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ASTRONOMY

American Astronomers in Norway to Observe Eclipse

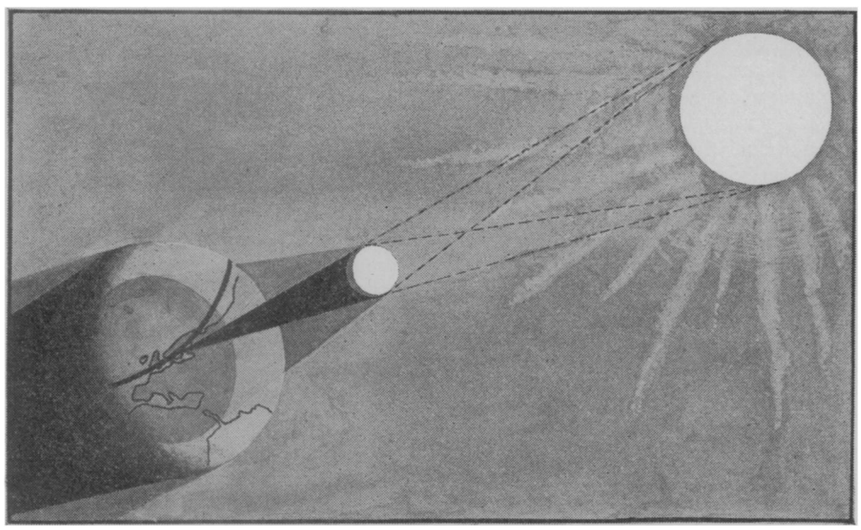

DIAGRAM SHOWING THE CAUSE OF A TOTAL ECLIPSE of the sun. In the eclipse June 29, the path of totality, shown by the heavy black line, passes over England and the Scandinavian peninsula. People in the large shaded area will see a partial eclipse

By Dr. Samuel A. Mitchell

Leader of the McCormick-Chaloner Eclipse Expedition to Norway and Director of the Leander McCormick Observatory of the University of Virginia.

Next week, on the the 29th of June, the sun will undergo a total eclipse. The moon's shadow, which always stretches out into space behind it, although visible only when it sweeps across the earth, will then touch our globe. Throughout the region that it traverses the sun will be completely obscured, and from behind it will shine the corona, at other times invisible by reason of the sun's glare.

At 5:30 A. M., Greenwich time, or 12:30 A. M., Eastern Standard Time, the shadow will sweep across the Norwegian town of Stavanger, on the southwest coast. It will already have crossed England, and then as it sweeps northward, it will reach Fagernes, in interior Norway, where we have located the McCormick-Chaloner expedition of the University of Virginia. Already our instruments have been set up, and the members of our party are preparing for the crucial moment. With us is Dr. Harlan T. Stetson, of Harvard.

50,000 Miles For Fifteen Minutes

The life of an eclipse observer might well be likened to a hunter of big game. Since 1900 I have traveled more than 50,000 miles to witness six total eclipses of the sun. This will be the seventh that I have come to observe. If the weather next Wednesday is clear, and the chances are about fifty-fifty that it will be, I will have seen the sun eclipsed for a total of about 15 minutes in my entire life.

But eclipses are much more wary things to shoot than even the rarest of big game. Many months and even years are spent in preparing for one, in quietly investigating the problems; a costly equipment is accumulated and each piece of delicate apparatus is carefully tested at home to see that it will properly perform its designated function far afield. A long journey, like that which has brought us from Charlottesville, Virginia, to Fagernes, Norway, is usually necessary.

And then, after we have reached our destination, many weeks of preparation are required, in setting up the instruments, cameras and spectroscopes. Each member of our party drills constantly so that the task allotted to him may be well and carefully done, so that the photographic slides may be drawn and each camera lens may be opened at the proper instant.

Success lies in seeing that every one of a thousand possible chances of failure are obviated. At a certain hour, minute and second, the "zero-hour," operations are due to begin. But alas! there may be no "game," the eclipse itself may be eclipsed by clouds, and the long months of preparation may be of no avail since it will not be possible to try again on the morrow when the clouds have rolled away.

Amongst all the wonders of all the wonderful sciences there is no science which deals with such a gorgeous spectacle as that at the moment when the earth is shrouded in darkness, and around the sun appears the matchless crown of glory, the corona. Nor can any science duplicate the wonderful precision shown by the work of the astronomer in his capacity to predict hundreds of years in advance the exact hour and minute at which an eclipse will take place and the locality on the earth's surface where it will be visible.

But what good is a total eclipse? Why should we travel such great dis-

(*Just turn the page*)

INDEX TO THIS ISSUE

Coming Solar Eclipse

(*Continued from page* 381)

tances to see it? Until about the middle of the nineteenth century little interest was taken in the subject, although information regarding the sun was comparatively scant. The eclipse was only observed when its track happened to cross the home of the observer, and even then the only observations of value were noting the exact times of contact of the edges of the sun and moon. The beautiful corona was watched with awe and admiration, and some indifferent drawings were made of its form, but it was not even known whether it was a part of the sun or the moon.

Helium Discovered at Eclipse

At an eclipse in 1868, the spectroscope, which analyzes light from the sun and stars, and tells us what elements compose the heavenly bodies, was applied to eclipses for the first time. Janssen, a French astronomer, found a yellow line at first supposed to be due to the element sodium, most common as a constituent of ordinary salt. But it turned out to be due to an unknown element, which was called helium, because it was discovered in the sun. In 1895 helium was discovered on the earth, now it is used physical science, helium is no less important. It is one of the products of to fill our great dirigible balloons. In such elements as radium, which continually undergo change into other elements.

This is one of the useful things that have come out of eclipse observations, but their fundamental importance is much greater, for they tell us much concerning the sun, and it is on the sun that our very life depends.

The path of totality of the coming eclipse passes over England before it reaches us in Norway. Along the path, from Southport on the Irish Sea to West Hartlepool on the North Sea,

(*Continued on page* 387)

News-Letter Features

Born over four years ago of the demand and interest of those individuals who had caught a glimpse of *Science Service's* news reports to newspapers, the SCIENCE NEWS-LETTER has since proved interesting to laymen, scientists, students, teachers and children.

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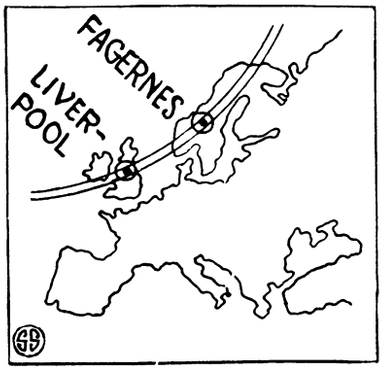

PATH OF TOTALITY IN EUROPE of the Total Eclipse of the Sun, June 29, 1927

Coming Solar Eclipse

(*Continued from page 382*)

British astronomers and interested laymen, will be gathered to make the most of the 24 seconds that the total eclipse will last at the center of the path. In England, the total phase occurs about 5:25 A. M. Greenwich time. Weather experts estimate that there is only about one chance in three of the eclipse being seen in England, and for that reason the McCormick-Chaloner expedition has picked out Norway, where the chances for clear weather are about even.

First in England in Two Centuries

But despite the probably poor weather conditions in England, no recent astronomical event has attracted so much popular interest. The last chances that Britishers had to observe eclipses were on May 2, 1715, and May 22, 1724. Both of these were observed by the great astronomer Halley, who is known to us as the discoverer of the periodic character of Halley's comet. If clouds prevent observations next week, British astronomers will have a long wait ahead of them for the next eclipse, because it occurs on Angust 11, 1999. Then it will just touch the southwestern tip of Cornwall.

Chances Better in Norway

Besides being a little later in the morning in Norway than in England, and with the chances for clear weather better, the eclipse there will last a little longer. At Fagernes, where we are located, it will last about 34 seconds, or 10 seconds longer than in England. For photographs of the corona, made with a large camera during the time that the sun is completely obscured by the moon's disc, these extra seconds are precious. They will enable us to make longer exposures, and so to record the outermost extensions of this delicate structure, which take a long time to record themselves on the photographic plate.

What does the corona consist of? and whence comes its light? Its feeble light has been traced to the enormous distance of ten millions of miles from the sun's surface. It cannot be a true atmosphere consisting of gaseous particles for, if it were, the pressure at the sun's surface would be colossal, and we know for certain that such pressures do not exist. As a further proof we know that occasionally comets come close to the sun's surface, dashing by the sun at the rate of a hundred miles per second—and yet the comet goes through the corona without any friction and without any perceptible impeding of its velocity, which would be impossible if the corona contained much matter. The only true atmosphere possessed by the sun is the chromosphere which stretches up to a maximum height of 10,000 miles.

When the light from the sun is analyzed by means of the prisms of a spectroscope, the resulting spectrum shows a bright band of color crossed by numerous dark lines. Each of these lines is due to some particular element in the sun, and by their aid we can tell of what substances the outer layer of the sun is made.

What is the Corona?

We must rely mainly on the spectroscope to give information on the constitution of the corona. On account of the feebleness of its light it is almost impossible to use a spectroscope as powerful as one that we can use on the sun itself. None of the lines in the spectrum of the corona, amounting to about forty, have been identified with terrestrial sources. The strongest line in the whole spectrum is in the green, at wave length 5303. This belongs to the mysterious and unknown element "coronium". Part of the coronal light takes its origin from the gaseous coronium which gives a spectrum of bright lines, and part by sunlight reflected from the molecules of the corona, since a dark spectrum is also observed. It has been difficult to decide whether the reflection and scattering of the ordinary sunlight is in the corona itself or whether it takes place in our terrestrial atmosphere. At the eclipse of 1922 in Australia, Dr. Moore of the Lick Observatory secured some very valuable observations.

Many astronomers have attempted to photograph the corona in full sunshine, using many different kinds of instruments, while high mountains like Pikes Peak and Mount Blanc were ascended in order to get above the heavier strata of the earth's atmosphere. But all to no avail! The work of Dr. Abbot, of the Smithsonian, Prof. Stebbins, of the University of Wisconsin, and others have told the reasons, namely that the coronal light is excessively feeble compared with sunlight. This brings the unfortunate conclusion that investigations of the mysterious corona must forever be confined to the few brief moments of a total eclipse.

Although Dr. Stetson will make observations of the heat of the corona, for the main purpose of our expedition, the short duration of totality at this eclipse is unimportant. I have

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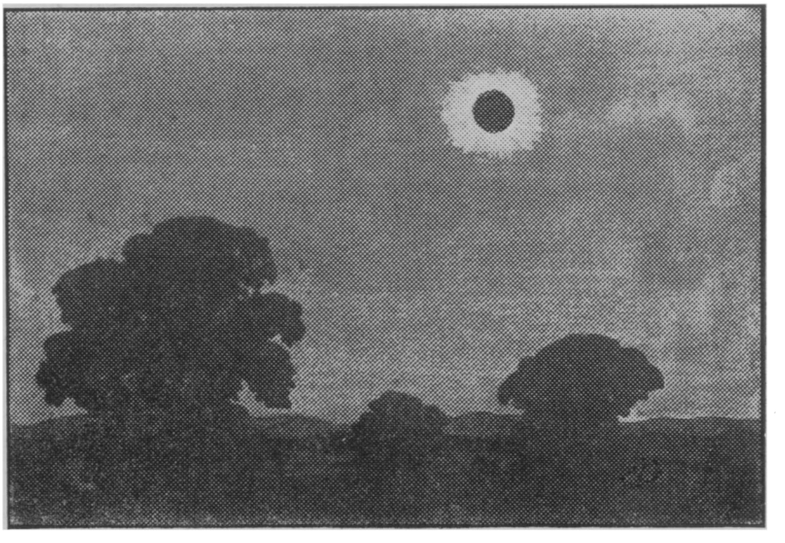

HOW THE ECLIPSE WILL PROBABLY LOOK IN ENGLAND. This drawing is based on one made for the British Admiralty

Coming Solar Eclipse

(*Continued from page* 387)

always been chiefly interested in what we call the "flash spectrum."

If we could get the light from inside the sun through our spectroscopes, without its having traversed the outer layer, or "chromosphere," it would look like a spectrum from a white hot poker, or the white hot filament of an electric bulb, that is, the dark lines would not be present, and instead the spectrum would be a continuous band of color. But if the light comes from a glowing vapor, such as that of sodium, which can be obtained by putting a pinch of salt in a colorless gas flame, the spectrum will show only two bright yellow lines, close together. Similarly other elements besides sodium will each give a characteristic "bright line" spectrum.

Spectrum Shows Dark Lines

Now, if the light from an incandescent electric lamp, which is much brighter than the sodium light, shines through the glowing vapor in the flame while we examine the spectrum, we see a bright band of colors crossed by two dark lines in the same position as the two bright lines of the spectrum of sodium alone.

The outer layer of the sun—the chromosphere—resembles the sodium flame, because it consists of glowing vapors. As the light from the hot interior of the sun passes through it, some of the colors are absorbed, not only those corresponding to sodium, but iron and many other elements as well. The result is the solar spectrum that we ordinarily see. The only time that it is possible to see the light from the outer layer by itself is at the time of a total eclipse.

When the moon's disc crosses the face of the sun, and completely covers its surface, the total eclipse begins. At this instant the narrow crescent of the chromosphere shines for a few seconds only until covered by the advancing moon. At that moment the only light that reaches the earth comes from this layer of glowing vapors, and the spectrum, shows a series of bright crescent-shaped lines. The image of the chromosphere layer appears in the light of each of the elements that it contains, and effects can be studied that are visible at no other time. The flash spectrum is visible for 3 to 5 seconds just at the beginning and at the end of the total eclipse. Consequently, for photographing the flash spectrum, a short duration of totality like that of the 1927 eclipse is just as good as the longest possible duration of seven minutes.

Tells Heights of Vapors

One advantage of the flash spectrum is that we can tell from it the height of the elements in the chromosphere. Take a penny and a dime out of your pocket. Lay the dime down with the side upon which appears the words "United States of America" uppermost. This will represent the sun, and the circular inscription the chromosphere. Now slide the penny, which represents the moon, over the dime. The penny is a little larger than the dime, just as the moon disc is apparently a little larger than that of the sun at the time of a total solar eclipse. Place the edge of the penny right under the initial "S" in "States," and you have a model of the conditions prevailing at the time the flash spectrum is visible.

All the rest of the sun is now covered, the only light comes from the chromosphere. Notice the bottoms of the letters. Only the bottom of the "S," and perhaps the "T," is visible. The top of more letters are visible, from the top of the "N" in "United" to the top of the "O" in "of." And as for the edge of the dime, it is visible half way around.

This is similar to what happens at the time of the flash spectrum. The higher layers in the sun's chromosphere are represented in photographs by the longer crescents. By measuring the lengths of these crescents, we can calculate the heights of the different gases in the chromosphere. If the moon's diameter, as seen from the earth, is only slightly larger than the sun, as at this eclipse, some of the outermost elements in the flash spectrum may show as complete circles.

The sun is the nearest of the fixed stars, and it is the only star which permits us to examine its atmosphere in detail at the time of a total eclipse. A knowledge of the heights attained by the solar vapors gives information regarding the pressures under which the spectroscopic lines take their origin. At very reduced pressures in the sun's chromosphere and at the high temperature found there it is readily possible for an atom to lose an external electron and become ionized. The spectrum of the ionized atom differs very much from that of the neutral atom which has not lost an electron. In the ionized spectrum certain lines are enhanced in intensity and these are the lines which are stronger in the spectrum of the electric spark than in the electric arc. Knowledge of these things are of the very greatest importance in furthering our knowledge of the chemical atom, a quest in which astronomy, physics and chemistry are vitally interested.

And so, with the other astronomers who have come to Norway, we are anxiously awaiting the 29th. We are the only American party, but nearby are numerous parties of astronomers from European countries. If the weather is clear, and we make our observations successfully, we will have the material for many months of study; if the weather is cloudy, then, at least, we can feel that we have done our duty.

Science News-Letter, June 18, 1927

About $25,000 worth of gold is mined each month in New South Wales.

May-flies that live as winged adults only one night have only a trace of mouth and digestive apparatus.

The first radio beacon south of the equator has been established near Cape Maria Van Dieman, New Zealand.