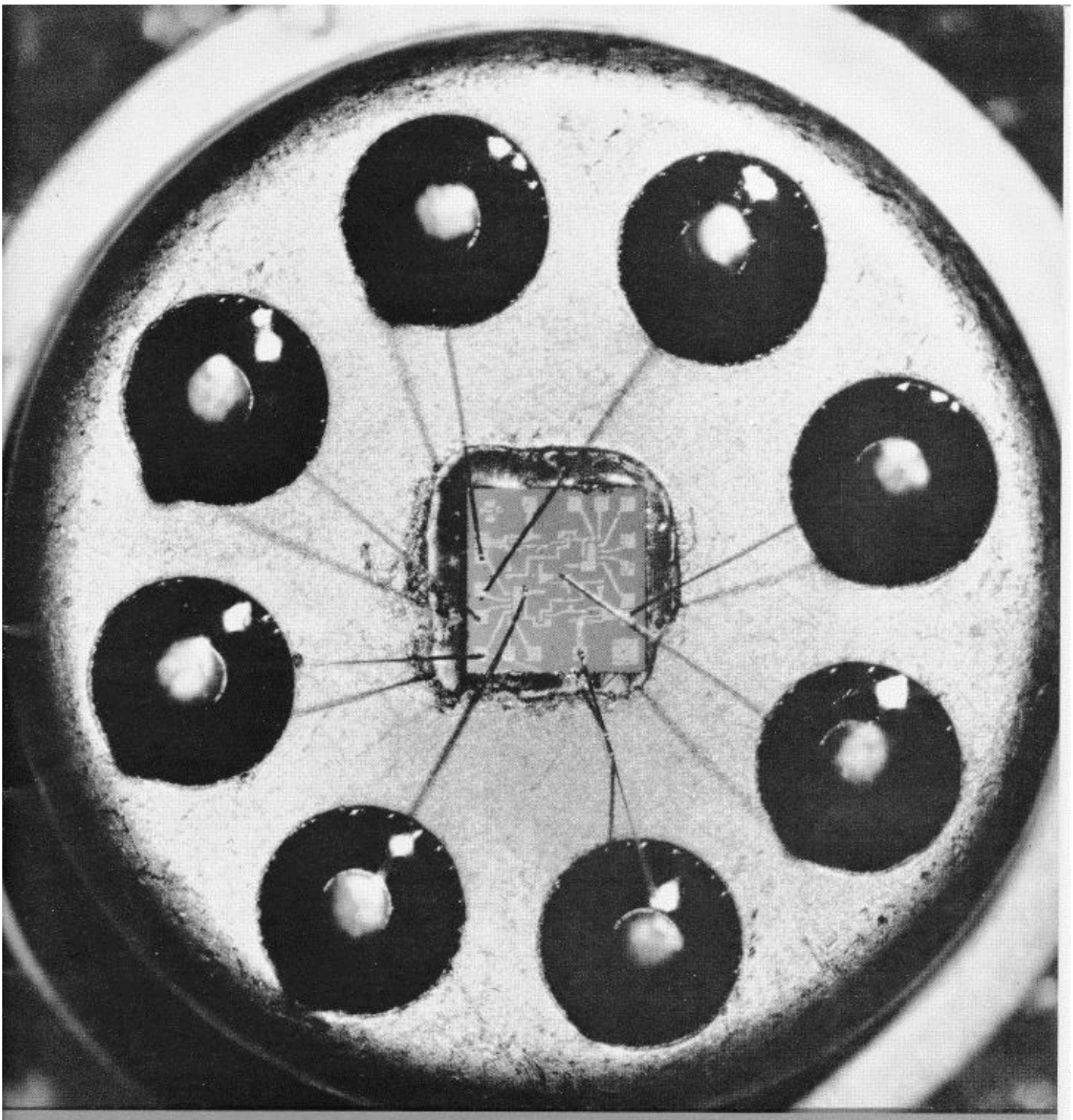
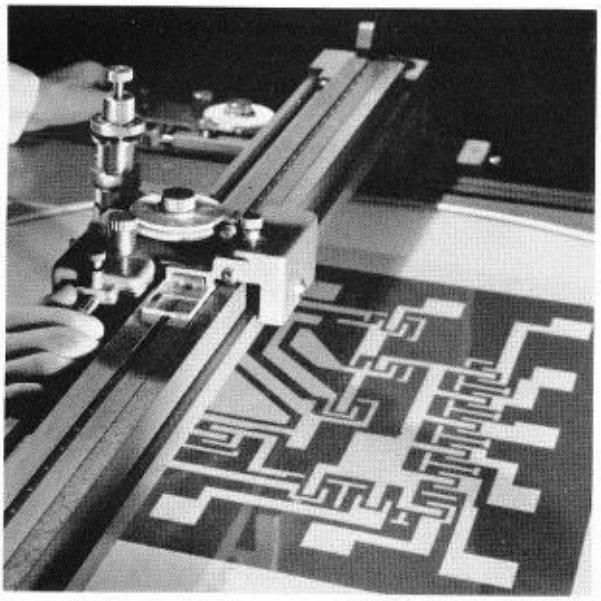


A Micronor circuit, one of a family of logic elements made at Witham. Circuits of this type are used in System 4 computers

MICROELECTRONIC CIRCUITS FOR OUR NEW PRODUCTS

Microelectronics Division has made rapid strides since its formation two years ago. The Division is now producing circuits in quantity for Marconi Myriad computers, and other components are being supplied for many new products to keep Marconi in the forefront of electronics.

The five pilot factories at Witham are now fully commissioned, and a completely new plant is



Preparing the master pattern of the circuit on an Aristo co-ordinatograph

being built there which will provide 90,000 sq. ft. of floor space. This will become the Division's headquarters with development, production, and commercial services under the same roof. It will enable us to produce microelectronic components with more speed and in greater quantity, and will help us to meet intense competition from overseas manufacturers.

New circuits are always in demand, and originate in the Company, in 'English Electric', E.E.L.M., or from other electronic equipment manufacturers. Circuits for our own particular purposes are generated in the Division's application and development groups.

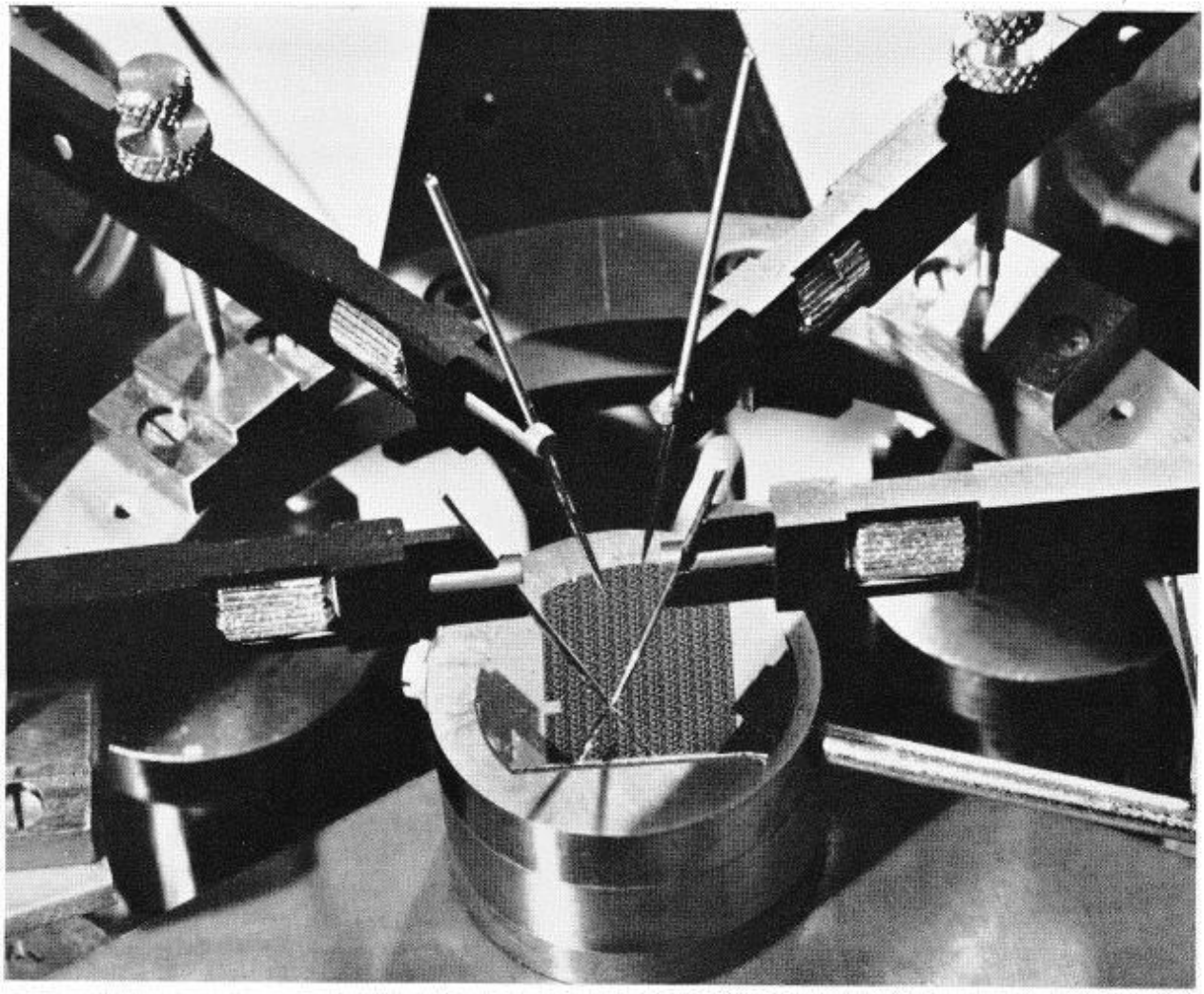
The most efficient form can only be developed by detailed discussion between the engineer, micro-circuit designer and semi-conductor specialist, and this form is inevitably a compromise so that the circuit function can be built in silicon and associated materials. A vital link exists between designer and producer.

The circuit is drawn in detail at 200× scale as shown in the accompanying picture, and the design is discussed by the development engineers to ensure that no errors are built in.

The next job is to prepare master layouts of each step of the semi-conductor process. For this purpose an Aristo co-ordinatograph is used which has a cutting accuracy of plus or minus 0.001 inches. This gives a design which can be reduced by a series of photographic processes to a pattern 1/20×1/20 inches with a possible accuracy of five micro-inches. This micro-circuit pattern is then repeated in a wallpaper layout so that there are hundreds of similar ones on a photographic plate. (See picture of probing.)

The patterns are now printed on a slice of silicon, and to make a micro-electronic circuit the silicon must undergo a series of closely controlled processes

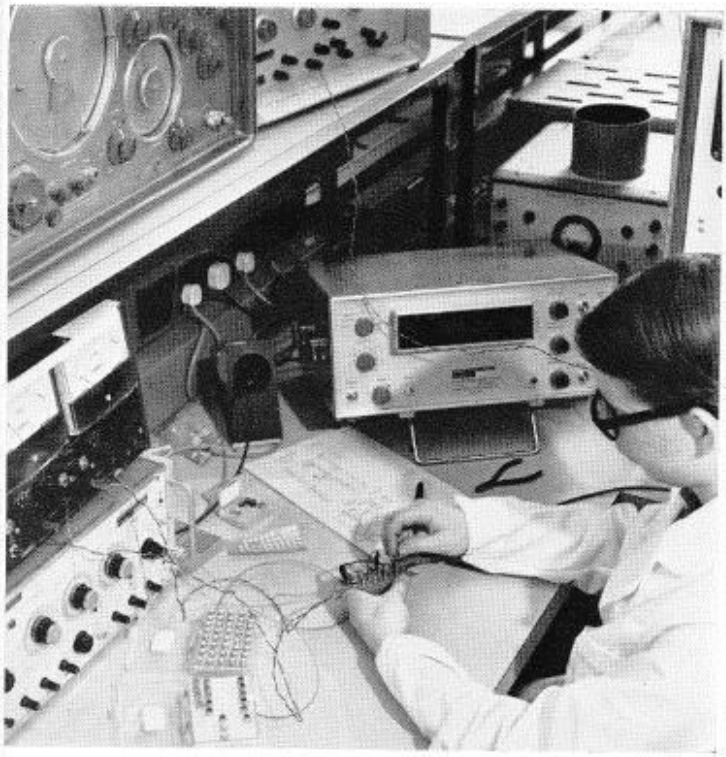
The new factory being built at Witham which will become the headquarters of Microelectronics Division. This factory will come into operation in 1967, *will provide* 90,000 *square feet of floor space, and will be the largest and most up-to-date microelectronics plant in Europe. When equipped it will represent a* £3,000,000 *investment by the Company*



ABOVE: *A silicon slice, one inch in diameter, carrying several hundred separate microelectronic circuits. Each circuit is tested by an operator who, using a low power microscope, places probes in the centre of circuit contacts only two or three thousandths of an inch square. This multi-probe was designed and made at Baddow Research Laboratories.* BELOW: *Loading silicon slices into a diffusion furnace*

and treatments involving high temperatures, such as 1,200° C, in epitaxial furnaces and diffusion furnaces. At given stages the photographic pattern is printed and etched on the semi-conductor, with micro-inch accuracy, so that the electrical functions are incorporated in the silicon slice. When the batch of slices emerges from the series of operations, simple electrical tests can be made to assess a primary yield. Then each slice can be divided into hundreds of 'chips' or 'dice', each 1/20 × 1/20 inches.

Although many processes are complete, the component is far from finished. The next important step is to alloy the dice to a suitable mount or header and then to connect wires. On the micro-electronic scale the wiring is now 0.001 inches diameter, with gold or aluminium wires connecting the circuits of the dice to the leads of the package.



ABOVE: *A new microcircuit being investigated in Microelectronics Division*

Various techniques for making these metal welds on a microscopic scale are used.

The package is sealed to make the component reliable. The cans are tested for leaks, using high pressure helium. A centifruge is used to apply 20,000 g to the connecting wires. The circuit can now be given complete electrical testing before being despatched.

There are many steps to success, hence the importance of correct design. But the final product has high reliability, in addition to other advantages, as already demonstrated by the efficiency of the Marconi Myriad computer.

The manufacture of large numbers of these micro-electronic circuits imposes special problems which have been vigorously tackled by Microelectronics Division, and production in the Witham factories is carried out by specially trained staff in clean areas. The semi-conductor process area of the new plant will be even better equipped and will begin to boost output in 1967.

BELOW: *A section of Assembly at Witham where contacts are welded. The girls are using bonding machines developed and produced by the Company. Microelectronics manufacture is now being carried out in five units at Witham. The original production unit was set up at Baddow Laboratories*