

## BIOLOGY

# Youth for Living Cells

**Tissue culture keeps cells young for years. Time, space and money seem only limits to their longevity. Quick freezing also preserves organs and tissues for later use.**

➤ A TOMATO root has been steadily growing for 21 years, its cells still young and vigorous; a bit of a chick's embryonic heart grew for many years before "euthanasia" was performed on it.

Does this mean that modern science can find man's long-sought goal of eternal youth and immortality?

Tissue culture seems definitely to have made a kind of immortality theoretically practical. Animal and plant cells have been kept alive for years in special cultures. Only time, space and money impose limits on the life-span of the cultures.

A culture of heart cells from a chick embryo was started in 1912 by the late Nobel prize-winner, Dr. Alexis Carrel. The tissue was not discarded until many years later when its scientific usefulness had ended.

Last spring a culture of tomato root cells, eternally young in a sense, celebrated its 21st birthday. The youth and continuance of this culture comes from the scientific care and imagination of Dr. Philip R. White, not from a drink at the magical Fountain of Youth. Dr. White is at the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Me.

He started a tiny bit of tomato root, cut off from a germinating seed, growing in a solution containing plant nutrients, and the root has been growing at the rate of about one-third of an inch a day since March, 1933.

## Periodically Destroyed

Paradoxically, partial destruction of the culture periodically is one of the secrets of this kind of cellular immortality. The rate of growth of these cells is so great that only by destroying much of the culture each week can a scientist keep the culture in bounds. Without this destruction, the tomato root would have grown to astronomically huge lengths by this time, assuming there was some way to keep it growing.

People are sometimes surprised when something about a plant turns out to be more complicated than an animal. Dr. Carrel used a combination of chicken blood plasma and chick embryo fluid as the nutrient for his heart tissue culture.

Plant cells, however, are not bathed in a free nutrient fluid when they grow naturally. Each cell receives its food by diffusion through neighboring cells. For this reason, plant cell culture had to wait for the development of man-made nutrient solutions that would sustain cell life.

Dr. White was the first scientist success-

fully to design such a solution. Its complexity can be somewhat indicated by the number of ingredients: oxygen, hydrogen, carbon, calcium, potassium, magnesium, nitrogen, sulfur, phosphorus, iron, manganese, zinc, boron, iodine, carbohydrates, vitamins, hormones, amino acids and organic complexes.

Mixed in proper proportions, these substances formed a successful nutrient. Eternal youth is much more complicated than seekers for the Fountain of Youth imagined.

Another problem to be overcome in tissue culture investigations is that of infection. Bacteria, viruses, fungi and other infectious agents would quickly kill off any cultures they reached. All the nutrients are sterilized and every precaution is taken to keep the cultures in a sterile condition.

In 1946, Dr. White was able to make a nutrient solution for chick embryo heart cells. Heart tissue has been kept alive and pulsing for 12 weeks in this medium.

## Synthetic Nutrient

This synthetic nutrient fluid for animal cells eliminated one of the great difficulties that had faced experimenters with the Carrel-type culture.

The chemical structure of body fluids is not completely known. This meant it was impossible to be exact in analyzing the effects of substances on cell growth. The synthetic nutrient solution for animal cells was made up of dextrose, mineral salts, 11 vitamins and 12 amino acids. By varying the composition of this solution the effect of nutrients on cell growth and division can be studied directly.

Such tissue culture work has been used in cancer studies in an attempt to differentiate between the biochemical requirements and structure of cancerous and normal cells. Dr. White is now growing mouse tumors in this medium.

## Hopes in Quick-Freezing

This kind of immortality and eternal youth probably will not satisfy man's dream, but it does point up the fact that individually and in tissues the cell seems to be capable of living a very long time—provided enough scientists are around to protect it from the world.

Quick-freezing techniques offer more hope to those who want a Fountain of Youth to help the middle-aged business man who has discovered his arteries are older than his ideas.

Two London University scientists discovered that skin from a rabbit's ear could



**"ETERNAL" TOMATO ROOT — Dr. Philip R. White, Jackson Memorial Laboratory, Bar Harbor, Me., examines a flask holding part of his tomato root culture that has been steadily growing since 1933. The root is about the size of store twine.**

be transplanted after four months in a freezer. The rabbit skin was first impregnated with glycerine and frozen at 70 degrees below zero, Centigrade.

This led to the suggestion of a skin or artery bank in which a person could deposit some of his own youthful body tissues for later withdrawal. The frozen tissues would then replace arteries worn out by years of tension, or skin wrinkled by the advance of age.

In similar experiments, Drs. A. S. Parkes and A. U. Smith of the British National Institute for Medical Research succeeded in grafting male sex glands in rats when the glands had been stored in a frozen state for as long as 22 weeks.

They hinted in their report that the special freezing method might make possible transplants of human gland tissue. The glands were frozen in a material containing glycerol.

The same method was used successfully for grafts of rat ovarian tissue.

The most serious problem facing any surgical attempt to transplant organs from one individual to another is the reaction of the body to a foreign protein substance. Grafts to be successful must be from the subject's own body or an identical twin.

At the University of Kansas Medical Center, surgeons have succeeded in transplanting quick-frozen lungs from one dog to another. Using dogs which were litter

mates, the dogs survived the operation for 30 days.

Drs. Creighton A. Hardin and C. Frederick Kittle found that cortisone helped the dogs with grafted lungs survive a little longer, but benadryl and X-ray treatments did not help in fighting the body's reaction to a foreign substance.

One experiment was made by removing the spleen, the organ which manufactures the antibodies to foreign substances in the body. This, however, did not affect survival rates in the dogs.

Although the dogs survived the operation for only short periods, the transplanted lungs did function as breathing organs. Proof of this came from two animals that survived two and one days, respectively, when they had only the transplanted lung to breathe with.

#### MEDICINE

## Forsee Better TB Cures

► A BETTER understanding of how the body is damaged in tuberculosis and some future hope of new weapons against the disease is coming out of research at the University of California.

Dr. James B. Cason, professor of chemistry, has isolated from the tuberculosis germ a rare acid that causes TB lesions in animals.

He has also worked out some of the architecture of the acid molecule, and has built a synthetic model containing all of the molecule's known structural features.

The synthetic molecule and similar molecules are being tested in animals by Dr. Sanford Elberg, professor of bacteriology. The tests are not complete, but they already show that small differences in geometrical molecular shape can cause very large variations in reactions of the animals.

An implication of the work is this: if the chemical proves beyond question to be responsible for the TB lesion, tuberculosis may at some time in the future be fought on new grounds.

The scientists cautioned, however, that a great deal of work remains to be done, and that no treatment could be based on their research to date.

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Freezing has also made a kind of immortality possible for bulls. The situation is reminiscent of that described in the popular song of several years ago, "I'm My Own Grandpa."

By freezing the male sex element of the bull, it is possible for a bull to father calves long after he died. This might give rise to a "family" in which every offspring for several generations had the same father.

Frozen semen banks have not yet taken their place with blood and bone banks, but live calves have been born from cows artificially bred with frozen semen. The technique used is the glycerol method developed by the British scientists. The Wisconsin Scientific Breeding Institute has bred several thousand cows with the frozen semen.

Science News Letter, September 18, 1954

The work is an outgrowth of research begun about 20 years ago by Dr. R. J. Anderson at Yale University and Dr. Florence Sabin of the Rockefeller Institute. Dr. Anderson isolated a mixture of branched chain fatty acids from tubercle bacilli, and Dr. Sabin found they caused TB lesions in animals.

Not until Dr. Cason isolated a pure component from the mixture, was it possible to tell precisely which acid was responsible for the damage. The acid appears to be the agent, or one of the agents, by which the bacillus harms the body.

Dr. Cason and his co-workers have separated the fatty acid from five different virulent strains of tuberculosis. It was not found in two non-virulent strains. Other strains must be investigated to determine if the acid makes the different between virulence and non-virulence.

The research is very tedious because only minute quantities of the acid are present in the bacilli. Two pounds of bacilli will yield only about one-hundredth of an ounce of the toxic acid. Only about one-twentieth of an ounce have been isolated so far.

Science News Letter, September 18, 1954

#### PATHOLOGY

## Liver Cancer, Cirrhosis Increase Since Repeal

► BOTH LIVER cancer and cirrhosis of the liver have been increasing since the repeal of prohibition, it appears from figures reported by Dr. Hugh A. Edmondson of Los Angeles to the International Congress of Clinical Pathology meeting in Washington.

The increase in cirrhosis has been five-fold, that of cancer of the liver ten-fold since repeal of prohibition, Dr. Edmondson said. His figures were from autopsy reports at the Los Angeles County Hospital.

Science News Letter, September 18, 1954

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