100 YEARS AGO

The cleanliness of electric lighting has always been urged as one of the great claims in its favour, and it has been justly pointed out that the saving effected in redecoration partly balances its extra cost. Although this is true, electric light cannot be regarded as perfectly clean; it has long been noticed that there is a marked tendency for dust to accumulate on electric light fittings and wires, and on the walls and ceilings in their immediate neighbourhood. This is partly, no doubt, due to the air currents produced by the local heating, but it is also partly an electrical phenomenon. The dust particles floating in the air are presumably at air potential, and are consequently attracted to the conductors on the non-earthed side of an earthed system; they either stick to these permanently, or remain on them until charged, when they are projected on to and stick to the walls… If switches are always put, as they should be, in the non-earthed wire, the deposition of dust will only occur during the time the lamps are alight, and will be minimised. Mr. D. S. Munro, writing in the *Electrical Review*, points out that a still further improvement can be effected by using concentric flexible conductors instead of the ordinary twisted cord, the outer conductor being connected to the earthed side of the system.

From *Nature* 25 June 1903.

50 YEARS AGO

During the course of an ecological investigation of the polychaete annelid *Pygospio elegans* Clap., a remarkable mode of asexual reproduction was noticed… The bodies of the adults, both males and females, divide into pieces consisting of varying numbers of segments, generally about three or four, sometimes up to seven; several times fragments consisting of one segment only have been observed. Fission takes place in any part of the body. When just separated, the single fragment looks as if it had been cut off with a knife… Every single fragment is able to form a new individual exclusively from its own tissue. The rate of regeneration is very high, and at 20 °C. the regeneration of a new animal was completed in eight days; then the asexually formed individual will start a new division process.

From *Nature* 27 June 1953.

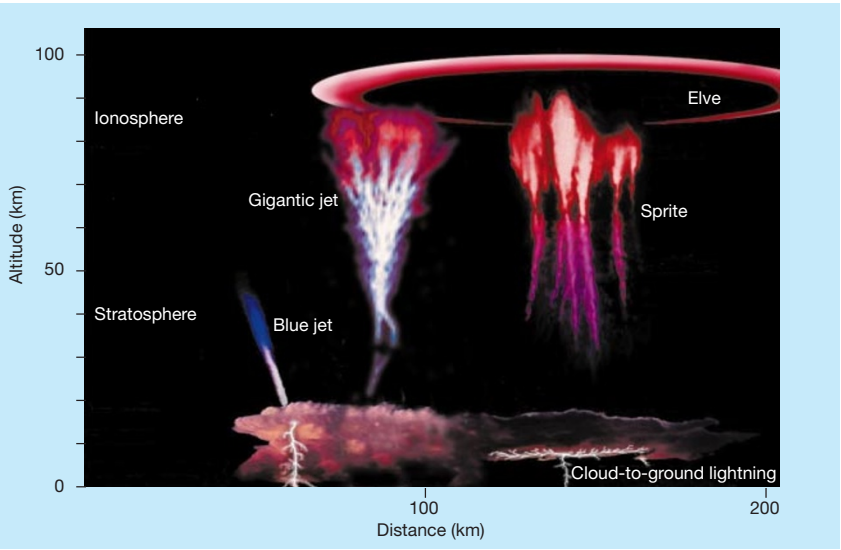

Figure 1 **Lightning-related transient luminous events (TLEs). Several types of TLEs are known, and some examples are shown here: relatively slow-moving fountains of blue light, known as 'blue jets', that emanate from the top of thunderclouds up to an altitude of about 40 km; 'sprites' that develop at the base of the ionosphere and move rapidly downwards at speeds of up to 10,000 km s^{-1}; and 'elves', which are lightning-induced flashes that can spread over 300 km laterally. Su and colleagues[2] now report their observations of several gigantic jets, which propagated upwards from thunderclouds to altitudes of about 90 km. The strong emission of electromagnetic radiation from these events, detected as radio atmospherics thousands of kilometres away, indicates that several tens of coulombs of negative charge were transferred from the thundercloud to the lower ionosphere. (Graphic adapted from ref. 15, with the permission of the American Geophysical Union.)**

a few tens of kilometres of the Earth's surface. For instance, 'blue jets' — TLEs that terminate at altitudes of around 40 km (Fig. 1) — probably move some charge to the upper plate of the capacitor. But no associated radio atmospherics have been detected for these events, probably because they take much longer to develop than the more impulsive jets reported by Su and colleagues.

Atmospherics of the strength recorded by Su *et al*. have previously been observed only in conjunction with the most powerful cloud-to-ground lightning discharges and the TLEs triggered by them, known as 'sprites'[10]. The authors admit that there may be a slight chance that the atmospherics they detected were associated with cloud-to-ground lightning discharges in the underlying thunderstorm — but then these discharges must have been repeatedly missed by the local lightning detection network, which is unlikely. However, it is clear that the events observed by Su *et al.* are very different from sprites, which typically start at altitudes of about 70 km and propagate downwards: the gigantic jets seen by Su and colleagues branch upwards from thunderclouds, spreading to a diameter of about 40 km at an altitude of 85–90 km (Fig. 1).

The ionization created by a gigantic jet is likely to have a significant chemical effect on that volume of atmosphere. In fact, the occurrence and dynamics of many TLEs, including those observed by Su *et al*., closely resemble the behaviour of 'streamers' — miniature needle-shaped filaments of ionization, commonly observed when an electric field is applied to a small volume of relatively un-ionized ambient air at ground pressure. Streamer discharges can lead to significant power losses on high-voltage transmission lines and can damage insulating materials; a streamer plasma of hot electrons embedded in cooler air is a good source of highly reactive species for use in the chemical treatment of hazardous and toxic pollutants[11]. Because streamer filaments have high electric fields around their tips, streamer plasmas can easily generate electrons with sufficient energies to dissociate atmospheric oxygen molecules. The dissociation initiates a chain of reactions that leads to the formation of ozone in air (this process has been used for industrial ozone production for more than a century[11]).

As atmospheric pressure is much lower at ionospheric altitudes than at the Earth's surface, streamers that would have diameters of a fraction of a millimetre at ground level instead appear as channels of glowing plasma that are many kilometres long and a hundred metres in diameter — easily observable above thunderclouds by low-light imaging systems deployed hundreds of kilometres away[12]. High-altitude streamers also have the ability to produce highly active chemical species and can effectively 'treat' thousands of cubic kilometres of atmosphere. The branching observed in atmospheric TLE discharges, including those documented by Su and