

military forces would be blind. Then they went back to fundamental research.

One of the researchers there was Dr. R. B. Sosman. About a decade ago he was persuaded to join the research laboratory of U. S. Steel Corporation then being organized under Dr. John Johnston, Director of Research, and former Sterling Professor of Chemistry at Yale. The steel industry as well as the pure science foundation, with steel-earned Carnegie funds, needed a man who knew about quartz and silica. For this is stuff that withstands the heat of furnaces. It is axiomatic in research that it is wisest to do a thorough, fundamental job of "pure science" knowledge manufacture. The by-products will pay industrial dividends in the near future and the pure science main product may produce a new industry a few decades hence.

One of the mere by-products earned the cost of Dr. Sosman's researches a

good many times over during the depression. You'll remember that steel production dropped then. That meant less need for coke and that caused a shut-down of by-product coke ovens. But it cost money to keep an oven shut down, or at least it used to. The ovens are lined with silica brick, which when cooled has a large volume change, so large that it wrecks the lining. The practice had been to preserve the ovens by firing them with gas, though they were idle and useless.

Dr. Sosman heard about this and remembered his researches on transition points in silica. He was able to predict that if the ovens were cooled very, very slowly in the range 400 to 500 degrees Fahrenheit the disastrous volume change could be avoided. The idea worked perfectly and while the ovens were shut down for three to four years about \$500,000 in gas bills was saved.

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A new visualization presented by Prof. George A. Baitsell, of Yale's department of zoology, bridges the gap between the living and the non-living with recent new knowledge of gigantic chemical molecules of viruses that act as though they were alive.

The difference between the living and the non-living is shown to be a matter of complexity. The same materials are used in both domains and they conform to the same elemental patterns. The natural world is fused so effectively that the procession of organic development flows uninterruptedly from atom to man. There is no need to worry as to just when and at exactly what stage life was infused into the evolving stuff of the natural world. In that ultra-Lilliputian borderland where the most powerful microscopes lose their sight, increasing complexity evolves into what has been labeled "life."

"From the simplest substances in the organic world to the most complex patterns of living substance there must be a graded series," Prof. Baitsell told the scientists. "Should evolution begin at the level of the living organism? The union of hydrogen and oxygen to form water, the union of carbon and oxygen to form carbon dioxide, the union of water and carbon dioxide to form sugar, the addition of other elements to the sugar molecule to form protein—were not all these stages in the evolutionary processes which have led to ever-increasing complexity, reaching their climax in the world of life?"

Viruses Living?

ONE of the major controversies of science today may be settled with the verdict: Everyone right.

The viruses that cause diseases like smallpox, infantile paralysis and other diseases are living? Correct. They are non-living? Correct. They are the beginnings of life? Yes. They are the last possible stage in parasitic degeneration? Also yes.

Contradictory as this may sound, it may be the explanation of the findings in this latest field of disease research, in which protein molecules, exceedingly minute for germs and exceedingly large chemically, are the puzzling actors.

One of the leading researchers in this field, Dr. Thomas M. Rivers of the Rockefeller Institute for Medical Research, believes that these viruses, much too small to see, are a very "mixed lot," having only their size and disease-causing ability in com- (Turn to Page 28)

BIOLOGY

Plant Tissues Shown to Have Potential Immortality

Plant Callus Grows and Grows in Laboratory, But Its Cells Remain Immortally Young and Undeveloped

YOUNG plant tissue has shown potential ability to stay young forever, in cultures prepared by Dr. Philip R. White of the Rockefeller Institute for Medical Research, Princeton, N. J. Dr. White, who was winner of the \$1,000 prize of the American Association for the Advancement of Science a year ago, reported his newest researches before the same organization, at the recent Richmond meeting.

The living material used in the experiments was taken from a hybrid ornamental Nicotiana plant, and consisted of stuff called callus. Plant callus is a mass of undifferentiated, unspecialized cells that form when the plant is wounded; it is essentially embryonic, or physiologically young tissue.

Dr. White kept his bits of callus in specially prepared nutrient solution consisting of a sugar, certain necessary mineral salts, together with vitamins and plant hormones which have been found essential to growth. The tissue grew and grew, but the cells showed almost no tendency to mature into any of the specialized forms found in plant organs. It was immortally young.

Each week Dr. White discarded part of the growth and kept the rest. At the end of the week new growth would have increased the pieces to three times their original size.

This kept up for forty weeks. By that time, he calculated, had he been able to keep all of the tissue as it grew, the original piece would have increased to 10 to the 19th power (10,000,000,000,000,000,000) times its original size.

For several years, Dr. White has kept cultures of roots going, unattached to any parent plant, but this is the first time that it has been possible for him to produce unspecialized tissue that is "just plant." The new material is analogous to the cultures of chick embryo, long since famous in the scientific world, first prepared many years ago by Dr. Alexis Carrel.

Evolution in Non-Living

EVOLUTION of man and all lesser living things gains scope and takes on new grandeur by being traced far below the world of life to the very chemical elements themselves.

larger. Finally Science Service found it necessary to get more critical investigation of the situation. This report is the result.

Predictions

If the child is further investigated psychologically or physically, no abnormalities will be found. Either the present interest will cease and then the alleged phenomena disappear or even more exaggerated claims will be made to accompany the growing demands.

Lest we perpetuate the notion of a benighted, superstitious people inhabiting this part of the country, let us remind you again of the refusal of the large majority to be hoodwinked. Even many close to the scene did not find it worthwhile to make a visit to the place. The remark of one man seemed to typify the character of the people:

"I'm always interested in new agricultural developments but not in new things of this sort."

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mon. Dr. Rivers gave the latest news of the viruses in an address before the American Association for the Advancement of Science.

"Some of the viruses," he said, "may be minute, highly parasitic micro-organisms, the midgets of the microbial world, capable of reproduction only within susceptible host cells, others may represent forms of life more or less unfamiliar to us, and still others may be fabrications of their host cells aided by the processes of autocatalysis.

"What life is and where the transition from the non-living to the living takes place, if it does, in the scheme just set forth is not known. Furthermore, the transition may be so gradual that it will be difficult for investigators to assign the particular point at which it occurs."

If Dr. Rivers' view is correct, that the viruses are not all alike, it would after all only describe again a situation quite familiar among the disease germs that can be seen through ordinary microscopes. Some of them are bacteria, some are one-celled animals or protozoa, some are fungi, and some belong to still other classes of microscopic life. "Germs" are also a very much mixed lot.

Yet despite the handicaps which their minute size and often puzzling behavior impose on research, Dr. Rivers stated that a good deal has already been found out about them, and that a small army of research workers is hard after them

to wrest away still more of their secrets.

We have a pretty good idea of the sizes of some of them, he said; they range from almost the size of some of the smaller bacteria down to that of single protein molecules. We can also infer that at least three shapes are found among them: round, oval and rod-like. We know that they commonly have the same kind of electrical charges found on protein molecules.

With his co-workers, Dr. Rivers has made a special study of the vaccine virus, which is the virus of cowpox used in vaccinating against smallpox. They worked out a new method of producing it in quantities large enough to handle by laboratory methods, and thus got a good supply to study.

Among other studies was a direct chemical analysis of purified elementary bodies of this virus, that is, of the tiny units that actually produce the biological results of vaccination. The dried elementary bodies were found to contain 83.12 per cent. protein, 8.54 per cent. fat, 0.72 per cent. ash, 5.56 per cent. residual moisture, 2.06 unidentified material, including a trace of carbohydrate.

"These analyses," Dr. Rivers stated, "do not differ materially from those recorded for bacteria or for protoplasm."

Objective of all this research, Dr. Rivers declared, is control of the diseases of man, animals and plants caused by the viruses. In part, this has already been achieved, as in the case of human smallpox, encephalitis of horses, etc. But other terrible scourges remain still unconquered, like infantile paralysis and such crop-destroying plagues as plant mosaics.

To get the better of these it is first necessary to understand them, and to understand them it is necessary to continue intensive research.

"Good Old Days" a Fallacy

THE IDEA that life was healthier in the days before civilization is a fallacy, studies of the bones of aboriginal American Indians show.

"In fact," said Prof. W. M. Krogman, of the University of Chicago, in reporting the studies, "the 'good old days' of 'natural life' and 'freedom from illness' just weren't.

"In addition the aborigines averaged about 35 years of mortality—the life span had been run by the mid-fourth decade."

Mastoid infections, osteomyelitis, osteosarcoma or cancer of the bone, osteitis fibrosa, multiple myeloma, arterioscle-

rosis or hardening of the arteries, and kidney and bladder stones are among the conditions which all afflicted the aboriginal Americans as they do modern Americans. Evidences of these diseases have been found in examinations of the bones of the first Americans.

The most frequently found sign of disease is in the skull, where bone has been cut away to relieve a compressed fracture caused by war clubs. This was especially frequent among the Incas of Peru. The right side of the skull was most frequently cut open, the surgical tools being flakes of flint or obsidian used to saw, scrape and cut the bone away.

Cases of five successful healed operations of this type have been found, Prof. Krogman said.

Fractures were fairly common, splinting was known but not often used. When the fracture healed, the affected arm or leg was usually shorter than its mate. Evidence of amputations and artificial peg-legs was also found among Inca bones.

Skulls of Inca, Maya and Aztec show a tendency to a condition which may be similar to rickets or at least to some deficiency of vitamins or minerals.

The question of whether syphilis occurred first in the New World or the Old World cannot be settled on the bones alone, Prof. Krogman declared. There are six sites in the New World, he said, where skulls and long bones of Indians that lived before Columbus arrived on these shores look very much like syphilitic cases.

People On Mars?

ARE there people on Mars?" is a question that over half the boys and girls in typical junior high schools, interviewed by Herbert S. Zim, of Ethical Culture Schools, New York City, are wondering about.

While boys and girls do about the same amount of wondering about scientific matters, Mr. Zim found that curiosity of the girls does not lead to action as often as it does in the case of boys. The boys participated in scientific activities about five times as often as girls.

Whether or not the students have a definite interest in science, they seem to be curious about the same things.

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Ranger naturalists in California say that deer are not voiceless—young fawns and yearlings moan audibly when separated from their fellows.