1974). Piddington's model is based on twisted 'ropes' of magnetic flux, where the twist is essential to the stability of the spot and the decay of the spot is due to untwisting of the flux ropes. The main criticism of this model is the lack of observational evidence for large twist in sunspot magnetic fields or for untwisting during decay. Wilson stressed the similarities between the Parker and Meyer *et al.* models, rather than their differences. In Parker's model, the sunspot magnetic field divides into several smaller flux tubes a short distance below the solar surface. The Meyer *et al.* model is based on a single large flux tube, but Wilson suggested that this tube may be fragmented by internal convection and flux expulsion below a depth of about 2,000 km and hence looks very like the Parker model. Both models postulate a presently undetected subsurface flow to provide stability for the sunspot, and this is perhaps their weakest feature.

Dynamical phenomena and fine structure in sunspots were reviewed, with R.L. Moore (NASA–Marshall Space Flight Center) presenting the observations and J.H. Thomas (University of Rochester) the theory. According to Moore, very high-resolution white-light photographs of sunspot penumbras show some of the dark fibrils to be elevated, translucent structures lying above a pattern of modified granulation. Thomas demonstrated how this might lead to a better understanding of the Evershed motion as a siphon flow (first proposed by F. Meyer and H.U. Schmidt in 1968) along elevated dark fibrils.

Moore showed that the observed umbral velocity oscillations in the photosphere and chromosphere and umbral flashes in the Ca II K and Hα lines, with periods of about 3 min, are all manifestations of the same phenomenon, with the flashes corresponding to the strongest velocity oscillations. New observations reported at the meeting by B. Lites (Sacramento Peak Observatory), A.H. Nye (Rochester Institute of Technology) and F. Kneer (Kiepenheuer Institute) support this picture. Thomas showed how the umbral oscillations may be explained theoretically as a resonant mode of the entire sunspot atmosphere, excited by overstable convection in the subphotosphere.

The bright umbral dots are generally considered to be a small-scale convective phenomenon. E.N. Parker (University of Chicago) has shown that they may arise from penetration of hot, field-free gas from below due to overstability in the regions between flux tubes in his sunspot model. It was agreed that reliable observational data on the velocity, temperature and magnetic field in umbral dots were lacking.

Recent satellite measurements of dips in solar irradiance coincident with the passage of large sunspot groups across the solar disk (Willson *et al.* Science **211**; 700, 1981) have stimulated searches for effects of sunspots on the solar irradiance and luminosity, which were reviewed by P. Foukal (Atmospheric and Environmental Research, Inc.). H.S. Hudson (University of California, San Diego) presented a model of the effect of sunspots that accounts for the observed drops in solar irradiance. Observations suggest that the missing energy flux of sunspots is stored in the convection zone rather than being redistributed instantaneously over a large region of the solar surface. Theoretical calculations of the energy storage mechanism in the convection zone were presented by Foukal and by H. Spruit (Max Planck Institute for Astrophysics, Munich).

S. Vogt (Lick Observatory) reviewed the properties of spots on other stars. Work in the area has progressed rapidly to the point where certain classes of stellar light curve can be unambiguously interpreted as being caused by large dark spots on the surface of these stars. Direct measurement of magnetic fields associated with these spots is considerably more difficult, but recent studies by Vogt and his colleagues promise to yield reliable field strength measurements. Although strong similarities do exist between sunspots and starspots, the long lifetime, large size and relatively hotter spot temperatures on the stars suggest important basic differences as well.

An announced goal of the workshop was to produce an overall empirical model of a typical sunspot atmosphere, analogous to the well known Bilderberg and Harvard–Smithsonian models of the quiet solar atmosphere. C. Zwaan (University of Utrecht) chaired the day-long session devoted to the model, which included important contributions concerning the umbral photosphere (P. Maltby, University of Oslo), chromosphere (H. Beebe, New Mexico State University; H.S. Yun, Seoul University; B. Lites, Sacramento Peak Observatory; and A. Skumanich, High Altitude Observatory) and transition region (K. Nicolas, Naval Research Laboratories). The participants agreed upon the properties of a one-dimensional empirical model of a sunspot atmosphere, and E. Avrett (Smithsonian Astrophysical Observatory) agreed to make the final calculations and prepare the model for publication in the conference proceedings. This model sunspot will be very useful to theoreticians and will not doubt serve as a focus for criticism and future improvements. □

100 years ago

At a recent meeting of the Banburyshire Natural History Society Mr. E. A. Walford read a note "On the Occurrence of a Fire-ball at Watergall" on August 23. In answer to Mr. Walford's queries, Mr. Fessey, jun., had sent an account as follows, dated "Watergall, Leamington, August 30: As regards the fire-ball, I was about 200 yards from it, in a waggon hovel. I saw it directly it left the sky, as I was looking in that direction at the time. When I first saw it, it looked like a ball of fire, about as large as a dinner-plate. It slowly descended, and I have no doubt I could have run twenty yards from the time I first saw it until it struck the ground; but when about fifteen to eighteen feet from the ground. it exploded with a loud crash, quite as loud as a cannon, distinctly before the thunder, which was very loud also. The explosion shook the whole buildings. I certanly thought the slates were falling in, but when it exploded one part struck the hedge, making a hole in the ground about a foot deep, and laying all the roots bare, but not damaging them. For some time the place looked all on fire, and there was a considerable quantity of smoke when it hit the ground, lasting for a second or two. It was seen by myself and four men. They also agree with me that this is as near as possible a correct explanation of it. We dug the hole out yesterday, but found nothing. The soil was blackened for several inches deep".

A severe earthquake was felt three weeks ago in the southern part of the North Island, New Zealand. No lives were lost, but in some of the townships in the Manawate district scarcely a chimney was left standing. In Foxton, for instance, no less than 250 were thrown down. Fissures extending for many miles are reported to have been made, and the railway line was rendered unsafe in that neighbourhood, owing to the undulations of the earth alternately raising and depressing the rails. Since the large shock a good many of a slight nature have occurred. Two shocks of earthquake, each lasting from four to five seconds, were felt at noon on September 2 at Spalato in Dalmatia. The earthquake, which was accompanied by a subterranean rumbling, passed from the south-west to the north-east. It also made itself felt in the neighbouring islands of Brazza and Mascarsa, and in the town of Sebenico. A shock of earthquake was distinctly felt by several individuals at Courtown House, Gorey, Ireland, on August 27, at a quarter to five o'clock. Many heard a rumbling noise as thunder, some noticed the rattling of doors and windows, and one experienced what he called a "shiver". Lord Courtown noticed a rumbling noise, coming apparently from the north, passing under the house, and so away to the south; the door of the room in which he was sitting rattled. A slight shock of earthquake was felt at Naples at eight o'clock on Saturday morning. At about the same hour severer shocks took place at Popoli, Pescara, and Orsogna, in the Abruzzi. The seismographic instruments on Mount Vesuvius show great activity. At Atessa the church of St. Giustina was seriouly damaged. There is a great panic everywhere amongst the population. A shock of earthquake occurred at Sanpietro Brazza (Dalmatia) on August 29, at 9 p.m. It lasted four seconds. Over forty shocks of earthquake have been felt at Khoi, Persia, between the 28th ult. and September 11. Some houses were destroyed, but no lives have been lost. Most of the inhabitants have left the town, and are encamped outside. The direction of the earthquakes was from north to south. The shocks were accompanied by rumbling noise.

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