

ASTRONOMY

Predict Sun's Effect on Radio

New theory, an upside-down-umbrella effect on the sun, may allow more accurate forecasts of shortwave radio reception. It explains shape of sun's pearly white corona.

By ANN EWING

► BY LOOKING at the sun with a special instrument, scientists expect in the near future to be able to tell more accurately whether there is going to be a blackout of long-distance radio communications.

What the shortwave radio forecaster soon may be doing is using a picture of the sun, viewed with an instrument that shows the outer atmosphere as though it were in a total eclipse, to make his prediction more accurate.

Atomic bombardment of the earth by the sun is thought to cause the earth's great magnetic storms. We know these occur by the blackouts of radio communications, the brilliant auroral displays, and the rapid movements of a magnetic needle they cause.

Scientists have suspected for a long time that actions in the corona, the usually invisible outer atmosphere of the sun, were tied in with these plaguing interruptions of shortwave radio and the mysterious "northern lights."

Now Dr. Walter O. Roberts, director of the High Altitude Observatory at Boulder, Colo., believes that a new theory of how the sun's corona is formed that he and his colleagues have worked out will help radio experts forecast when magnetic storms are going to occur.

Coronal Shape Explained

This new theory, the result of nearly ten years research on the sun, also explains why the shape of the corona seen at eclipse time changes with the sunspot cycle, an 11-year period. Dr. Roberts has dubbed it the "upside-down-umbrella" theory.

Some of the most up-to-date equipment anywhere in the world for peering directly at the sun's atmosphere is at the Climax Observatory, run jointly by Harvard University and the University of Colorado. The newest instrument for spying at the solar atmosphere at non-eclipse times is known as the coronagraph. Until its invention in 1931 by the French astronomer, Bernard Lyot, astronomers were forced to make their observations of the corona during the few brief moments of a total solar eclipse.

For these fleeting seconds when the sun's light is completely blacked out by the moon, many things in the transparent atmosphere normally invisible to the unaided eye become strikingly visible.

The coronagraph, in effect, produces an artificial eclipse, permitting unwanted light from the sun's surface to be shut out at any time observing conditions are suitable.

The device, however, will not work where there is dust or haze in the earth's atmosphere, hence the high altitude of Climax Observatory and other solar observing stations around the world that use coronagraphs.

The difficulty in photographing the corona, the giant, pearly white halo of the sun so spectacularly visible during totality, is that its light is about half a million times less brilliant than that of the sun. Yet it is so close to the sun that blanking out all light except the very feeble fraction of the corona is extremely difficult.

In his pioneering studies of the sun with the coronagraph, Dr. Lyot originally used the white light of the corona, that is, the light of all the rainbow colors taken together, rather than just one color, as red or green, for taking photographs.

However, because it was much more difficult to catch the intricate pattern formed by the corona in white light than in either

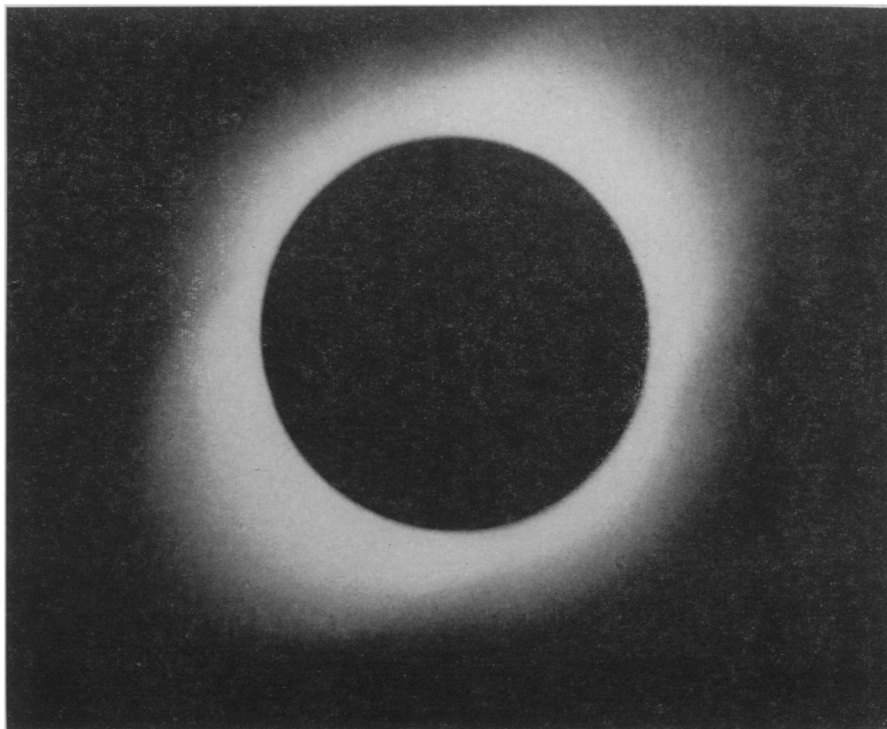
red or green light, until recently only these two parts of the full spectrum of light were used for taking daily photographs with the coronagraph. Astronomers believed that the patterns would be the same in red or green light as in white light.

Only during the last two years or so have the scientists at the Observatory realized that by looking at the sun in white light, as Dr. Lyot did, rather than in red or green light, they might discover that the coronal patterns differed.

Different White-Light Pattern

The difference, Dr. Roberts believes, is that the patterns formed in red and green light come from distinct and separate parts of the sun, the "active regions" where great sunspots are often formed, while the patterns for white light come from small gaseous jets, the spicules located all over the entire sun, but focused by the active regions.

The new theory of coronal shape and formation is thus tied in with sunspots, the large dark spots on the sun's face that, on occasion, are visible to the naked eye when properly protected. The number of spots



CORONA DURING ECLIPSE—This photograph shows the solar corona as it appeared from 13,000 feet over the southernmost tip of Hudson Bay during the total eclipse of June 30. The sun at present is near the minimum in the 11-year sunspot cycle, and the predominance of the equatorial rays is clearly shown. A new theory explains the changing shape of the corona during the sun spot cycle, and ties it in with magnetic storms on the earth.

that can be seen on the sun varies greatly in different years, showing a full cycle, from high to low and back to high again, in about 11 years.

Structure of Corona Varies

The shape and structure of the solar corona during an eclipse, either natural or man-made, varies depending on whether sunspots are at a high or low point in the 11-year cycle.

At the present sunspot minimum, there are long equatorial streamers and, in the polar regions, short plumes or tufts. When sunspots are at a maximum, the corona extends more nearly equally in all directions. Dr. Roberts believes that magnetic forces acting out from the sunspots push the corona away, forcing it to take the various patterns that are seen at eclipse time or with the coronagraph.

This action, he explains, can be pictured by thinking of the tip of a gigantic umbrella upside down at the sunspot. If there are two sunspots, separated by several hundred thousand miles, then the giant inverted umbrellas covering each would overlap and so the magnetic forces would join.

Dr. Roberts accounts for coronal streamers as being formed where the two giant "umbrellas" meet. Rays and plumes, or tufts, can also be explained by his new theory, which links the various patterns to the earth's magnetic storms.

Fortunately for us, the sun, our nearest neighbor star, is quite a stable star. Except for its relative proximity, only 93,000,000 miles, the sun is a most average star—it is neither extremely large nor extremely small, it is neither very bright nor very dim. Like all other stars in the sky, the sun is a gigantic globe of glowing gas. Its diameter is 864,000 miles, and from it radiant energy

of all kinds is being poured forth at a tremendous rate, equivalent to 250,000,000 tons of matter every minute. This reaches us in the form of heat, light and other radiation.

Although scientists are pretty well agreed that the sun's lavish radiation has continued, and will continue, practically unchanged for hundreds of millions of years, only in the last 50 years or so have they begun to make systematic observations of the "other radiation," from X-rays to radio waves.

Weather-Like Phenomena

There are many similarities, Dr. Roberts points out, between the words used to describe our weather and the appearance of the sun's atmosphere, where the vast clouds of gas seem to behave in a somewhat weather-like way. Some of the terms for describing its continual motion are clouds, tornadoes, rain and cyclones.

The two principal features of the sun's atmosphere are the chromosphere with its prominences, and the corona.

"Prominences are huge clouds of atmospheric gases extending high above the solar surface," Dr. Roberts explained. "They possess a very jagged, irregular shape that is continually changing. They are supported in delicate equilibrium with the powerful force of solar gravitation, which is more than 25 times as potent as the earth's gravitation.

"The corona, on the other hand, surrounds the sun like a giant halo, and radiates a soft, pearly light. This light is partly caused by streams of electrons in the sun's atmosphere, dense enough that they scatter the brilliant sunlight that passes through them, but still very tenuous by all earthly standards."

Science News Letter, July 17, 1954

DENTISTRY

Protect Mouth in Sports

➤ MANY MOTHERS and probably a few fathers will cheer the University of Illinois dental scientists in Chicago who declare all schoolboys playing football and similar games should wear mouth protectors to avoid broken teeth and other mouth injuries.

More than half the injuries suffered by high school and college football players occur in the mouth area, the dentists, Drs. George Watts, Archie Woolard and Carl Singer, state. Even in grammar school, boys taking part in contact sports probably suffer an astounding number of dental injuries.

"Schools spend an average of 90 to \$120 annually to outfit each football player with protective clothing, which affords him protection only for those regions in which 48% of the injuries occur," the dentists state.

"If the public is convinced of and educated to the necessity of mouth protectors in contact sports, it will insist that they be

made available to the young people participating in any and all contact sports."

They made an experiment at St. Rita's high school in Chicago where they devised mouth protectors for the 26 members of the school's football team.

"Although the football season had only just begun, the team had already incurred four dental injuries before the mouth protectors became available," dentists report in the *Journal of the American Dental Association* (July).

The injuries included three broken front teeth and a fractured jaw.

"At the end of the season," they reported, "dental injuries had been reduced 100%. The opposing teams in the same games had suffered an average of two injuries in and about the oral cavity."

Vellum rubber and vellum acrylic materials were found to be satisfactory substitutes for mouth protectors.

Science News Letter, July 17, 1954

HEMATOLOGY

"Drumsticks" in Blood Show Sex Difference

➤ "DRUMSTICKS" in blood cells will tell a person's sex. If six of the "drumsticks" are found in 500 neutrophil cells of the blood, the blood came from a female. If none are found, the blood came from a male.

This "drumstick" blood test for sex is announced by Drs. William M. Davidson and D. Robertson Smith of King's College Hospital Medical School, London, in a report to the *British Medical Journal* (July 3).

The "drumstick" is a little bump, shaped like a drumstick, that juts out from one lobe of the blood cell nucleus. It is made up of chromatin, easily stainable part of the cell nucleus which is the carrier of the genes in inheritance.

The new sex-differentiating test may be of medico-legal interest and, the doctors state, has already proved valuable in checking the origin of some blood specimens prepared for microscopic examination.

Science News Letter, July 17, 1954

GENERAL SCIENCE

Number of Scientists Is Increasing in U. S.

➤ THE NUMBER of scientists and engineers is increasing in the United States, but the 500,000 engineers and 200,000 scientists constitute less than a half of one percent of our total population.

Dr. Harry C. Kelly of the National Science Foundation, reporting these figures in *Science* (July 2), states:

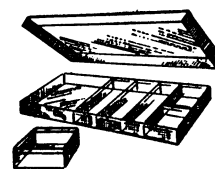
"One of the grave problems facing the nation is how to use these crucial skills and, at the same time, preserve the freedom essential to the advancement of knowledge."

Nearly half of the high school graduates who have the intelligence to do college work do not go on to college, Dr. Kelly pointed out, and an appreciable number of those who enter college do not finish.

The rate of producing well-trained scientists and engineers seems to be higher in the Soviet Union than in the United States, Dr. Kelly warned. He estimates there are more than 400,000 engineers and 150,000 scientists in the Soviet Union.

Science News Letter, July 17, 1954

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