paper (Blethen *et al.*, *ibid*, 1671). By mild treatment the apoenzyme, free of prosthetic groups, can be prepared and, when this is titrated back with pyridoxal phosphate, each mole (referred to the molecular weight of the holoenzyme) binds ten moles. At the *p*H corresponding to maximum activity (about *p*H 5), sedimentation equilibrium gives the molecular weight as 850,000 with a sedimentation coefficient of 23·3*S*. If the *p*H is raised, and divalent cations are absent, dissociation occurs, with loss—substantial or complete—of activity, to a species of 8·0*S*, with molecular weights, again determined by sedimentation equilibrium, of 165,000. This suggests that there are five sub-units. When a substrate analogue is now added to the dissociated species, new boundaries appear in the ultracentrifuge and components of sedimentation coefficient 12·1, 16·4 and 19·5*S* are found in addition to the 8*S* and 23*S* forms. From the usual relation between sedimentation coefficient and molecular weight for globular species, these correspond precisely to all the aggregation states from one to five. These striking results are excellently borne out by electron microscopy, using negative staining. At *p*H 5·4 the molecules present the unmistakable appearance of five sub-units in a closed shell with a five-fold symmetry axis.

The holoenzyme contains ten pyridoxal phosphate groups, and it does indeed appear that the monomer contains one such group, for the authors briefly state that in dissociating solvents a molecular weight of about 85,000 is found. Whether there is one monomer species or two is unknown. At all events, arginine decarboxylase presents a case which is so far unique, and can perhaps be regarded as freakish.

However, another situation, thought to involve odd sub-units, is described by Paetkeu *et al.* (*J. Mol. Biol.*, **33**, 721; 1968), who has studied the rather more familiar enzyme phosphofructokinase. Its activity is controlled by the inhibitor ATP. The active form of the enzyme has a molecular weight of some 380,000 and can be made to dissociate into smaller sub-units, and also to aggregate. Sedimentation equilibrium in 5·5 M guanidine hydrochloride produced an apparent molecular weight of 45,000–50,000. When the denaturant concentration is increased to 6 M, this value is apparently halved. The survival of sub-unit structure in 5·5 M guanidine hydrochloride is remarkable indeed. (It is difficult to form an impression of the precision of the data because the procedure is rather briefly described.) To these findings must be added the earlier measurements of ATP binding by Kemp and Krebs, who found that one mole of fructose 6-phosphate was bound per 90,000 g of protein, but that the same weight bound three moles of ATP (but only one of AMP or ADP). If this is to be regarded as the protomer (in the parlance of allosterism) it must therefore contain three regulatory and one catalytic site, and the suggestion is that there are in fact four chains per protomer, corresponding to the molecular weight in 6·5 M guanidine hydrochloride. (This would mean, however, a curious constitution for the species of 50,000 molecular weight.) Counting of peptides in a peptide map, and a new procedure based on labelling of tryptophan-containing peptides, confirm that more than one type of chain is present. Paetkeu *et al.* point out that the protomer must be either of the form A_3B, with A the regulatory and B the catalytic sub-unit, or A_2BC. Either will, in principle, explain the observed behaviour (assuming the numerology is good), but many questions still remain.

Solar Flares

from a Correspondent

On September 1, 1859, an amateur solar observer, Richard Carrington, was busy drawing a sunspot group which he was observing by means of an image of the Sun projected on a screen when, to his astonishment, two patches of intensely bright light suddenly appeared over the spot group. He immediately hastened to summon a witness to the phenomenon, but "on returning 60 seconds later was mortified to find it was already much changed and enfeebled". Carrington had seen the flash phase of an intense solar flare, and had started a train of investigation which has continued with ever increasing activity to the present day.

The sudden short-lived increase in optical emission from the chromosphere, which is usually visible only in monochromatic light, is now known to be only one, and perhaps a minor, aspect of the flare phenomenon. At the COSPAR Symposium on Solar Flares held in Tokyo from May 9–11, there was much discussion of the ultraviolet, X-ray, radio frequency and energetic particle emissions which are perhaps of greater significance than the optical emission in understanding the basic processes taking place. The energy release in a flare takes place with explosive suddenness, generating a blast wave which can be photographed as it races across the solar surface with a velocity of hundreds of kilometres a second. This same blast wave propagates out into space through the solar wind signalling its arrival at the Earth a day or so later by the sudden commencement of a magnetic storm and an associated auroral display.

Flares play a key part in the complicated sequence of terrestrial phenomena related to solar activity and an understanding of the basic flare process is clearly important if we are to have a complete picture of Sun–Earth relationships. In spite of a vast accumulation of observational data, however, the source of energy for the basic flare process has not yet been identified. Some 10^{32} ergs are required for a major flare and, in the absence of any plausible alternative, it has been customary in the past to assume that the source of this energy is the sunspot magnetic field. Consequently, many of the postulated flare mechanisms are essentially devices for the rapid conversion of this magnetic energy into the required forms—optical, X-ray, radio, energetic particles, blast wave and so on. Some scepticism about this by now almost traditional belief was expressed at the symposium and the present mood is one receptive to alternative possibilities. Two or three such possibilities were discussed, including the suggestion that the energy is stored in the form of energetic protons trapped in the sunspot field in much the same way that protons and electrons are contained in the Earth's magnetosphere.

The energetic particle flux from solar flares represents a radiation hazard both to astronauts and to travellers in future high flying supersonic airliners, and in consequence the subject of flare prediction is currently attracting considerable attention. One session of the symposium was devoted to this problem, but progress is necessarily relatively slow.