100 YEARS AGO

The most important archæological event reported from Egypt during the last excavation season (1903–4) is the discovery by Prof. Naville, of the University of Geneva, and Mr. H. R. Hall, of the British Museum, of the most ancient temple at Thebes… It is the funerary temple or mortuary chapel of the most distinguished monarch of the eleventh dynasty, Nebkherurā Mentuhetep, who reigned about 2,500 B.C.… So far as platform, ramp, and colonnades are concerned, this is precisely the arrangement of the great temple of Queen Hatshepset, or Hatasu, to the north… The curious plan of the great temple has puzzled archæologists and architects from Wilkinson's time to the present day. Whence this curious arrangement of platforms, inclined planes, and colonnades, so totally unlike anything else in Egypt? Various theories have been propounded, but it is only now that the solution has been found, owing to the discovery of the temple of Nebkherurā. Colonnades, platforms and ramps are then a feature of the older temple-architecture of Egypt; they were, at the time of the eighteenth dynasty, when the great temple of Hatshepset was built, old-fashioned, archaic, but it is evident that the great temple is, as far as its main arrangements are concerned, a mere enlarged copy of the thousand-year older temple at its side.

From *Nature* 16 June 1904.

50 YEARS AGO

The existence of a large number of discrete sources of extraterrestrial radio radiation (radio stars) has now been established. For the majority of the sources there is no information about their distance… The present communication describes a new method for the measurement of the distance of radio stars in the Galaxy, and gives preliminary results for the two intense sources in Cygnus and Cassiopeia. The method depends upon the absorption of the radiation from the radio stars by interstellar hydrogen at a frequency of about 1,420 Mc./s., corresponding to the spectral line of the ground-state of the neutral hydrogen atom. If the radiation from the source traverses neutral hydrogen in the Galaxy, it will suffer absorption at the line frequency, whereas its emission at neighbouring frequencies will be unaffected… Thus from observations of the spectral distribution and the magnitude of the absorption, the distance of the radio star can be estimated. D. R. W. William & R. D. Davies

From *Nature* 19 June 1954.

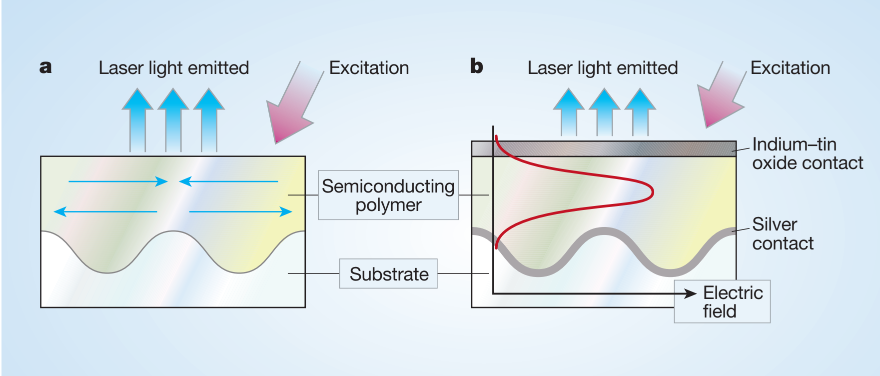

Figure 1 **Low-cost lasers from plastic.** a, **A laser consists of a light-amplifying material and a resonator. Polymer (plastic) semiconductors can be used to amplify light, with a corrugated structure acting as a resonator. The corrugation diffracts light travelling to the left back towards the right, and vice versa. Hence, light is sent backwards and forwards through the amplifying medium. Typically, the excitation is provided by another laser. It would be more convenient, however, to make polymer lasers that operate using electrical excitation — say, from a battery.** b, **Reufer *et al.*[1] have shown how to apply electrical contacts to a semiconducting polymer laser without spoiling its optical properties. With a thick semiconducting polymer layer in the laser, the electric field of light in the polymer is weak at the contacts. So absorption (hence, loss) of light at the contacts is low and the laser works effectively (although still, for now, with laser excitation).**

be suitable for a wide range of applications, from plastic optical circuits to biological screening and assays.

Lasers consist of two key components: the gain medium and a resonator. The gain medium is a material in which light is amplified. In most lasers, this would be a crystalline inorganic material, such as ruby or gallium arsenide (the latter is commonly used in CD players and laser pointers). Light passes backwards and forwards through the gain medium, thanks to the feedback generated by the resonator. In plastic lasers, a semiconducting polymer is used as the gain medium[3–5]. Light can be passed backwards and forwards through the polymer with mirrors[3,4], but in most polymer-laser work, including that of Reufer *et al.*[1], a corrugated gain medium is used instead (Fig. 1a). The corrugation acts as a diffraction grating that diffracts light travelling in one direction back in the opposite direction, thereby creating feedback and enabling lasing to occur. As there are no mirrors in these lasers, they are compact, robust and exceptionally easy to align.

A laser needs energy in order to operate. This can be supplied in two ways: either optically (from flash-lamps or another laser) or electrically. There is a minimum energy, the threshold, required for operation. Above threshold, the gain (or amplification) exceeds all the losses in the device, and lasing begins. At present, all polymer lasers are optically excited, or 'pumped'. However, as mentioned above, light emission from semiconducting polymers can be induced electrically, and an electrically pumped laser would be much more convenient.

There are three main reasons why it has so far been possible to make only optically pumped polymer lasers. The first is that, in order to reach the threshold typical of existing lasers, a higher current density would be required in a polymer laser than most semiconducting polymers can readily withstand. The second is that an electrically pumped polymer laser would require electrical contacts. These would normally be metal and would introduce substantial additional losses, raising the threshold even further. Finally, the electrical charges injected would also absorb light, leading to increased losses and higher threshold.

The first problem can be solved by using pulsed excitation. Reufer *et al.*[1] have addressed the second problem — the losses associated with electrical contacts. A few groups have suggested possible solutions[5–8], and lasing has been achieved in the presence of a metal contact but with a considerably increased threshold[9]. Now Reufer *et al.* have demonstrated a way in which a metal contact can be applied without a threshold increase (Fig. 1b). The losses depend on the electric field distribution through the polymer layer. If the polymer layer is made thicker, this reduces the strength of the electric field at the metal contact, thereby reducing the associated losses. The metal contact used was silver, but the approach should be more generally applicable. To allow the light out of the laser, Reufer *et al.* used a very thin (20 nm) layer of indium–tin oxide, a transparent conductor, as the other electrical contact. This additional layer only slightly increased the threshold.

It should be noted that the polymer laser was optically pumped (that is, energy was supplied by another laser). But this latest work does show a way of dealing with the losses associated with electrical contacts, and hence is a significant step towards an electrically pumped polymer laser. There