



DR. JOHN B. WILBUR AND THE "ROBOT EINSTEIN"

MATHEMATICS

## Robot Mathematician Solves Nine Simultaneous Equations

A ONE-TON machine that in a single action can solve nine simultaneous equations with nine unknowns so complicated in form they might well require days of laborious computation by trained mathematicians has been developed at the Massachusetts Institute of Technology.

Known as the simultaneous calculator, the machine is the product of three years' research by Dr. John B. Wilbur of the department of civil engineering. Cooperating with him has been Dr. Vannevar Bush, vice-president of technology and dean of engineering, who under the Institute's program to eliminate delay and complications in engineering and research, has previously made important contributions to the mechanical solution of mathematical problems, including the famous differential analyzer.

The simultaneous linear algebraic equations solved by the new machine occur constantly over a wide range of engineering and scientific analyses. Thus although the calculator was originally designed for the solution of problems in civil engineering, such as those involved in the construction of skyscrapers,

it is expected to prove equally useful in such diverse fields as nuclear physics, geodetic surveying, genetics and psychology. The mathematician will be able to use it for the evaluation of determinants especially and in several other fields, since the machine under some circumstances can solve for even more than nine unknowns.

The machine weighs approximately 2,000 pounds and has more than 13,000 separate parts, including 600 feet of flexible steel tape and almost 1000 ball-bearing pulleys. The outgrowth of an experimental model built by Dr. Wilbur two years ago, the new machine has undergone exhaustive tests and is now in active operation.

The simultaneous equations which constitute the basis of the machine's operation are mathematical expressions relating a number of unknown quantities in such a way that the value of each unknown may be determined by a simultaneous consideration of the relations involved as expressed by the equations.

In the design of a suspension bridge, for example, the stresses on each part depend on the stresses on other parts.

In addition, each of these stresses depends on the physical elastic properties of the parts themselves. Yet the value of the stresses can be calculated by solving a set of simultaneous equations which show the relations between these various stresses.

In the usual analytical solution this process involves considerable laborious manipulation of the factors. With Dr. Wilbur's new machine, however, it is necessary only to set a series of tilting plates to account for the various coefficients and constants and a single movement of the mechanism mechanically performs in a few seconds computations that might take days by ordinary methods.

Construction was made possible by a fund established by Sir Douglas Alexander of New York City.

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ASTROPHYSICS

## Sunspots More Numerous; Radio Range Increases

THOSE commanding police calls on short-wave radio that strike terror into the hearts of criminals and speed officers to crime scenes are now frequently heard across the Atlantic. Two years ago they could be received only 30 to 40 miles away.

The increased number of sunspots is the cause, Dr. L. V. Berkner, Carnegie Institution of Washington physicist, explained. The activity on the sun produces its effect by increasing the density of the electrically charged layers 65, 130 and 190 miles above the earth that reflect radio waves.

When the police radio stations were first established, the high frequency (short wave) radio signals used penetrated these ionosphere layers and were lost in space. Now owing to the increased density of ions in the layers, they are reflected back to earth and their echoes are received at great distances.

Electrical conditions in the earth's outer atmosphere vary radically not only from day to night but also with the seasons, an intensive research program of the Carnegie Institution's Department of Terrestrial Magnetism has shown. Many vagaries of radio transmission and fluctuations in the earth's magnetism can be explained by changes in the ionosphere.

There are three well-defined regions of electrification that exist in the upper atmosphere, on a typical summer day at Washington about noon. In the lowest, 65 miles aloft, called the E-region,

the electrical particles or ions number about 2,800,000 per cubic inch. The F<sub>1</sub> region, with a height of 130 miles, has 5,300,000 per cubic inch and the F<sub>2</sub> region, 190 miles aloft, has 16,000,000. Ultraviolet light ionizes the two lower regions, while corpuscles from the sun

are believed to cause the high charge on the outermost layer.

During the past two years due to increased sunspots the electrical charge in the two lower layers has increased by 50 per cent and in the upper layer 200 per cent.

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#### AVIATION

## Airline Safety Problem Holds Focus of Attention

**T**HE WINDOW-dressing of aviation and the skeleton in the aerial family closet hold dual roles at the present time. The recent National Aviation Show in New York exhibited the new improved types of planes in the vanguard of developments in speed, safety, efficiency and performance. And in Washington the family skeleton of airplane crackups was up for an overhauling at the conference sponsored by the Bureau of Air Commerce.

At present prices few people can afford to buy airplanes, although the number of planes owned privately increases year by year. But a large number of people now ride the airlines and so have a personal stake in the crashes which in recent months have aroused public indignation.

In the present situation, therefore, the skeleton probably has more news value than the show window.

Up for discussion at the Washington conference were many things, but the highlights included:

1. The possibility that the investigation of airplane crashes be removed from the jurisdiction of the Bureau of Air Commerce. The point is that many accidents appear, either directly or indirectly, to be the fault of the so-called aids of navigation like radio beams, which are maintained by the Bureau. Thus, under the present setup the Bureau may be called upon to investigate itself. No matter how conscientiously this may be done there is bound to be, on occasions, a criticism of "white-wash." Eugene Vidal, director of the Bureau, has already pointed out this paradoxical situation and urged a change from the present arrangement.

2. A better system of blind landing. Back in 1933, the Bureau of Air Commerce had its choice of the Army system now in use and the bent beam system then under partial development by the scientists of the National Bureau of

Standards in Washington. At that time the system chosen may have been the best but whether it still stands in the favored spot today needs study. Demonstrations of the bent beam blind landing system were held during the conference. With the government economy wave of 1933, the scientists who developed this bent beam system were dropped from Federal employ but have since banded together as the Washington Institute of Technology and pushed further their development work.

3. Improved radio beacons on the airways. The known troubles of multiple courses that give false bearings to airplanes on occasion seem experimentally to be removed if the power of the beacons is decreased so that they can be heard only 50 miles instead of 100 or more as at present. The answer, therefore, seems to mean weaker stations, set closer together along the routes of the transport planes. But the necessary appropriations will require good arguments to bring them into being.

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#### PHYSIOLOGY

## Rats Wear Out Teeth In Order to Stay Alive

**W**HEN a rodent's teeth do not meet and wear by contact with each other he dies by slow and involuntary suicide, according to Dr. Dewey G. Steele, professor of genetics at the Connecticut State College.

Unlike the teeth of a man those of a rodent grow through its entire life. If by some chance they do not meet each other and wear down they often grow up through the mouth and into the nasal or brain cavities. The upper teeth grow down into the lower jaw.

Extreme pain, infection and death usually result, according to Dr. Steele.

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#### METEOROLOGY

## Dust Bowl Grows While Floods Rage

**F**LOOD is not a problem in some parts of the country, despite its continued dominance of newspaper front pages. In the Southwest's notorious Dust Bowl, drought shows its white fangs again, a summary report from the U.S. Weather Bureau indicates. During all of January and thus far into February, less than a quarter of normal precipitation has been received in considerable parts of the region.

Meantime, the Southeast continues to struggle with its problem of unseasonable warmth. Peach trees in Georgia are in full bloom, and Southern vegetables are far too advanced for the season. A stiff frost could work havoc throughout the Southeast—and the frostline pushed dangerously deep into Dixie recently.

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#### ANTHROPOLOGY

## Weather Disasters Bred Wars in U. S. History

**A**BOUT 250 years ago, disasters of weather suffered by Plains Indians were breeding wars for United States history. This object lesson from Indian archaeology is drawn by Dr. W. R. Wedel of the Smithsonian Institution.

The warlike temper of Plains Indians, when white settlers ventured in covered wagons among them, is blamed, indirectly at least, on drought.

It appears that before the white men came a major drought had swept the Great Plains, driving Indian farmers out of their villages, and ending an era of peaceful agricultural life in the region. The "rehabilitated" Indians found themselves pushed into a greatly restricted section after the drought. In their economic worries they quarreled among themselves, fortified their villages, endured raids and massacres from their neighbors.

When white traders came, bringing horses, the situation grew worse, as many tribes became roving bison hunters or combined farming with roving. With swift horses, raiding and defensive fighting among the Indians became more frequent. When white settlers arrived, the psychology of an entire region had subtly degenerated from a state of peace to a state of war and suspicion, and the white men were received with warcries and violent resistance from hostile red men.

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