PHYSICS

New Model for Nucleus

➤ THE INNER part of an atomic nucleus is best represented by a black hole, not a "hard core" as scientists have thought.

This applies at least to the reaction between protons, the positive cores of hydrogen atoms, and anti-protons, tiny bits of matter in every way like protons but with negative charges. When protons and anti-protons smash into each other, both are annihilated and a burst of energy released.

Dr. Geoffrey F. Chew of the University of California's Radiation Laboratory, Berkeley, told the American Physical Society meeting in Stanford, Calif., that this annihilation was "inevitable" once the inner cores of proton and anti-proton touched. However, when the outer fringes of each nucleus only brush each other, scattering instead of annihilation can result.

The small black hole Dr. Chew uses to represent the central region of the nucleus is surrounded sometimes by a repulsive "wall" and sometimes by an attractive "well."

"Both situations occur," he said, "because the nuclear force has a strong spin dependence and may be either attractive or repulsive," depending on whether the spins are in the same or different directions. The scattering can result when there is a repulsive wall around the center's black hole.

Dr. Chew derived his theoretical model of how protons and anti-protons interact to explain the experimentally observed fact that anti-protons seem to be almost twice as large as ordinary protons. Because of this, scientists have thought that a fundamentally different mechanism of interaction was involved when negative matter collided compared to the collision of two protons.

This is not so, Dr. Chew has concluded. The seemingly large size of anti-protons is due to the "substantial effects" of the fringe areas, the walls surrounding the nucleus' center.

In these fringe areas there are nothing but "garden-variety" pi mesons, the subatomic particles believed to hold the nucleus together. The pi mesons form a cloud at the outer edge of the nucleus.

This pi meson cloud, Dr. Chew said, guides the anti-protons inward so that they bang into the nucleus' center and are annihilated. The area in which annihilation can take place should be much closer to 10 millibarns than to the currently accepted 60 millibarns.

A barn is the physicists' measure of the effective area in which reactions occur when the nucleus is bombarded with atomic particles. It was coined because trying to hit an elusive nucleus with protons is even more difficult than trying to hit the proverbial side of a barn. One barn is equal to an area one-hundredth of a million-million-billionth of a square centimeter, and a millibarn is one-thousandth of that area.

Science News Letter, January 4, 1958

BIOLOGY

Ultraviolet Aids First Life

➤ THE EARTH'S atmosphere was made up of carbon monoxide, nitrogen, and lesser amounts of hydrogen, water and carbon dioxide when life began.

This picture of what it was like when the first living creatures evolved is drawn by Dr. Philip H. Abelson, director of the Carnegie Institution of Washington's Geophysical Laboratory, in the Institution's annual report.

Experiments by Dr. Abelson to shed light on the origin of life has led him to take issue with others who have "postulated that a thick organic soup was formed and that when living creatures were available they quickly depleted this broth."

This "organic soup" theory, Dr. Abelson believes, would have left the earliest living creatures in the frightening and "catastrophic" position of starving to death once they depleted the soup.

By simulating in the laboratory the effects of the sun's rays on the atmosphere as he has postulated it existed when life began, Dr. Abelson believes organic compounds could have been formed as a stop-gap diet for the creatures.

These organic compounds, including amino acids, building blocks of life, would have tided the earth's first creatures over until they could have evolved an alternative food supply, such as photosynthesis.

When they succeeded in developing the photosynthetic process, a drastic change took place in the earth's atmosphere. Oxygen would have been poured into the atmosphere to blank out the ultraviolet light of the sun's rays. These same ultraviolet rays were instrumental in creating the organic material that the living creatures used to get over the first hurdle of life.

Dr. Abelson's picture of the origin of life, drawn from his experiments with ultraviolet light and the early earth atmosphere, contrasts with some earlier ones of the supposed conditions under which life-like systems might have originated on the earth.

Other highlights from the report are:

Under appropriate conditions, the biophysics group has found, rather large particles containing nucleic acids, proteins and lipids can be formed "spontaneously" from disintegrated cellular material. The particles have a definite shape and size, are quite stable, and are found to contain several of the constituents of bacterial protoplasm, and for these reasons have been named "protomorphs."

Work by Atomic Energy Commissioner Dr. Willard Libby on radioactivity may now make possible the introduction, into the high school and college classroom and laboratory, of radioisotopes of real chemical interest, convenient life-time, and low enough specific activity to be completely safe.

Eight kinds of nuclear reactions are used by stars in forming the elements. The eight processes are necessary to account for the known abundances of the 327 isotopes known in the solar system. One path of synthesis is so newly known it is known only as the "x" process, which is thought responsible for building deuterium, lithium, beryllium and boron. The greatest portion of stellar energy production comes from the "burning" of hydrogen to produce helium.

Science News Letter, January 4, 1958

PHYSICS

Forces of Nucleus Extend Into Surrounding Space

➤ THE FORCES binding atomic nuclei extend into the surrounding space beyond that occupied by nuclear matter.

This result of delving into the structure of the nucleus was reported to the Stanford Conference on Nuclear Sizes and Density Distributions at Stanford University, Calif., by Dr. Lawrence Wilets of the Institute for Advanced Study, Princeton, N. J.

He said the surface thickness of the nucleus, which is the core of an atom, had been determined very accurately by experiments at Stanford in which the tiny bits of matter known as electrons were hurled at nuclei. Dr. Wilets concluded that nuclear forces extend to greater distances than nuclear matter by comparing results of the Stanford experiments with those in which the heavier particles of matter known as protons and neutrons were thrown at nuclei.

The greater extent of nuclear forces resulted from three effects: the finite range of nuclear forces, the saturation of nuclear forces, and the Pauli exclusion principle, which holds that no two electrons can occupy the same position in the outer electron structure of the atom.

One of the methods of determining nuclear sizes involves using the atomic electrons which surround the nucleus as probes, Dr. Robert L. Shacklett of Fresno State College, Fresno, Calif., reported.

Because the nucleus occupies a definite volume of space, its attraction for certain atomic electrons will be very slightly reduced due to the fact that these electrons spend a small amount of time inside the nuclear volume. By comparing the theoretical and measured values of this attraction, physicists can learn about the size of the nucleus.

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● RADIO

Saturday, January 11, 1958, 1:30-1:45 p.m.EST

"Adventures in Science" with Watson Davis, director of Science Service, over the CBS Radio network. Check your local CBS station.

Dr. Facundo Bueso, dean of the College of Natural Sciences, University of Puerto Rico, San Juan, P. R., will discuss "Science in Puerto Rico."