while the distal parts were well formed. The more intense the dose of radiation the greater the extent of the affected region. This is explained by arguing that the radiation kills a certain fraction of cells throughout the bud. Rudiments which are laid down shortly after irradiation are reduced in size for two reasons: first because a proportion of their cells has been killed, and second, because displacement from the progress zone is slowed down by the reduction in the proportion of dividing cells more distally. Because only the surviving cells proliferate, the progress zone eventually becomes repopulated by healthy cells and so the rudiments which leave the zone last, which are the most distal parts, develop to their normal size.

Does this work provide support for the progress zone model? It does indicate that the rudiments of the limb are laid down in proximodistal sequence, and that at a given stage the proximal part of the bud is a mosaic while the distal part is still labile, so to this extent it is compatible with the model. But it does not seem to me to have any bearing on the mechanism of generation of positional values in the rudiments. In particular it does not connect positional values with the cell cycle, for the sequence of divisions undergone by the surviving cells is presumed to be normal. So I think that it would be wrong to conclude that any evidence has been produced in favour of the strong form of the progress zone model.

Let us now turn our attention through 90° and consider the anteroposterior axis of the bud. The mechanism of pattern formation in this axis seems to be somewhat different from that in the long axis. There is a zone of tissue at the posterior edge of both the wing and the leg bud which is called the zone of polarising activity (ZPA). It is so called because when it is grafted to the anterior edge, it influences the surrounding tissues and causes them to form a second set of limb structures which are arranged in a relation of mirror symmetry to the original set (Saunders *Ann. N.Y. Acad. Sci.* **193,** 29; 1972). It has been suggested that the ZPA is the source of a morphogen that can diffuse into the other parts of the bud and is there destroyed. In the steady state situation the morphogen would be present as a gradient of concentration running from posterior to anterior and its function would be to evoke different pathways of cell differentiation at different levels (Tickle, Summerbell and Wolpert *Nature* **254,** 199; 1975). Some progress has been reported towards the chemical isolation of the putative morphogen by McCabe and Parker (*Dev. Biol.* **45,** 349; 1975; *ibid* **54,** 297; 1976). Because this is probably the best analysed example of a morphogenetic gradient in the whole of embryology it was with some dismay that workers in the field listened to the talk given by Saunders at a meeting of the British Society of Developmental Biology in September 1976. For Saunders, who had discovered the ZPA in the first place, claimed at the meeting that it had no function at all in normal development. One argument in favour of this position was that buds whose ZPA had been removed at an early stage could go on to produce limb structures which, although often incomplete, were arranged in the normal manner (Fallon and Crosby *J. exp. Zool.* **193,** 449; 1975). The other was that tissue other than the ZPA, for example flank mesoderm or mesonephros, could show the same activity, indicating that the property is not very specific.

To counter these objections to the morphogen model, Summerbell has now reported an experiment designed to demonstrate the activity of the ZPA *in situ* without the need to graft it to an unnatural position (*J. Embryol. exp. Morph.* **50,** 217; 1979). This is done by inserting a small piece of tantalum foil into the bud at right angles to the anteroposterior axis so as to interrupt the transmission of any signal. In the limbs which develop after this operation structures are usually present only on one side of the barrier and when the barrier is placed near the centre of the bud the sequence of structures is truncated in the anteroposterior direction. The explanation for this is that the concentration of morphogen rises on the side of the barrier nearer the ZPA and falls on the side away from it. So a structure which is formed in response to a particular morphogen level will be deleted if its threshold lies in the concentration gap or will be shifted towards the barrier if it is still represented in the interrupted gradient. Summerbell produces computer simulations to demonstrate the reasonableness of this argument, and also describes a control experiment which shows that the gaps in the pattern are not simply the result of damage caused by insertion of the barrier. In many ways the logic and the results of this experiment are similar to those of constriction experiments on insect eggs (reviewed by Sander *Adv. Insect Physiol.* **12,** 125; 1976) which are also believed to indicate the existence of a morphogen gradient with a high point at the posterior end.

It would certainly be unfortunate if the ZPA did not have a role to play in normal development because it has now been detected in the limb buds of mammals, reptiles and amphibia as well as birds and has found its way into a number of textbooks. But plausible though it is, it is difficult to see how the morphogen gradient model can be proved conclusively by macroscopic experiments alone, and whether the chick embryo limb bud will be capable of supporting the investigations down to the microscopic level of cellular physiology and biochemistry still remains to be seen. □

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A hundred years ago

On the night of Sunday, May 25, loud bellowings were heard by the dwellers on the northern slopes of Etna. Towards the morning of the 26th these increased, and about midday a dense cloud of smoke was seen to issue from the side of the mountain below the great crater, apparently half way between Randazzo and Linguaglossa. This cloud increased, and on the 27th the mountain was rendered invisible, and an effect like that of an eclipse resulted. A rain of fine black ash, "like powdered emery," fell for miles around, and was so thick that Capo di Schiso could not be seen from Taormina, distance of two miles. This black rain continued all day accompanied by thundering noises from the mountain. No exact information could be procured concerning the position of the centre of disturbance, because no one could approach the new craters. During the night of the 27th the ashes continued to fall, and "huge fires could be seen looming through the black clouds"—no doubt the reflection of the molten lava on the smoke above it. It was reported in Piedemonte, a village on the north-east flanks of Etna, that three craters about a mile apart had opened at the points of a triangle, about six miles above Passo Pisciaro, a posting station nearly midway between Randazzo and Linguaglossa. Lava was said to be flowing in a valley to the north of the Val del Bove. On the 28th a great stream of lava was seen from Taormina to be descending the mountain in the direction of Randazzo, "while from the new craters great balls of fire were thrown high in the air, and burst into showers of fire like gigantic rockets, accompanied by thundering explosions." On May 29 the lava was still flowing, but the shower of ash was diminished. The facts, as above stated, were witnessed by an Englishman living in Taormina, 800 feet above the sea, at the north-eastern termination of the flanks of Etna, about fifteen geographical miles from the new craters.

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