



storage requirements. But it is essential to work in the smallest possible detail to achieve a high quality of reproduction.

A domestic television set — with around  $625 \times 1,000$  pixels — is marginally more 'coarse-grained' than the high power monitor we spoke of earlier. So we can be confident that any work in this detail or better will look as realistic as an ordinary television picture. Even with available techniques we can create an accurate impression of reality by means of animated pictures.

In order to create the image in this sort of detail both sophisticated software and purpose-built or specially adapted hardware are needed. The most popular method uses a device known as a 'bit-pad digitiser', which is rather like a large drawing board



IAN DOBBIE AT RESEARCH RECORDINGS



that contains a wire matrix. This mesh is used to sense the position of a stylus passed across it. The computer then displays the resulting line or point on the monitor screen. It is possible to trace from existing artwork, draw freehand, or use conventional drawing instruments, just as if one were working on paper. The image is digitised (its X-Y coordinates are worked out), written in memory and displayed by the computer. The character of the mark that appears on the screen can be defined by the user, just as one might choose to use a pencil, a pen or a brush. Likewise, the colour can be defined by calling up the palette — an array of colours at the bottom of the screen looking much like an oil-painter's palette. If the colour one wishes to use is not standard, it can be mixed, exactly as one would when using paint. The stylus can also be used as an eraser, and 'drawings' can be laid over one another.

So, having created a single image, how does one

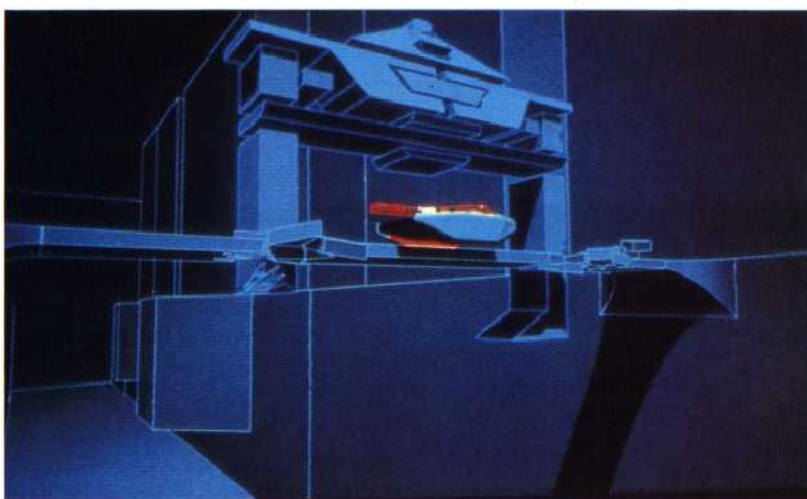
go about making it move? One method is simply to mechanise the conventional process, by using the computer system to file material, to colour frames and perhaps to show roughly made-up sequences. Even this approach will speed up the task, but clever programming techniques make it possible to do much more. Just as curves can be automatically smoothed, so can whole blocks of action be fabricated by specifying the first and last frames of a sequence. This process, known as 'tweening', is performed in a conventional animation studio by an assistant known as an 'in-betweener'. Indeed, most of the work of animation is performed by assistants, and it is these that the computer system replaces. We noted earlier that the introduction of computers into the animation process releases the artist to concentrate on the quality of the image. Most of the hand animator's effort goes into creating the illusion of movement, but this task is precisely definable on a computer. Once the rules are stated, simply obeying them will produce the desired result — once again, a sure sign that the job is appropriate for computerisation.

#### Seeing Is Believing

Using the ultra-fast processing power and huge storage capacity of modern computers it is possible to create on film or on the TV screen an image that is actually indistinguishable from a photograph. Then, using programming techniques developed for statistical and numerical problem-solving, it is possible to manipulate these created images in such a way as to make the viewer believe them to be real

#### TRace ON

First of a new generation of feature films that use these techniques of computer-assisted image generation was Walt Disney Productions' 'Tron'. Set partly in reality and partly inside a giant computer, 'Tron' uses a mixture of computer-animated imagery and special effects photography to create a stunning realisation of a fantasy world



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