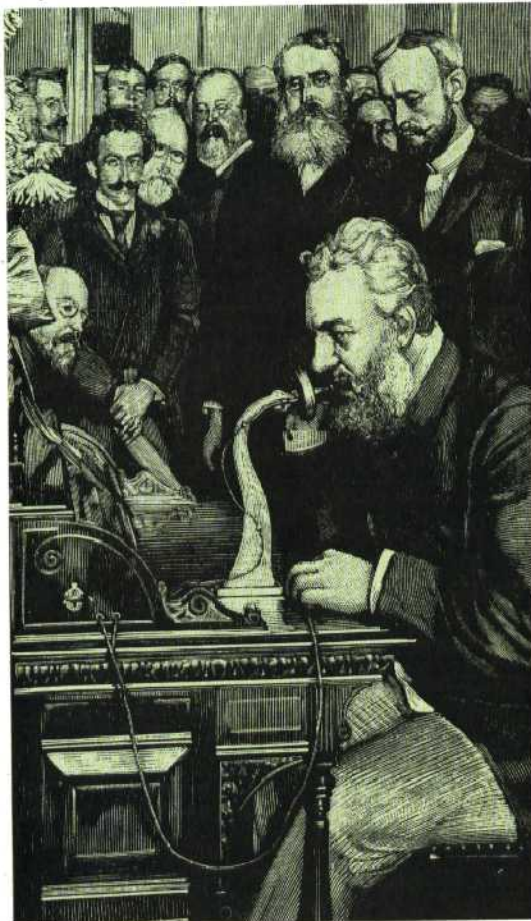# Ma Bell

Bell Laboratories has been responsible for numerous developments in the history of the computer — both in hardware and software

A hundred years ago, Queen Victoria was greatly amused by a new invention that allowed her to speak with her ministers in London from the Isle of Wight. The telephone has been greatly improved since those days of the hand-cranked set through research and development, and one of the spin-offs from this work has been the computer. In the early stages of the telephone's development, the American Telephone and Telegraph Company decided to set up an organisation that would research ways of improving the telephone system. Thus, in 1925, Bell Laboratories (known as 'Ma Bell') was born at Murray Hill, New Jersey.

Bell Labs is an unusual institution since it is solely devoted to doing research, and yet is owned by a corporation whose only purpose is to make profit. The scientists are deliberately kept away from the day to day engineering problems encountered in running such a business because Bell consider research to be a long term speculative investment. Gifted scientists are allowed to pursue those aspects of research that they think are important because, the corporation believes, a few of their ideas will be worth the investment. Over the years, Bell Labs has collected two Nobel prizes and made discoveries in quite diverse areas of scientific research. Here, we consider some aspects of their research that were particularly relevant to the development of the computer.

By the 1930's, telephone systems were becoming increasingly automatic and sophisticated. Messages were sent in analogue form over the telephone cables and the calls were connected using information contained in a digital dialling code. The number dialled was first converted at the exchange from an analogue signal into a sequence of digital pulses. This was temporarily stored in a memory made out of relay switches until the connection was completed by a bank of crossbar switches. These counted the pulses in the dialling code and converted them into co-ordinates on an electromechanical switchboard. All the ingredients of a computer were included — they were just waiting for the right person to come along.

George Stibitz was a mathematician employed by Bell who noticed the similarity between 'counting' pulses and adding them together. Working at home on his kitchen table with some old crossbar switches and electromechanical relays, he made the first relay computer circuits.

Stibitz then began working with an experienced switching engineer, Samuel B Williams, who had been building switching circuits for 25 years, and the two men created a Complex Number Calculator (complex numbers involve the so-called 'imaginary' numbers — the square roots of negative numbers — and are needed to obtain complete solutions to polynomial equations). Work was begun in 1937, and the device consumed 450 relays and 10 crossbar switches. It operated in binary notation and was able to divide two eight-digit numbers in 30 seconds. The Complex Number Calculator became operational on 8 January 1940, and in September of the same year it was demonstrated to the American Mathematical Society at Dartmouth College (where BASIC was later formulated). The calculator had the facility of remote and multiple access through typewriter keyboards connected by telephone wires to the calculating mechanism in New York. People were particularly impressed by its 'human' form of operation: after the calculator was asked a question it would seem to pause for some seconds before giving the answer!

Many minor hardware devices also originated at Bell, such as the floating air-cushions used in magnetic tape heads, and negative feedback amplifiers. But the most famous invention was the transistor, created in 1947 by Bardeen, Brattain and Shockley (see page 47). It was the transistor that made possible the second generation of computers.

The Bells Are Ringing

Bell Laboratories takes its name from Alexander Graham Bell (1847–1922), who is generally credited with the invention of the telephone in 1876. It is generally believed that the first words ever transmitted over wires by electrical means were from Bell to his assistant, situated in the next room; they were 'Come here, Mr Watson, I want you!'