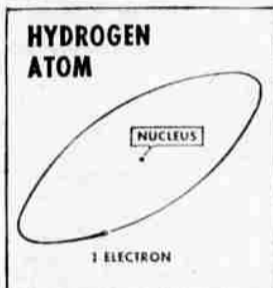
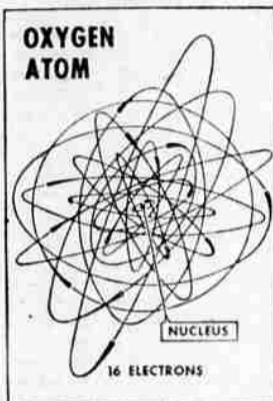


Scientists Explore Inner World

Where Near-Nothing Is Everything

Editor's Note: While some scientists have set pioneering sights on the stars, others are probing a different universe — the strange, infinitesimal world of the atom. And they are uncovering secrets that could lead to new power sources, new disease controls and even new forms of matter itself. First of a series of three.

By **ALTON BLAKESLEE**
Associated Press Science Writer
Scientists in brilliant exploration



and some of the largest machines on earth. And scores of millions of tax dollars each year.

Due to all this effort, scientists in effect are peeling the atom as you might peel an onion.

They find tinier wheels whirling within tiny wheels.

Smashing atoms into smithereens, they discover 30 bits and pieces can come flying out. Many disappear within millionths or hundredths of millionths of a second.

The great goal is to understand the true nature of the puzzling heart of atoms and where this fits into the great scheme of nature. That can mean understanding the entire immense universe. It can tell us what we are.

For atoms make up everything in the universe — the stars, the flesh and brain cells of humans, houses, clothes, the air we breathe, the ink with which this is written. The ink to form one single letter contains billions of atoms.

Cracking the riddle of the atom's nucleus might bring dazzling dividends. Perhaps unexpected new sources of power. Perhaps the means to create new kinds of matter. Perhaps astonishing controls over diseases.

FUNDAMENTALS

But physicists promise nothing. Their thirst is purely to understand this immense, fundamental secret of nature.

It is pure, basic research. But basic research has led to some of man's greatest technological advances, including atomic energy, transistors, drugs and vaccines. Basic research is the reason for building dozens of powerful atom-smashers or "particle accelerators."

The world's most powerful machine — half-a-mile around and costing 31 million dollars — just started operating at Brookhaven National Laboratory, Upton, N.Y. Physicists plan more, and sometimes costlier, machines.

They gleefully announce discovery of the anti-proton or a particle called sigma zero. They talk of a curious "zoo" of nuclear particles

detected within or coming from the cores of atoms. They ponder the meaning.

Is this all beyond the understanding of the average citizen?

By no means, at least in broad outline of this fascinating inner universe. As a caution, though, some of it may seem preposterous, but simply because it doesn't fit our usual concepts of common sense.

To begin, an atom is similar to a miniature solar system.

It has a nucleus (like a sun) with electrons (like planets) whirling about it. Electrons form the outer shell, giving the atom shape and form.

But there is only empty space between the electrons and nucleus, like the space between the earth and sun.

If the nucleus were the size of a baseball, the nearest electrons in various atoms might be half-a-mile to 20 miles away.

The nucleus represents virtually all the mass or weight of the atom. Electrons are so lightweight they scarcely count.

Heavy Little Ball

The nucleus is so tightly packed that — if all the electrons were stripped away — all the nuclei of all the atoms on earth could form a ball only 400 feet across, Dr. Robert Hofstadter of Stanford University estimates. Yet this ball would weigh nearly as much as the earth.

The hearts of all the atoms in your body would amount to an infinitesimal speck. We and everything else are mostly empty space.

Thirty years ago, the nucleus was thought to consist of just two kinds of pieces of matter — the proton, and the neutron. Protons have a positive electric charge, the neutron no charge. Both weigh about the same. An atom has one circling electron, with a negative charge, for every proton in the core.

Atoms make up all the known 102 chemical elements.

Wondrously, the only difference between an atom of gold and an

atom of silver — or any other atom — is the total number of protons and neutrons in the core (with a circling electron for each proton).

The simplest atom, hydrogen, has just one proton and one electron. Oxygen has 16 protons and neutrons. Gold has 197, silver 107, explosive uranium has 235.

The nucleus is not altered when one atom joins another atom to form a molecule. Two atoms of hydrogen and one of oxygen form a molecule of water. But all they do is share electrons.

The stupendous energy of every atom is locked up in its nucleus.

It was this which was set free when scientists learned how to split atoms for bombs and for peacetime atomic power plants.

What happens is that part of the material in the nucleus is suddenly transformed into energy.

Even before World War II and the A-bomb, scientists had evidence and suspicions that the heart of the atom was far more wondrously organized than first suspected.

Brilliant deductions and theories and studies with cosmic rays and atom-smashers have borne them out and advanced the story.

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matter of FACT



Until the 19th century ropes were made entirely by hand on ropewalks, long, low buildings in which the ropemaker walked backward, step by step, unwinding the golden fibres from around his waist. At the upper end of the walk a boy turned a wheel to which one of the rope yarns was attached. This wheel kept twisting the yarn while it was being spun. Almost all rope is now made by machinery.

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First jet plane was flown in Italy during the fall of 1939. Show-Low, Ariz., is 50 miles from Snowflake, Ariz.

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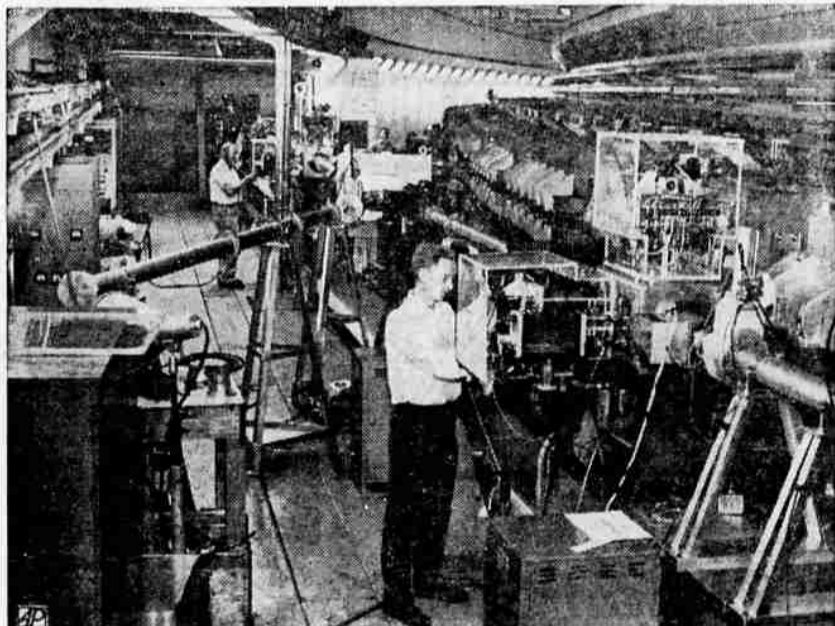
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BASIC RESEARCHERS: Technicians man their posts on the atom smasher or "particle accelerator" at Brookhaven National Laboratory, Upton, N. Y. Such costly accelerators are probing the secrets of the inner universe, a basic research which, though seemingly aimless, could lead to new sources of power or controls over disease.

TELEPHONE CALLS

Alaskans, in 1958, averaged 581 telephone calls per person, highest in the world. Hawaii, with 522 calls, came next, followed by Canada with 497, the United States with 460 and Iceland with 452, in turn.

The grizzly bear has lived in North America for a million years.

FIRST CONVENT

Maryland claims the first convent in the United States. Four Carmelite nuns from Antwerp, Belgium, landed at Port Tobacco, Md., in July of 1790 to establish the American headquarters of their congregation.

Eighty-five per cent of the eligible voters cast ballots in the recent elections in Sweden, a new record.

LONG IN USE

Copper has been known and used longer than any of the other common metals. The Egyptians made articles of copper at least 5,000 years before the birth of Christ.

Paper ballots were used as early as 1634 in Massachusetts. These were unofficial and provided by the voter himself.

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