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## THE SWISS EXPEDITION TO THE SUDAN FOR THE OBSERVATION OF THE SOLAR ECLIPSE OF FEBRUARY 25, 1952.

(A Report and First Results: By Professor M. Waldmeier, Director, Zurich Observatory).


The total eclipse of the sun which took place on February 25, 1952 was visible over a belt 140 km or about 82 miles wide, extending from the Atlantic shore across Aequatorial Africa, the northern part of the Belgian Congo, the Sudan, the Red Sea, the Persian Gulf, and the Highlands of Iran. Total eclipses are rare and very seldom can they be scientifically observed, as they are visible only over relatively small parts of the globe, and too often observation is impeded by bad weather. We speak of a total eclipse of the sun when the moon passes directly in front of the sun for a short time completely covering the solar disk (seven and a half minutes at the maximum). Then only we can observe a kind of shining gaseous atmosphere casting rays far beyond the limb of the sun. This is the so-called "corona". It is only visible during a total central eclipse of the sun. Under all other circumstances, including partial eclipse, the corona is drowned by the rays of the sun, whose light is a million times stronger than that of the corona. It is very rare for an eclipse to cross in its path a permanent observatory. Therefore expeditions must be organised to observe and study the corona during total eclipses.

The Swiss Federal Observatory at Zurich, which for a hundred years has specialized on solar observation and has long been an international center for this kind of research work, had prepared a vast programme for the study of the corona during the total eclipse of February 25, 1952. The instruments specially built for this purpose weighed 2½ tons and were shipped already in 1951. In January 1952 eight members of the expedition set out from Zurich under the leadership of Professor Dr. Waldmeier, Director of the Federal Observatory. The expedition was mainly financed by the Swiss Society of Natural Science, whose President, Professor Dr. A. de Muralt (Berne) gave the expedition every possible help. Contributions were also granted by various Swiss cantons and by numerous private institutions.

The choice of the best post of observation presented no particular difficulty. Most favourable weather conditions could be expected to prevail in the Nile Valley, whilst they would be much less reliable in Central Africa and Iran. For this reason the Swiss Expedition decided to establish its headquarters at Khartoum, Capital of the Sudan, situated at the junction of the White Nile and the Blue Nile, only 9 km (5.2 miles) north of the shadow axis of the eclipse. Communications and accommodations were good and all material conditions looked favourable. The instruments were put up in a perfectly ideal place, a camp formerly occupied by British troops on the northern shore of the Blue Nile. The sky was generally clear, but transparent clouds were rather numerous at times. They might have badly interfered with the programme if they had been there on the day of the eclipse. There was even greater danger from the dust which was raised up by a permanent northern wind and penetrated every instrument. Only three days before the eclipse we experienced a violent sandstorm which obscured the sun. But in the

evening the stars came out again, and on the great day the sky was absolutely clear and there were no clouds.

Whilst former expeditions for the study of solar eclipses specialized on the study of just one or two details or problems, the Swiss Expedition purposed a general observation of the physical nature of the corona. This necessitated a large number of instruments and a considerable staff of attendants. Numerous measurements were made on the ground concerning variations of temperature, atmospheric pressure, degrees of brightness of the zenith, atmospheric parasites, velocity of the wind, etc. Fifteen photographic apparatuses were used, varying from a small hand camera to a big horizontal camera with a focal distance of 8 meters. All the optical methods used for the observation of the corona were applied: photometry, polarimetry, spectroscopy. To measure the distribution and intensity of brightness of the corona we had 4 apparatuses with focal distances of from 20 cm. to 800 cm. A polarization double camera and a cinema camera measured the state of polarization of the corona. Four apparatuses were reserved for the spectroscopic analysis of the light of the corona, viz. a glass spectrograph for the whole visual spectrum, two prism spectrograph for the short-wave spectrum, a quartz spectrograph for the ultra-violet rays, and a double objective prismatic camera. Further instruments served to compare the relative intensity of brightness between the sun and the corona, to determine the nature and structure of the corona and in particular its rays and their situations. During the period of the central total eclipse, which lasted 186 seconds, 40 photos of the corona were taken, 16 of



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the polarized light, then 17 spectral photos were taken, and 12 meters of cinematographic film were used. These photos were developed during the three following nights, 30 kg. of ice being used for this operation. All the photos are excellent. They are now being studied — a work which will take another two years at least. The highest expectations of the programme seem to have been realized. The numerous photos will allow us to separate the various component elements of the corona light. From their intensity it will be possible to determine the density of the electrons, the gasses and the particles of cosmic dust. The temperature of the corona proved to be extremely high. At the poles it is about 500,000 centigrades. Above the major sun spot, which happened to stand on the western fringe, the temperature approached a million centigrades. This temperature was not expected and cannot yet be explained. It contributes to make the corona of the sun one of the most interesting objects of astrophysical research. Nowhere else, neither on earth nor anywhere else in the cosmic world do we know of any matter capable of such temperatures.

The eclipse took place under the very best conditions. With a morning temperature of only 12 centigrades the day was one of the coolest experienced by the expedition in the Sudan. Even in the afternoon the thermometer did not rise above 28 centigrades, whilst during the previous days of preparation we had repeatedly measured temperatures of 43 centigrades. The partial eclipse started to the second. It took more than an hour until totality was reached. When the brightness of the sky decreased crowds began to

gather. During the last minutes preceding the total eclipse darkness increased very rapidly. But not before the very last moment, not even when the sun had become as thin as a mere thread, could we look at it with unprotected eyes. And then the corona began to flash up in rays of bizarre forms. The characteristic rays of the corona stood out most strikingly, two on the western edge flashing at least 6,000,000 km. into space. The ray seemed to sit on the brim of the sun which served it as its basis, and it ended in a fine point like a lance. Very soon the totality stage of the central eclipse was over, and as soon as the first ray of the sun appeared behind the moon the corona vanished and will not be seen for years, until the next total eclipse. For the thousands of natives it was a most impressive event of unequalled beauty and power. And for the Swiss Expedition it meant a very great success.



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