VOLCANOLOGY

Exploding volcanic myths

Jonathan Fink

FOR students of explosive volcanism, the 1990s have been a time of unparalleled accomplishment tempered by tragic loss. New modelling experiments from two groups of workers may now help us to come up with better ideas of when volcanoes are due to erupt violently, lessening their deadly impact. Mader *et al.*[1] published their results late last year; those of Sugioka and Bursik[2] appear on page 689 of this issue.

Geologists have had two notable successes in their recent attempts to mitigate the hazards of erupting volcanoes. The most dramatic was in 1991 at Mount Pinatubo in the Philippines, where timely warnings saved thousands of lives and billions of dollars' worth of military equipment. Last September's reawakening of Rabaul Caldera in Papua New Guinea prompted an evacuation that greatly reduced casualties. In both cases, scientists were able to notice familiar patterns of deformation and seismicity and then explain the significance of this activity to responsible civil officials. This recognition came from studying what had occurred at eruptions elsewhere, and also from predictions of what might happen locally based on theoretical models.

Over this same period, smaller explosive eruptions have been more difficult to anticipate, and both scientists and civilians have paid the price. Comparatively mild outbursts from Galeras in Colombia, Unzen in Japan and Guagua Pichincha in Ecuador have taken the lives of eleven volcanologists. Re-examination of seismic and gas data from the days before the Galeras eruption revealed correlations that are now being used to look for future explosions of this type[3]. The Unzen lava dome, whose collapse gave rise to deadly pyroclastic surges, had been carefully monitored for months. At Pichincha the two scientists killed had received a warning based on seismicity an hour before. Thus the deaths arose not so much from lack of information as from the inability to interpret it correctly. An important lesson that has been learned from these fatalities is that better theoretical models are needed to tell us which data to collect and what such numbers mean.

Most geologists agree that the triggering of explosive eruptions involves certain

OBITUARY

Adolf Butenandt (1903–1995)

ADOLF Butenandt, the outstanding biochemist in Germany in the first half of this century, died in Munich on January 18. Given the methods of the time, his achievements in isolating hormones were truly towering.

Butenandt studied chemistry and biology in Marburg and Göttingen, and did his PhD thesis under the supervision of Adolf Windaus. As a young PhD, he was appointed at the Institute of Organic Chemistry in Göttingen, under Windaus, to start work on the female sex hormone, now known as oestrone. He isolated this hormone in the summer of 1929, simultaneously with but independent of Edward Doisy, and by 1932 had already worked out its chemical structure. He then turned to the male sex hormone androsterone, which he isolated from men's urine. Time-consuming purification procedures, guided by a bioassay, were necessary to obtain crystals of the hormone. The structure followed shortly afterwards: androsterone also turned out to be a steroid.

The next task was progesterone; this time the starting material was pig's ovaries. Again, difficult purification procedures monitored by a biossay were necessary. In the final step, a chemical reaction (formation of a semicarbazone) helped to achieve crystallization. The results were published in 1934. So, within a mere five years Butenandt had isolated three important hormones. For this work he received the Nobel Prize for Chemistry in 1939, but the Nazi government prevented him from accepting the honour.

Butenandt then left the field of steroid hormones and began to work on the genesis of insect eye pigments. Mutants of *Drosophila* and the flour moth *Ephestia* were known that had light eyes because one component of the eye pigments was missing. Transplantation experiments had shown that a soluble substance was responsible for pigment

Butenandt (standing) at work with Ulrich Westphal on the isolation of progesterone in 1934.

formation. Butenandt followed up a hint that this substance might be a metabolite of tryptophan. He went on to discover that it was kynurenine, which led him to postulate that "genes act by providing an enzyme system that converts tryptophan to kynurenine". This was nothing other than the one-gene – one-enzyme hypothesis, published in 1940.

By this time, Butenandt had already risen to the position of director of the Kaiser Wilhelm Institute in Berlin-Dahlem. In 1944, the institute was transferred to Tübingen because of the war.

For his next project, Butenandt chose another problem in insect biochemistry: isolation of the hormone responsible for moulting. I was a participant in this research. The bioassay concerned was based on work by G. Fraenkel, and involved use of ligated larvae of the blowfly *Calliphora*. The starting material consisted of pupae of the silkworm, and in the summer of 1953 we bought up all silk cocoons available. We used cocoons of both sexes, the males for the moulting hormone, the females for the sex attractant. From 500 kg of pupae, we ended up with 25 mg of the crystalline hormone which we called ecdysone. The structure, when elucidated, came as a surprise. Ecdysone was another steroid hormone.

The silkworm's sex attractant is produced in small glands sitting at the tip of the female's abodmen, and is released to lure the male moths for copulation. Isolating it was again a fight for enough starting material. The great campaign of 1953 yielded 200,000 sex glands, but even that was not enough. Butenandt and his co-worker Hecker had to order 500,000 glands from Japan, and from this material the attractant was extracted and its structure determined. This was the first insect pheromone to be isolated.

In 1959, Adolf Butenandt was elected President of the Max-Planck-Gesellschaft der Wissenschaften (this was the new name for the former Kaiser-Wilhelm-Gesellschaft). He served in this position until his retirement in 1972.

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