetracycline by mouth results in fluorescent material from the stomach contents of patients with cancer of this organ, but no fluorescence appears in those without cancer.

Drs. J. Edward Berk and Sheldon M. Kantor of Wayne State University College of Medicine, Detroit, state that the test was positive if a bright yellow glow appeared in the stomach contents removed from the patient, then processed and viewed under an ultraviolet lamp (p. 997).

Rare Cancer Operation

A rare case of a Mexican boy who at the age of 15 underwent total colon operation for cancer is reported by Drs. Edward S. Murphy, Mario Mireles and Arturo Beltran of Mexico, D. F.

Stomach cancer followed the colectomy, and the investigators related the carcinoma to hereditary factors (p. 1026).

Syphilis Test Can Be Inaccurate

Reactions indicating falsely that syphilis is present rarely occur in tests for syphilis, a questioner is told in the questions and answers page, but almost any disease of the central nervous system is potentially capable of causing such a reaction. Technical errors in the laboratory also can occur, which may be indicated by a weakly reactive blood test (p. 1034).

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Plow-worked *soil* is very susceptible to erosion in winter, the melting snow and rain causing puddling of soil surface followed by soil washing.

Quick *clays* that lie under the flat farm lands and many towns in Norway and Sweden may suddenly, with little or no warning turn to a moving, sliding, flowing mass of mud.

The *wistaria* plant grows strong and as high as 40 feet and, if left alone, will completely cover a house, wrestle the porch posts loose or pry off the roof shingles.