

PHYSICS

# Greatest Atom Smasher

## No Resting on Laurels for Prof. E. O. Lawrence; He Plans 6,000,000-Pound Cyclotron of Amazing Power

By ROBERT D. POTTER

**T**HE MOST powerful atom smasher ever conceived by the mind of man, that would dwarf present similar devices 10 or 15 times and whose huge electromagnet alone would weigh between 4,000,000 and 6,000,000 pounds, is the new project on which Prof. Ernest Orlando Lawrence, newest Nobel Prize winner in physics, is now hard at work.

This device is an enormous cyclotron that would create atomic particles 50 times as potent as those from radium and which would permit a frontal attack on a colossal scale against the nuclei of the atoms.

The penetration of the secrets of the mysterious cosmic rays by literally creating them, to some degree, in the laboratory, the possibility of the production of practical atomic power and the transmutation of the elements of the kind that ancient alchemists dreamed about; all these are among the potentialities of the enormous cyclotron which Prof. Lawrence now seeks to build.

The youthful University of California professor, only 38 years old, was far from his laboratory even before the Nobel Prize committee recently gave public recognition to something which scientists everywhere have long realized; that the cyclotron is one of the most versatile devices ever invented for studying the constitution of matter.

He was out in the world of big business and finance arguing, explaining and planning for \$750,000 to make possible the construction of this 2000 to 3000-ton

giant. Even while this trip was in progress his laboratory already possessed two other cyclotrons, weighing 85 and 200 tons, the latter the largest in the world today and only just placed in operation within the last few months.

The huge magnet of a 2000-ton cyclotron would be the size of a small home, 34 feet long, 25 feet high and 13 feet wide. The pole pieces of the electromagnet would be nearly eleven feet across. Some 244 tons of copper would be required in the windings. In tentative plans this giant cyclotron to end all cyclotrons would be buried in a hillside near the Berkeley campus of the University of California to provide better shielding of the surrounding neighborhood from its piercing radiations.

What manner of apparatus is a cyclotron that any man has the temerity to ask for \$750,000 to construct one? And

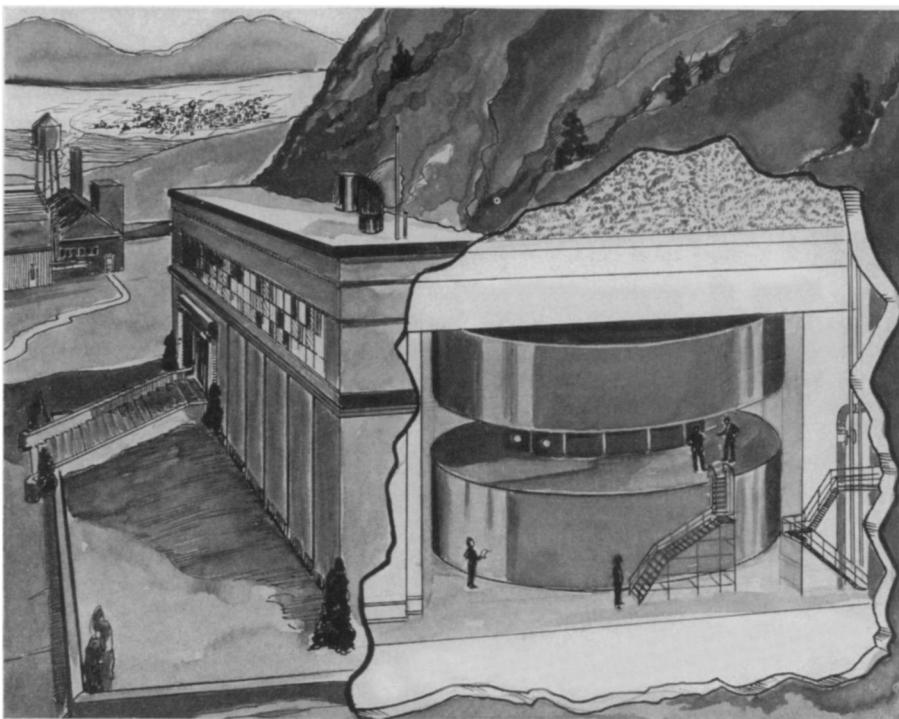
what worth has such an instrument that makes other men listen with reasonable sympathy to plans calling for research funds exceeded only by those needed to found a great astronomical observatory?

The answer to that story goes back to a September day in Berkeley, Calif., in 1930 when young 29-year-old Dr. Lawrence stood up before the nation's top-flight scientific body, the National Academy of Sciences, meeting there, and explained his hopes and dreams for an almost toy-like device for accelerating charged atomic particles. (See *SNL*, Nov. 18 for photograph.)

He hoped, Dr. Lawrence said, to build for a small sum a kind of magnetic and electric slingshot device that would whirl atomic particles around and around in spiral paths and, twice each revolution, speed them up by electrical "kicks."

His early plans envisioned the attainment of 1,000,000 electron volts of energy by a series of small electrical "kicks."

Known first as a resonance accelerator



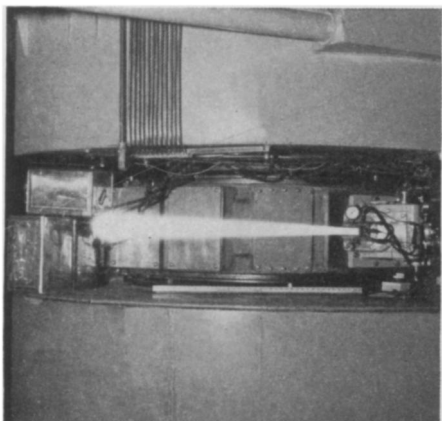
GIANT OF THE FUTURE

Artist's conception of the hillside laboratory which would house the enormous 3,000-ton cyclotron which Prof. E. O. Lawrence, newest Nobel Prize winner in physics, hopes to build at a cost of \$750,000. The cyclotron would be between five and six times as tall as a man. Its half-buried laboratory would be 1,000 yards from the nearest building which would be the control room shown at left.

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### ENERGY

The most powerful beam of energy ever created by man, the 16,500,000 electron volt deuteron beam from the U. of C. 200-ton cyclotron. It projects nearly six feet out into the air.

this experimental model shortly gained the name of cyclotron. Based on its success came a larger instrument whose magnet weighed 85 tons. Alpha particles having energies of 16,000,000 electron volts were obtained with this apparatus.

The large electromagnet of this unit was originally built during the World War for use in a huge radio transmitter which the Chinese government planned to construct. Never delivered, the magnet lay unused and eventually—with alterations—went at the task of keeping atomic particles whirling in their spiral paths.

Out of the success of the 85-ton unit, which produced artificial radioactivity in a whole host of normally stable elements, came plans for a complete and separate radiation laboratory that would house a still greater 200-ton cyclotron.

This new unit, just completed, works so successfully that it immediately created particles having energies of 32,000,000 electron volts. With a few adjustments alpha particles having energies of perhaps 50,000,000 electron volts can probably be secured.

Ahead and beyond the range of this newest cyclotron and capable of attack only by a huge 2,000-ton cyclotron is the problem of attacking the barred domain of nuclei that defies all atomic projectiles having energies less than a hundred million electron volts. Physicists already know that such energetic particles do strange things to other atoms as they collide with them in a battering impact. In one place, in the cosmic rays, particles of this energy already exist and fleeting evidence of their capabilities are known.

But with a new 2,000-ton cyclotron such particles could be created at will

and be controlled whereas particles found in cosmic rays are rare and completely uncontrolled.

Basic point of attack with a giant 2,000-ton cyclotron would be to study the enormous binding energies which link protons and neutrons in atomic nuclei and thus hold matter together into a stable form which (in much larger amounts than an atom) we recognize as a table, a piece of salt, copper or any element or chemical compounds. The proton-neutron link can now be attacked only by indirect methods which, so far, have yielded relatively little about its nature other than a rough idea of its magnitude.

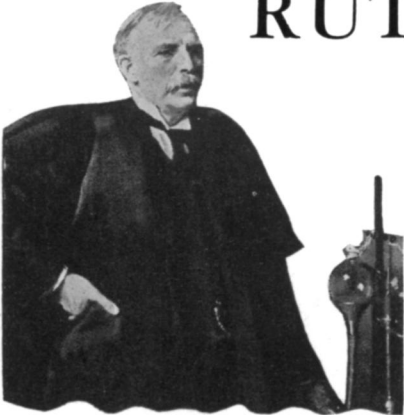
Prof. Lawrence feels that with a new and greater cyclotron a direct attack on the proton-neutron force could be affected. If the nuclear forces could be understood they might well be the key to developments of great practical importance. If this nuclear force can be liberated under controllable conditions the day when the energy locked up within atomic nuclei could be released would be at hand. A brief tantalizing hint has just this year been discovered by scientists, in the splitting of uranium atoms with the release of enormous amounts

of nuclear energy when bombarded with weakly energetic neutrons.

In very recent experiments performed in Prof. Lawrence's Radiation Laboratory by Prof. Malcolm Henderson of Princeton University it has been shown that the energy liberated amounts to 175,000,000 electron volts per atom of uranium. It takes only a bit of calculation to show that at this rate about 8 pounds of uranium would release energy equivalent to the 6,300 tons of fuel oil which a trans-Atlantic steamer like the *Queen Mary* carries in her bunkers on an Atlantic crossing.

The day when atomic power will become a reality is not yet at hand, make no enthusiastic mistake, but the possibilities for it are completely within the realm of reason. By the energetic bombardment of commoner substances than uranium with particles accelerated in a 2,000-ton cyclotron it is reasonable that perhaps other, more common elements likewise could be made to liberate their nuclear energy also.

Still another research possibility for a 2,000-ton cyclotron is the production of the transmutation of the elements on what would be, by present standards, a mass scale. Transmutation is possible



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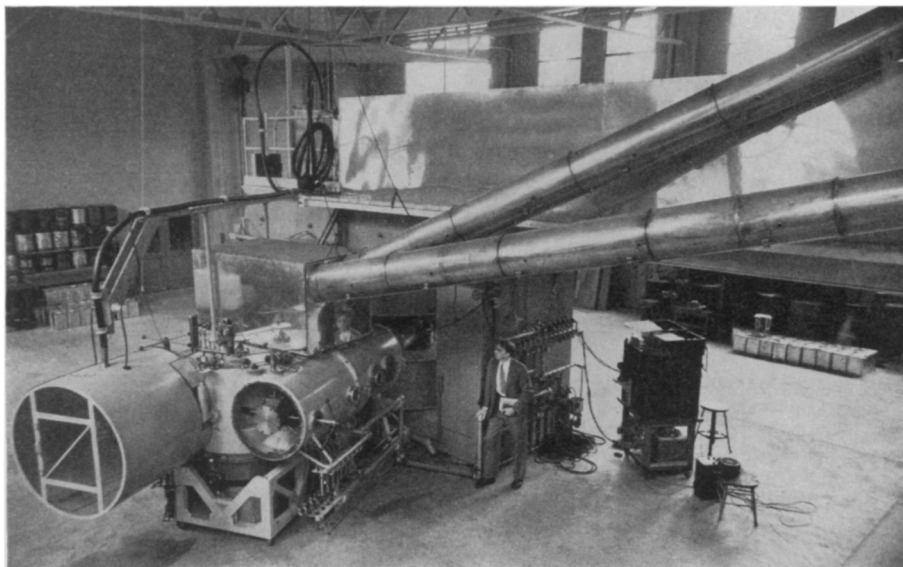
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### PATHWAYS OF PARTICLES

New view of the world's largest and newest cyclotron, the 200-ton giant of the University of California, showing the vacuum chambers down which the atomic particles are speeded, with energies as great as 32,000,000 electron volts after they have been accelerated in great spirals in the cyclotron proper.

now with present cyclotrons and its evidence can be detected by the radioactivity produced in normally stable elements like beryllium, boron and almost all the rest of the familiar 92 elements of the periodic table. But the amounts are most minute. While the alchemists' dream of transmutation has been technically ful-

filled the production of transmutation on a practical scale is far ahead.

And yet the day may not be so far off at that for it is estimated that three years of construction only would be needed to build a new 2,000-ton cyclotron. It is much more than pure day-dreaming to say that such an instrument might not only discover a new, cheap and almost inexhaustible source of power but it might (shall one say as a by-product) turn out to be the long-sought philosopher's stone—a means of transforming base metal into gold.

*Science News Letter, December 16, 1939*

### ENGINEERING

## Plastics Engineers Draft Plain Water As Lubricant

**P**LAIN ordinary water is now being used successfully as a lubricant for bearings in giant steel mill rolls and large ship propeller shafts through advances in the plastics industry, L. M. Tichvinsky, of the Westinghouse Research Laboratories, told the meeting of the American Society of Mechanical Engineers in Philadelphia.

Woven textile fabrics are impregnated with an organic binder and then treated by temperature and pressure to create these bearings, which require no oil or grease but perform efficiently when lubricated with water, which serves both as a cooling agent and as a lubricant.

*Science News Letter, December 16, 1939*

### GENERAL SCIENCE

## Marx "John the Baptist" Of Modern Social Science

An unofficial scientific ambassador from Great Britain to the United States is Julian Sorell Huxley, F.R.S., D.Sc., head of the London Zoo, grandson of the famous Thomas Henry Huxley of Darwin's day and an eminent biologist in his own right. Dr. Huxley comes to America as an exchange lecturer to represent British science at the Columbus, Ohio, meeting of the American Association for the Advancement of Science during Christmas week with a preliminary honoring banquet at Washington, under the joint auspices of the Association, the Smithsonian Institution, and of the Scientific Monthly.

**K**ARL MARX, founder of the modern Socialist movement, was declared to be "the true John the Baptist of Social Science" by Dr. Julian Huxley, speaking in Washington.

Some thinkers claim for Herbert Spencer, contemporary of Darwin and the elder Huxley, the distinction of being the first to point toward an eventual application of the findings and methods of objective science in the problems of human society, but Dr. Huxley relegated Spencer to a position analogous to that of one of the Hebrew prophets, rather than that of a direct precursor.

"He demonstrated that social science was an inevitable development," Dr. Huxley stated, "but his notions of what form it would actually take and what methods it should employ were vague and essentially erroneous.

"Marx, on the other hand, developed a system directly based on social facts and directly applicable to them. He did

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