

PHYSIOLOGY

Immortal Fatherhood

Biologic "Time Machine" Chilling Life to Standstill May Enable Today's Great to Have Sons Generations Hence

By WATSON DAVIS

A MILLENNIUM in the future a man now alive may be able to have a son. The human race, thanks to startling findings of physiological science from several university laboratories, may be standing on the brink of a sort of "immortality."

An American physiologist has suggested a way to produce one of the effects of H. G. Wells' famous and highly fanciful "time machine."

Life is chilled into standing still. The "private time" of a little gob of human male reproductive cells is essentially changed, while "public time," measured by the grind of the earth around the sun, or by the routine births, living and deaths of generations after generations of living things, goes on apace.

Because his wife had a fever of 104 degrees F. one afternoon nine years ago, Prof. Hudson Hoagland of Clark University, Worcester, Mass., made the observations that eventually led to his cautious report to the Federation of American Societies for Experimental Biology at Chicago. While Mrs. Hoagland lay ill with a burning fever of influenza, she asked Dr. Hoagland to do an errand at the drug store. He was gone only twenty minutes. Mrs. Hoagland insisted that he must have been gone at least an hour. Since, as Dr. Hoagland says, "She is a very patient lady," this immediately set him first to thinking and then hurrying to find a stop-watch.

Sickroom a Laboratory

The sick room became a laboratory. He asked his wife to count sixty at a speed that she believed to be one per second. He had her do this thirty or forty times during her illness without telling her why. At the time of each counting he noted her temperature and recorded the actual lengths of her estimated minutes with a stop-watch. This is what he found: Her counting was much faster at temperatures higher than normal, and slower at temperatures below normal, although she believed her counting rate was always constant.

Mrs. Hoagland's time sense galloped along more swiftly under the effects of

the fever temperature; her "private time" slowed down when she had a sub-normal temperature.

That is the reason that Dr. Hoagland disagrees with the words of the eminent British astronomer, Sir James Jeans: "Time does not cease to unfold itself at a uniform and uncontrollable rate which is the same for each one of us." Sir James meant what Dr. Hoagland calls "public time," the time measured by the earth's rotation on its axis. Dr. Hoagland was interested in our personal subjective appreciation of duration, which his wife had taught him varies with temperature.

For even when we are asleep our time sense continues to function. We are human alarm clocks; it is no uncommon thing for a person to awaken himself in the morning within ten or fifteen minutes of the time he had set himself for.

How Pace of Life Is Set

Why then does our personal clock, our biological clock, run at different rates? His physiology gave Dr. Hoagland the clue. The pace of life is set by the continuous oxidation or burning of foodstuffs by all living tissues, the brain included. These chemical processes basic to life are known to be markedly affected by temperature. The Swedish chemist Arrhenius years ago worked out the relation of chemical reaction and temperature. Up the temperature 10 degrees Centigrade (18 degrees F.) and the speed of most chemical reactions doubles or trebles. Dr. Hoagland showed that the speed of counting seconds varies exactly with internal body temperatures according to Arrhenius' equation after the manner of biological oxidations.

If then our sense of time duration depends upon chemical reactions in the brain cells, by speeding them up, higher temperatures should make subjective or private time pass slowly in comparison to public or clock time. In Mrs. Hoagland's case, the actual twenty minutes seemed to her much longer.

In a like manner, with the slowing of these same chemical processes at lower than normal body temperatures, time would appear to pass faster. If we could imagine living organisms at the abso-

lute zero of minus 273 degrees Centigrade private time for them must pass infinitely fast in comparison with clock time. This is because their physiological rates would be infinitely slowed. This is a temperature that science has approached but never quite attained. There all is still; molecular motion and energy manifestations are non-existent.

That gives a hint of the mechanism of Dr. Hoagland's biological "time machine," which is a step beyond his master "chemical clock" of our brain that controls our sense of duration.

Aging Slowed By Cold

This relation between time and temperature makes it possible for living organisms to travel forward into the future, a consequence of the fact that physiological rates, depending on continuous chemical processes, are slowed at low temperatures. All aging processes depending as they do on chemical changes are likewise slowed at lowered temperatures.

Suppose that a living person could be chilled to absolute zero temperature for a thousand or ten thousand years. Time would stand still for him. Suppose at the end of the millennium or ten millennia, he could be warmed to normal bodily temperature, and live normally again. He would be projected forward into time by this "time machine," a Connecticut Yankee in King Arthur's Court in reverse. But even a drop of 15 to 20 degrees of internal body temperature for several hours means death. There is no hope for human "immortality" by that means. The human body is far too complex and big.

So, Dr. Hoagland went to the other end of the scale of life to discover what happens to the small cells themselves when they are quickly cooled to very low temperatures. He dug into the literature and he sought the collaboration of his colleague at Clark University, Dr. Gregory Pincus, who will be remembered for his fatherless rabbits experiments.

Death comes to cells when the water within them crystallizes on freezing, disrupting the cell walls and throwing the delicately balanced chemical machinery out of gear. But it has long been known that low temperature can produce a vitreous instead of a crystalline solid state. The liquid becomes like glass, essentially

a very viscous liquid with properties of a solid. As Dr. B. J. Luyet of St. Louis University has shown, watery solutions of substances made up of large molecules can be vitrified readily by sufficiently rapid passage through a temperature range of some 30 to 40 degrees Centigrade below the freezing point of water. Under these conditions life is not necessarily disrupted. The stuff in some small living cells can be vitrified by plunging into liquid air, dropping their temperature 200 degrees per second, so fast that ice has not time to form. Their physiological time virtually stands still at very low temperatures. Warm them rapidly and they are restored to normal living.

Others Had Experimented

The literature showed that for one reason or another (without visualizing the "time machine" idea) many other research workers had experimented with life at low temperatures. Dr. Luyet with P. M. Gehenio published a book last year on "Life and Death at Low Temperatures." Other scientists, as well, showed that a great variety of small living organisms survive rapid cooling and subsequent rapid warming. Dr. W. Stiles was the first to show the importance of rapid cooling and warming in making possible a state of suspended animation. Most important, the length of time endured in the vitreous state of most of the organisms studied seems to have no effect on the percentage of organisms reviving. Dr. L. B. Shettles of Johns Hopkins University vitrified and revived a very small percentage of the male human reproductive cells, sperm, and Dr. Luyet had earlier demonstrated this for frog sperm. Cells once vitrified may be kept safely in storage at temperatures only 30 to 40 degrees below zero Centigrade.

If man himself cannot take the journey into the future, he may be able to send his immediate sons. That is the way that Dr. Hoagland reasoned. He and Dr. Pincus set to work. They confirmed Dr. Shettles' finding that human sperm survive immersion in liquid nitrogen at 195 degrees below zero Centigrade. With improved technique and treatment, they succeeded in reviving 30 to 40 per cent of the sperm given this frigid treatment. They also have been able to revive a small percentage of similarly treated rabbit and bull sperm, although human sperm withstands the treatment better than those of other mammals studied. The fertilizing ability of revived sperm is yet to be proved, although this seems most probable.

The "time machine" is about ready to be given a test run. The parts are ready.

Just as the first experiments will be upon lower animals, such as guinea pigs, rabbits and cattle (for such is the way of science), the practical application will be made first to animal breeding.

Artificial insemination is a growing practice in animal husbandry, but under present conditions the male reproductive cells cannot be kept in storage for more than four days. If the new vitrification method proves practical, a great horse-like Man o' War could have immediate sons many generations after his death. Dr. Hoagland suggests that through this method of stored germ plasm prize stock could be renewed years in the future even if faulty breeding allows it to degenerate.

Suppose these things had been known in the time of Socrates or Shakespeare or Newton. Their sons might be walking among us, mothered by virtuous females enamored of the past.

More frequently than the public knows, couples who otherwise would be childless call upon medical skill to give them the pleasures of parenthood. The biological father in such cases remains a remote and anonymous donor.

Dr. Hoagland, more or less humorous-

ly, has suggested the possibility that his biologic time machine, social sanctions permitting, might allow a part of each generation of the future to be fathered by the truly great men of the past, whose genius and qualities have stood the test of history.

In a disordered world bent on human destruction, profligate with life, it would be genetic insurance for the future if we could set up storehouses of precious human germ plasm. Our sons and daughters of a few centuries hence might value this inheritance more than all the gold at Fort Knox.

Science News Letter, April 26, 1941

Clerks in the Middle Ages, who slipped English words into their account books when they could not think of the Latin, have provided editors of a Middle English Dictionary several thousand English words for objects, tools, and farming and industrial operations.

Trees ten inches in diameter should stand ten feet apart, says a forestry specialist, citing a general rule that, for free growth, trees may well be allowed as many feet of distance apart as the stem diameter of the trees in inches.



FUTURAMA

Visitors to the 1940 New York World's Fair, who stood in a long line for an hour or so to look at the famous "Futurama" will be glad to learn that the Futurama is to appear in a smaller edition at the New York Museum of Science and Industry. Many of the original objects for the World's Fair exhibit are retained in the Museum's display. Visitors will not be able to sit in those nice moving chairs, but neither will they have to wait in line.