PHYSICS

Atoms Control New Clock

This revolutionary instrument is independent of astronomical calculations and promises advances in radio, astronomy and materials study.

See Front Cover

➤ AN ATOMIC clock which tells time by the movements of atoms in molecules of ammonia has been demonstrated by scientists at the National Bureau of Standards.

The new clock will not find its way to your mantle or wrist, but you may sometime get a greater choice of radio broadcasts in your home and countless other developments from this revolutionary instrument.

Here are some of the possibilities which may come from use of the clock that tells time with atoms:

More radio stations because of better control of the limited room on broadcasting bands. Atomic control of higher frequencies will aid radar, other microwave equipment and television relays.

More accurate answers to countless problems in astronomy, including, "How long is a year?" That one is what causes the confusion over the calendar and gives us a leap year that is not entirely satisfactory to science.

Better analysis of materials in chemistry and medicine, plastics, rubber, textiles, oil, food and drugs. The atomic clock will help scientists use their newest and most effective tool for studying molecules, microwave spectroscopy. These techniques are used to identify elements by their vibrations.

Bureau scientists said that the principle used in the atomic clock will greatly improve astronomical observations, long-range navigation and communication systems, precise surveying, military map making and systems where atoms serve as electronic components, including radio filters, telephone relays and radar.

First clock independent of astronomical calculations, the new instrument gets away from using the rotation of the earth on its axis as it revolves around the sun. All previous clocks are based on this, and scientists have found that the earth's rotation is not as reliable as you might suppose. The earth is very gradually slowing down, plus the fact that mysterious changes in the rate of rotation have made days shorter and longer from time to time for no known reason.

Vibrations of atoms in the molecules which they form create spectrum lines which scientists have located in the very-high-frequency region of the radio spectrum where microwaves are found. Extremely sensitive radio methods make it possible to measure these spectrum lines very precisely. These achievements have made it possible to build a clock which does not depend upon the not-always-reliable earth, and is unaffected by temperature, pressure and aging.

Parts of the atomic clock include a quartz crystal oscillator, a frequency multiplier, a frequency discriminator, a frequency driver, a special 50-cycle clock and a waveguide absorption cell. The cell is a 30-foot copper tube, wound in a compact spiral around the clock and is filled with ammonia gas.

The actual clock is electrically driven, world's most accurate electric clock. A low frequency radio signal is generated by the crystal oscillator and transformed into a microwave signal. This signal is compared with the natural vibration of the ammonia molecule and adjusted to agree with the molecular vibration. The resulting signal controls the electrically-driven clock.

While the atomic clock is in operation, the monitoring oscilloscope continuously displays a trace of the 3,3 absorption line of ammonia. The 3,3 line, strongest of many absorption lines in ammonia, corresponds to the quantum transition in which the quantum numbers J and K both have the value 3. The symmetric output pulse is produced by absorption of the FM control signal as it sweeps across the natural absorption-line frequency of the ammonia gas. The sharpness of this line on the oscilloscope screen is an indication of the time keeping accuracy of the atomic clock, as shown on the cover of this week's SCIENCE NEWS LETTER.

Based on the work of Dr. Harold Lyons, chief of the microwave standards section at the Bureau's central radio propagation laboratory, the new clock has a constancy of better than one part in 20,000,000. Potential accuracy theoretically is rated at one part in 10,000,000,000.

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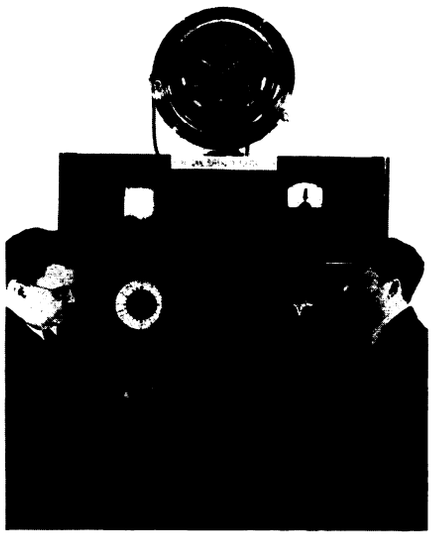

WORLD'S MOST ACCURATE CLOCK—Dr. E. U. Condon (left), director of the National Bureau of Standards and Dr. Harold Lyons, who developed the NBS atomic clock, stand before the control panel of the clock. Dr. Condon holds a model of the ammonia molecule which is used in controlling the timekeeping of the clock.

WILDLIFE

Alligators' Favorite Meat Found To Be Crayfish

➤ ALLIGATORS, despite widespread legends, do not feed mainly on little brown babies who stray too close to the water when their mammies aren't looking. Staple food of the grim-looking reptiles is, oddly enough, crayfish. They also eat a good many fish—real fish with fins—and quite a few turtles and water-snakes of various kinds. Only the big ones, as a rule, can manage meals of warm-blooded meat—birds and mammals, the latter mostly muskrats.

This information was obtained in the course of a systematic study of the alligator life of the Sabine National Wildlife Refuge in Louisiana, conducted by LeRoy W. Giles and Vandiver L. Childs for the U. S. Fish and Wildlife Service, with field headquarters in Sulphur, La. They present a detailed report of their results in the JOURNAL OF WILDLIFE MANAGEMENT, (Jan.).

They had dependable hunters take a sampling of the alligator population of the refuge. Out of more than a thousand alligators killed, nearly nine-tenths were less than five feet in length. This relatively small size helps to account for the predominantly crayfish diet.

Despite the fact that alligators do feed to some extent on the valuable fur-bearing muskrats, the two wildlife researchers do not favor large-scale killing of the big reptiles. They also have a considerable economic value, the report points out, because of their high-priced hides.

Science News Letter, January 15, 1949

Approximately 13,400 miles of *snow fences* are used in the United States to keep snowdrifts off highways; placed parallel to the road, they break the wind and cause drifts to form between them and the highway.