ANTICS - FROM STONE-AGE TO STEAM AGE

The development of computers for animation continues apace, but has still not produced a truly-versatile creative tool that will satisfy the highest standards of the film and TV industry. With the recent arrival of a new generation of hardware, such a tool is now possible. Too often, however, computers are programmed by people with no real experience or understanding of the animation industry. Grove Park Studio is perhaps the only small independent animation studio to have spent many years designing an "ideal" animation machine . . . in this paper the author describes the principles involved, and the progress achieved to date.

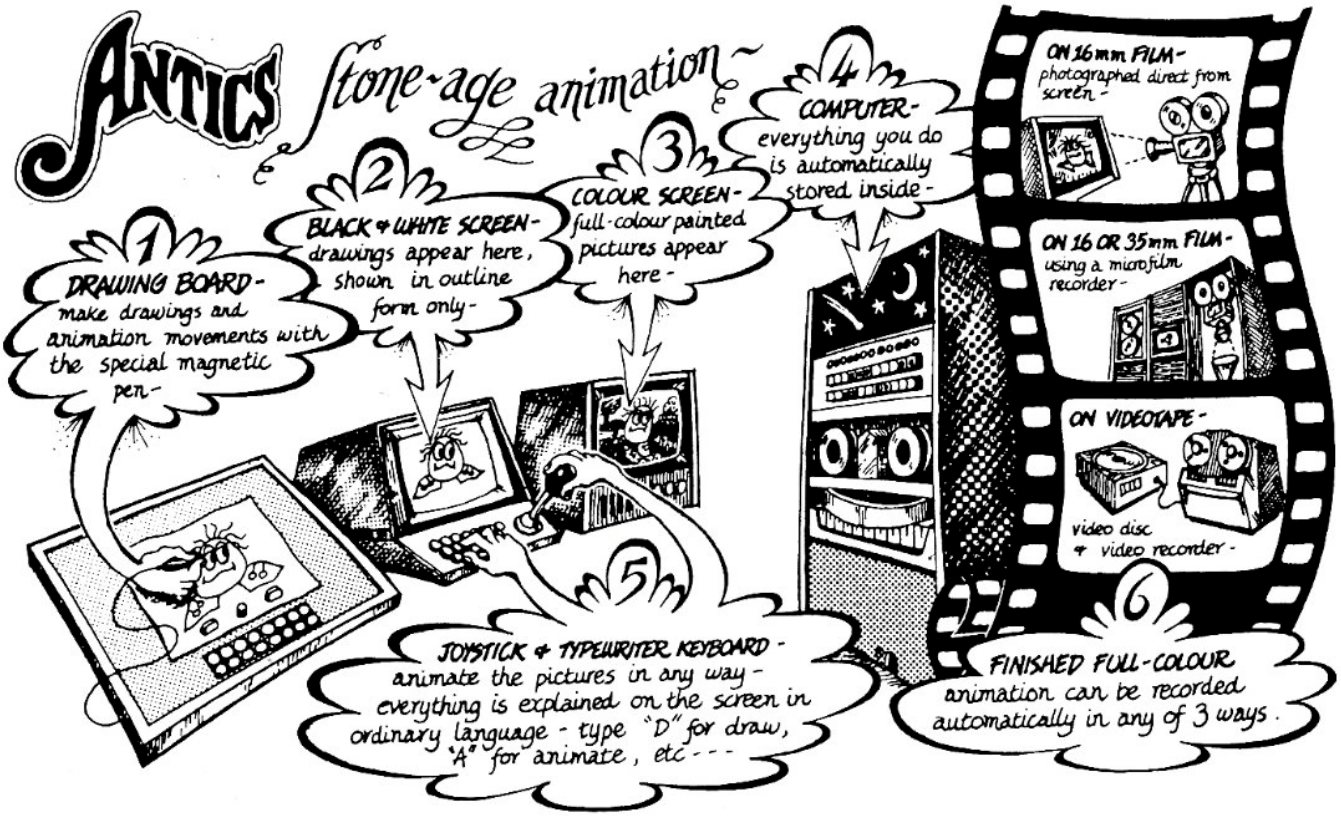
by Alan Kitching*

It's been many moons since I last wrote of Antics in the journal — a progress report is even more overdue than my membership subscription . . .

As many readers will know, our approach to animating the computer comes from a different direction to the usual one, where what happens is this — some outfit gets a load of hardware and then tries to make an animation machine out of it . . . the people doing the programming don't really understand animation, so they seek help from animators . . . but the animators don't understand computers . . . so everyone is groping in the dark towards something nobody knows quite what. I've been animating computers for 8 years, and before starting on this lark I spent ten years doing old-time hand animation. I used just about every technique going, and worked in all corners of the film, TV, and graphic design business. Consequently, we are not groping in the dark — we know what computers can do and what they can't do — we know what sort of machine the industry is looking for — and we know exactly how it should be built. Some people start with a load of equipment and no clear vision . . . we are starting with a very clear vision and no equipment!

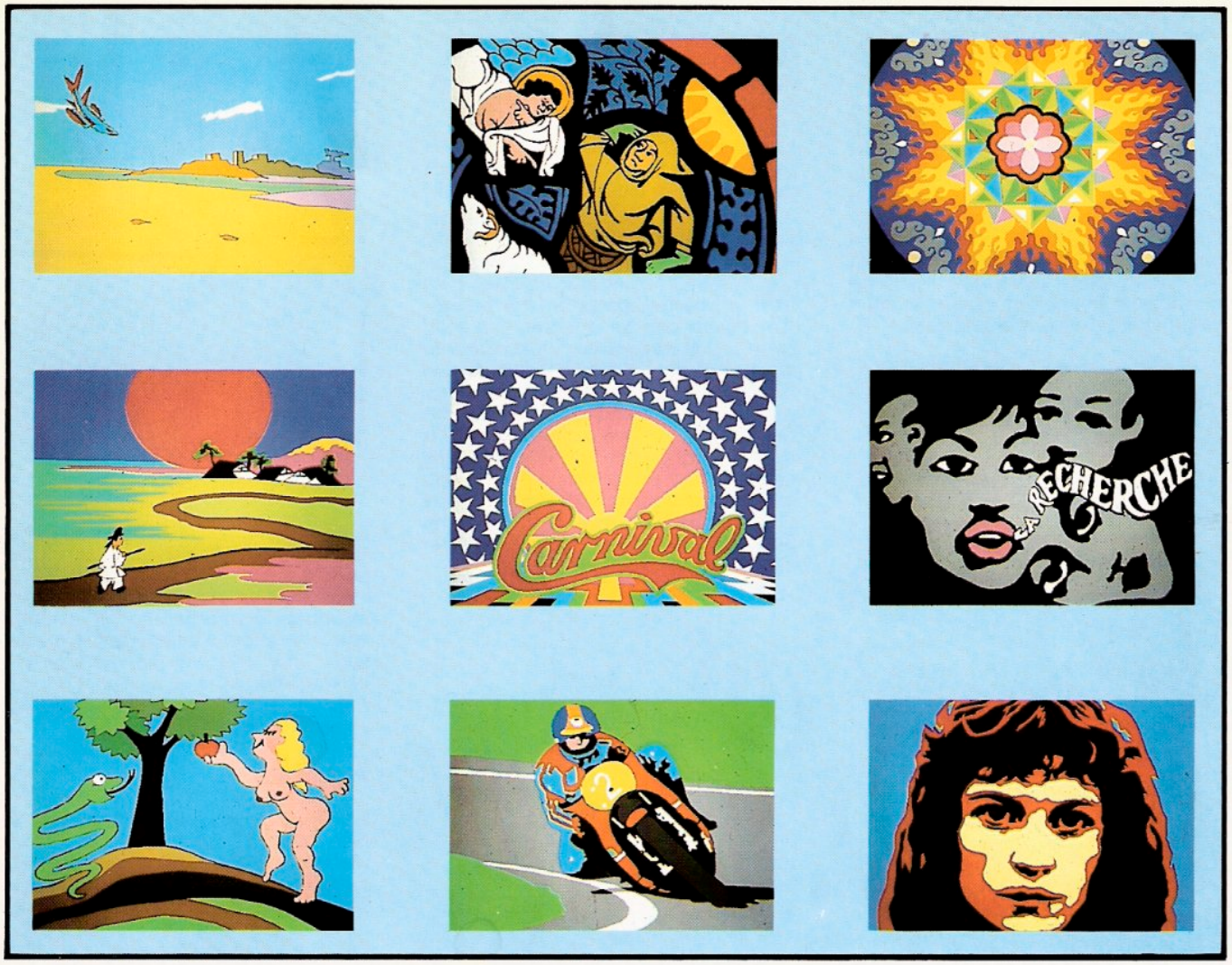
Our first chance to get Antics going came at the Atlas laboratory between 1973 and 75. This proved that all the basic principles actually do work, but the hardware was far too primitive to be a realistic production tool . . . it was the "paleolithic" version of Antics. The computer was a "batch processor", which means whenever you did anything, even the slightest alteration, you had to wait an hour or more to see the result. Getting the result onto film was even worse — one simple sequence could take several weeks. Even so, we produced a number of very successful sequences for TV titles and educational films, and a complete 12-minute movie called "Finite Elements" which explained some of the engineering research being done at the laboratory. From an animation point of view, the film was primitive — but from the sponsor's view it achieved its aim perfectly. Compared with animation previously done on the same machine, it was something of a mini-revelation. The film won several prizes . . . it earned world-wide acclaim from engineers, and became one of the Atlas Lab's most successful films.

Apart from earning us the BKSTS Denis Wratten award and a permanent display in the Science Museum, our Atlas Lab Antics also won us the opportunity to take the next step — the Antics "Stone-age" machine. The basic set-up is shown in the illustration. There's a drawing board for doing all the drawings, and also for making animation movements. As you draw, the picture simultaneously appears on the "line-test" screen. This is a high-contrast black and white screen which shows the pictures in outline form only. Next to it is the colour screen which shows the full-colour painted version. The computer automatically stores everything you do, and does all the donkey-work — inbetweening, painting, effects and camerawork. To control it, you use the typewriter keyboard and the joystick. The computer is the interactive sort, so there's no waiting around — everything you do you see the effect immediately after. It's like having a conversation with the machine. Everything is explained in plain ordinary language. There's no computer jargon involved,



Stone-Age Antics - the basic equipment for a complete full-colour animation machine.

*Grove Park Studio

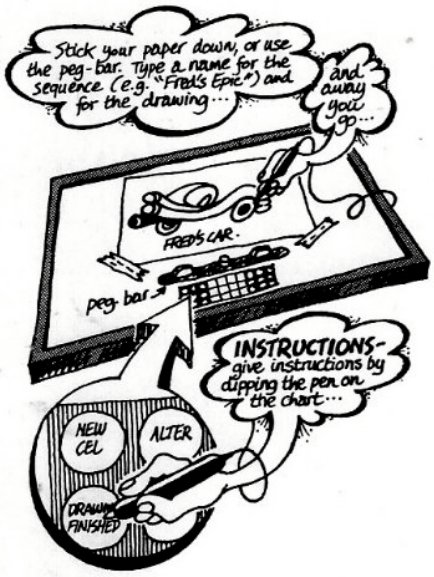


Stone-age Antics in Swedish TV - above - 35mm colour slides of typical stone-age pictures, photographed direct from the computer colour screen.

Below —the Antics set up . . . drawing board, Tektronix terminal, and photocopier. The computer is in another part of the building.

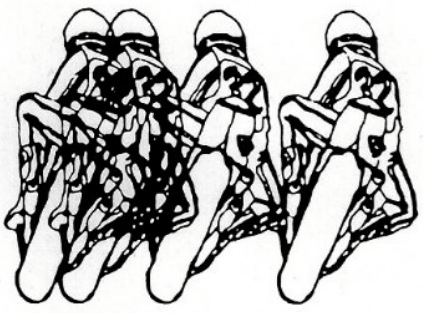
so anyone — even young kids — can have fun animating away immediately. The typing is all simple one-finger stuff — A for animate, D for draw, etc.

Recording on film is done one of two ways — cheapest is a 16mm camera, controlled automatically by the computer, photographing direct off the colour screen. On 16mm, this gives quite acceptable results. For high-quality work, in 16 or 35mm, a computer microfilm recorder is used. Recording onto video can be done direct from the colour screen using a small video disc and a standard VTR.



Drawing with antics

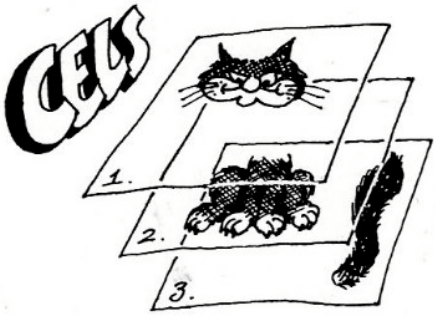
Drawings are done with the special magnetic pen. You can either draw freehand straight into the machine, or prepare your drawings in advance and trace them. The drawing board has a little chart on it with lots of instructions for altering things, etc . . . so it's very easy to improvise and experiment, or to compose complex patterns. Instructions include — rub out . . . alter . . . insert . . . get a drawing from store . . . zoom in to detail . . . repeat . . . give measurements . . . use field chart . . . join things . . . split things . . . shuffle things around . . . change size . . . shift 'em about . . . turn 'em round . . . etc . . . etc . . . To give an instruction, just plonk the pen on it.



Steve Baker on his 500cc Yamaha - photographed direct from the black and white Tektronix screen. Notice the quality of line - not the usual boring single thickness stuff!

The pen makes lines of any thickness, any colour — change it any time. Any area can also be painted in with solid colour. And you can also "dot" with the pen — great for shading and texture. A special feature is "join-the-dots". This works like the kids' drawing game . . . make two dots, and they're automatically joined with a straight line . . . add a third dot, it joins to the second, and so on. Perfect for drawings with lots of straight lines!

There's two ways to get your colours — either choose from a range of 700 colours on the printed chart and type the number . . . or mix up your own from primaries direct on the screen. Any colour can be *opaque,* like solid paint . . . or **transparent,** like coloured glass and gel . . . or **luminous,** like projected or superimposed light. You can also vary continuously between these three — like a ghost fading in and out, for instance. All things like colours, line thickness, dot size, etc, can be changed independently at any time — while drawing, after the drawing's finished, or during the actual animation.



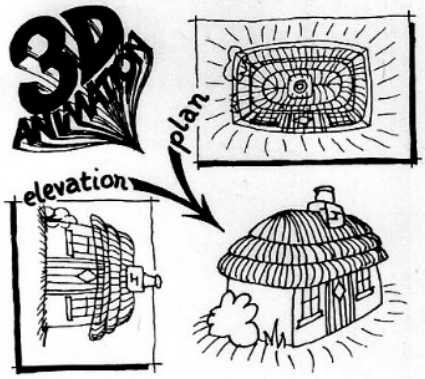
Drawings can be made up of separate parts called "cels". The principle is the same as conventional animation cels . . . they are laid on top of each other, level by level, to form the complete drawing. There can be several hundred cels on the screen at once — each one a different colour — and they can all be animated independently.

Typography

Antics will compose high-quality lettering automatically — just type the wording on the keyboard. We can supply any typeface you want (complete with accents, special characters, ligatures, swashes . . . anything you like) — and you can also draw new typefaces of your own. The machine's built-in library can store literally hundreds of founts. Lettering can be in any colours. Letter spacing is the same as metal type, or can be adjusted like photosetting — and fine adjustments can be made by eye direct on the screen. All photosetting features like italics, condensing, expanding, are done automatically . . . plus effects like drop-shadow, perspective distortion, bending, twisting, and distorting into any shape you can draw. Lettering can be combined with ordinary drawings and animated in any way.

Shapes

Antics will also draw geometrical shapes automatically — circles, squares, stars, triangles, polygons . . . these can be multiplied and composed in any way to create an infinite variety of designs and patterns.



3-D drawings

Stone-age Antics is basically designed for ordinary 2-D drawings, but it can handle simple 3-D stuff as well. The method is to do matching plan and elevation drawings — the machine will then show a complete front view, with any degree of perspective, looking like a solid model. This can then be animated in any way, just like a model or puppet.

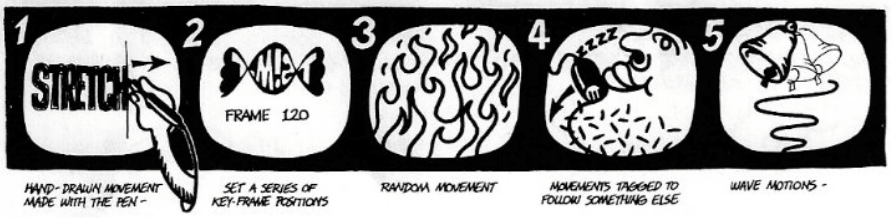
And lastly . . .

Some other ways of putting pictures into Antics . . . If your colour screen has a video input, you can put in any background you like with a TV camera. If you have a suitable still-frame video recorder (such as the Ampex VPR-2) you can also combine animation with pre-recorded live-action directly. And if you're a computer programmer, you can feed pictures direct into Antics from your own programs, using the standard Antics data format.

Animating with antics

The first thing to realise is — no machine can mysteriously "do animation" for you. To make good animation, you have to be a good animator. Creatively, what you put in is what you get out — the machine just fills in the donkey-work. There can be an awful lot of that in animation, and this is what puts people off take up the noble art. The beauty of Antics is that learning is so much easier and quicker — if you don't get it right first time, you can easily change things and keep trying until you do.

Too often in computer animation the movements look lifeless and boring because they are all mechanical. It doesn't matter how impressive the artwork is, if there's no vitality in the animation the effect soon gets monotonous. Good animation is all about bringing things to life on the screen and giving them *character.* This is something everyone can relate to — it's what gives the medium its international appeal, and makes for effective communication. Character animation is the key, not only for Tom 'n' Jerry, but for all kinds of stuff. Even abstract diagrams can be brought to life . . . if you can animate a character, you can animate anything.



3 kinds of animation

Antics works with a combination of 3 techniques — **skeletons, inbetweening, and effects.**

Skeleton animation brings movement to the bare bones . . . any drawing can be given a simple matchstick skeleton framework. You can then animate the skeleton any way you like, and the machine faithfully fits the flesh to the bones. Inbetweening makes smooth transformations from one drawing to another — take a couple of "key drawings", and the machine fills in the "inbetweens". And then there's a whole range of effects ("FX" for short). Some are like conventional *Camera FX* — zoom, pan, spin, fade, etc . . . others are *Graphic FX* — distortions like twisting a picture, stretching it, making it bend and wave. None of these things on their own is enough to make good-quality animation — all 3 principles must be combined together. In particular, the essence of lively character animation is *Movement* and *Expression*.

Skeleton animation gives good movement — inbetweening adds expression. Similarly, graphic FX used on their own soon get monotonous. But an effect can be animated in literally a few seconds, and Antics can handle several hundred different FX and movements simultaneously — so you've got plenty of scope for composing rich patterns of movements very quickly.

5 kinds of movement

Any kind of animation or effect can be animated with any of 5 sorts of movement — **hand-drawn, key-frames, wave, random,** or **tagged.** Hand-drawn movements are "performed live" directly with the pen, moving it up and down the drawing board. For instance, with the effect zoom, the drawing gets bigger as you move the pen up, smaller when you move it down . . . or for inbetweening, you move the pen freely back-and-forth between key drawings, and the inbetweening automatically follows. For ultimate precision, you can also draw the progress of the movement dot-by-dot. All movements in Antics, including hand-drawn ones, can be automatically speeded-up or slowed down to fit any timings you want.

Animation timings are normally measured in frames. **Key-frames** are specific points corresponding to specific positions. In the key-frame method you create a series of key-frames, and the machine fills in the movement between them. For instance, with a zoom, you set one position here, another there, and so on. Or for inbetweening key drawings . . . this drawing this frame, that drawing, that frame. The movement between keys can go various ways — it can go steadily at constant speed, like a continuous panning background. Or it can be "cushioned" so the movement starts and stops gently and smoothly. It can be "jump-cut" — no inbetweening, just a series of static positions that jump suddenly one to the next. It can be hand-drawn freely to-and-fro. Or it can follow any of the other sorts of movement . . .

Wave movement makes any kind of wave or vibration (sine-wave) — for things like springs, or things that swing, like a pendulum . . . or go up and down . . . or round and round . . .

Random movement can be added to any kind of animation, to any degree, giving a chaotic unpredictable quality to the action — great for things like flames, or leaves blowing in the wind, or flies buzzing about . . .

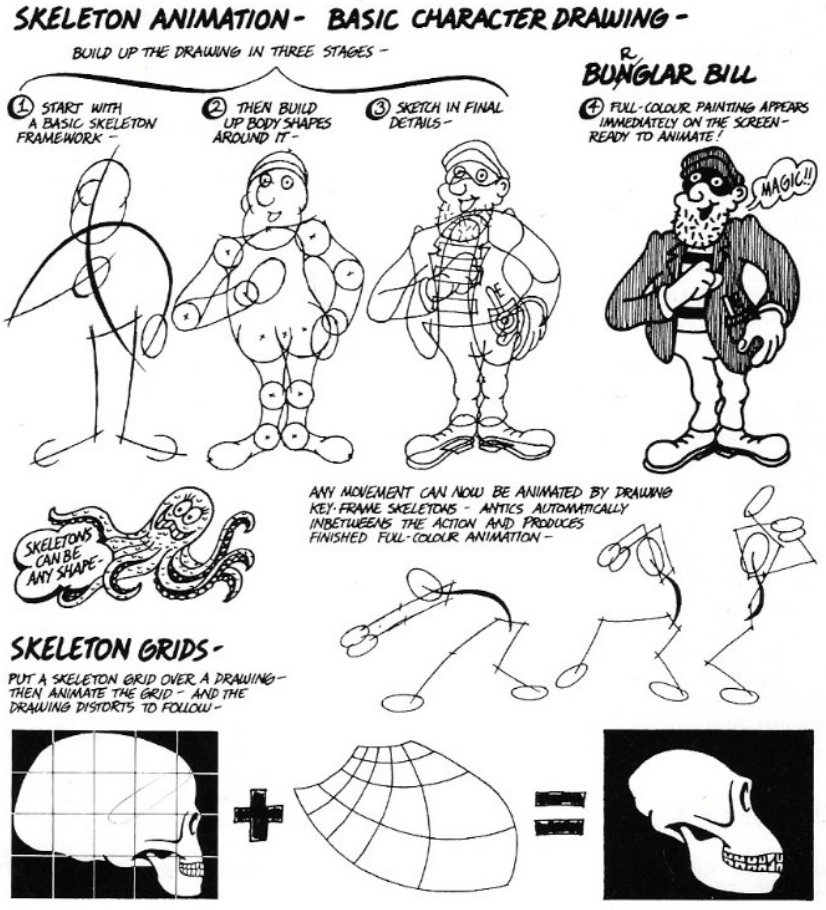
Any kind of animation can also be automatically **tagged** to the movement of something else. For instance, take a cog-wheel and set it spinning. Stick another next to it, and its movement can be tagged to synchronise with the first one exactly. Add on a few more and it could be a complete working model of a clock. Anything can be tagged to anything. Direction of eyes following the random flight of a fly. Pointer on the dial, digits on the meter, measuring its speed. Sizes of cars tagged to their position on the road . . . etc . . . etc. This facility is specially useful for instant on-air graphics in the TV studio. The width of Maggie Thatcher's smile can be directly tagged to the size of her majority . . . just type the number and the drawing changes. This last effect was in fact done with Sweden's party leaders in the 79 election broadcast. Not surprisingly, perhaps, it proved the most popular thing ever seen on election TV!

Skeleton animation

Skeleton drawings work like hinged cardboard cut-outs. The skeleton framework can be drawn on the machine in a few seconds just by "dotting" the hinge points. The drawing is fitted round it limb by limb. The machine then immediately paints up the full-colour version, ready to animate. Unlike cut-outs, the joins are totally invisible, and the limbs will squash and stretch to any degree. The limbs themselves can be independently animated in any way — with inbetweening, for instance, to give varying expressions, or to change from front view to side view, for animation "in the round" . . . and any other effect can be added.

Skeletons can also take the form of a grid. Put an outline round a drawing, or any sort of simple grid — when you animate the grid, the detailed drawing distorts to follow. Drawings can be animated into literally any shape . . . and this too can be combined with hinged skeleton action.

The most traditional way to animate skeletons and grids is the key-frame method, where you draw a sequence of key skeletons. For good-quality character animation, the average is



usually 3 or 4 keys per second of action — since they can be drawn in a few seconds, whole sequences can be animated very quickly. You can also draw the skeletons direct on the screen, or take a starting position and literally "push" the limbs into a new key position.

Skeletons can be animated with FX, just like any other drawing — give it random movement, tag bits to some other animation, etc . . . or you can animate any part of the skeleton independently, including individual points — with hand-drawn movements, or a wave perhaps . . . One example is a complete realistic-looking animation of the solar system. The skeleton has dots for the sun, moon, planets, etc, and the effect "spin" makes them all orbit correctly. Detailed drawings of the heavenly bodies are then fitted on the skeleton. Using the camera FX, you can then animate the view from a spacecraft window as it flies around the place.

Skeletons can be used to animate different drawings, so several characters can perform the same action without further to-do. You can build up whole libraries of actions . . . running, walking, skipping . . . on 2 legs, 4 legs . . . you can either use them directly, or adapt to different situations.

Inbetweening

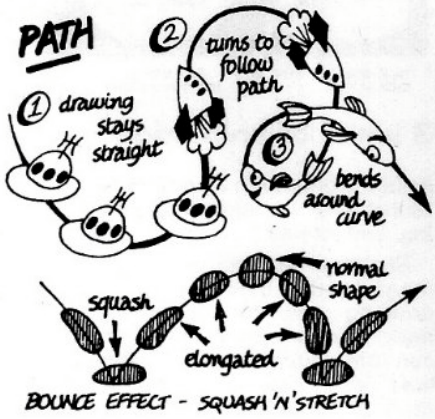
Skeletons on their own give movement, but that's only half the story — different facial expressions and hand positions — different views of a foot being raised — or for animation in the round, different angles of view, front, back, side, etc . . . these give the character solidity. All these can be done by inbetweening key positions. To make a coherent movement — one face to another, say — the key drawings are matched eye-for-eye, tooth-for-tooth . . . this is done by drawing everything in the same order — if you started with the nose on the first drawing, do the same on the other.

Inbetweening can also be used in its own right to make graphic transformations from any picture to any other . . . but beware of the beginner's mistake — using inbetweening for everything soon gets monotonous, because the machine's inbetweens just go straight from A to B. That's fine if the changes are quick (less than a second), or if they're used with good skeleton action . . . but slow transformations featured on their own should be enlivened by making different speeds, perhaps going back-and-forth in stages. Also, don't always arrive dead on target — actions look more natural if they slightly overshoot the end position and drop back . . . or if before moving off, you pull back slightly in anticipation first. It's touches like these that make the difference between lively animation, and the dead mechanical stuff — and they're all easy to do with Antics.

Camera FX

Zoom — unlike a normal camera zoom, the Antics zoom is not limited to a simple in-or-out on the whole picture at once . . . different drawings and cels can all zoom independently. Characters can run zooming in from the horizon while the background stays static. Different "layers" of trees, for instance, can zoom at different rates to give the effect of moving through a forest (the "multi-plane" effect). And the zoom ratio will go up to 10,000 to 1! Like all Antics FX, zooms can be animated all the usual ways — hand-drawn movements, setting key-frames, wave or random movement, or tagged to something else.

Spin is for turning things round, flat on the screen. **Pan** is a straight horizontal movement, and **tilt** is a vertical one.



Path is pan and tilt combined into a single hand-drawn movement — draw a line, and the object moves along it. The speed of the movement follows the speed of the pen . . . or if you draw dot-to-dot, the speed follows the spacing of the dots — close together is slow, widely-spaced is fast. Alternatively, you can draw the complete path, and then have the drawing move back-and-forth along it any way you like. There's various ways of following a path — one is where the drawing always stays at the same angle — another is where it turns to follow the direction of the path, but rigidly, without bending. Or you can make it bend round the curves with the **bendy** effect . . . or if it's a bouncing path, add squash and stretch to make the bounces feel right.

Fade is the same as an ordinary fade-in or fade-out . . . except, like all the Antics FX, it can be used selectively on individual drawings or cels — for instance, characters can fade in over a constant background, like beaming up Mr. Spock . . . The effect has another use — animating colours. Individual colours can be put through any kind of changes.

Cycle is used to repeat sections of animation. The repeats don't have to be identical, though, because any aspect of the action can be animated independently at the same time — to take a simple example, a character walking, front view, could be a repeat cycle, but on top of that he can be zooming in from the distance.

Levels is used to play around with cel levels when drawings are moving around each other.

Mask is used to cut things off invisibly in mid-air, without affecting the background — like uncovering caption lettering. You make a "mask line" by marking two points. This line can move around any way you like. Any part of the drawing that goes over the line simply disappears. Several mask lines can be combined — for instance, any animated picture could be trimmed into a square with 4 mask lines . . . this could then be fitted to the side of a tumbling soap packet, all in perspective, using the grid method.

Super handles animated "wipes" and superimpositions. A wipe is a transition from one scene to another,

via a fancy shape — like you start with a shot of an old manuscript, and then flames creep up from the bottom, consuming it gradually, to reveal an animating scene behind. Or start with one scene, and zoom in some animated lettering . . . inside the shapes of the letters, the second scene stands revealed. If your colour screen has a separate video input, either of the scenes can be pre-recorded live-action.

Graphic FX

Stretch'n'squash, pinch, wobble — these are all variations on the same theme — pulling the drawing around as if it were a piece of rubber. You can squash and stretch in one direction only, like a concertina . . . or so when it stretches it automatically gets thinner in the middle, like chewing gum. Or the squash and stretch can work oppositely, making it wobble like a balloon full of water. Pinch is for squashing or stretching at a particular point, and for pulling the thing over sideways in a skew action.

Twist is for twisting a flat drawing into a spiral or screw shape. You can twist from one end, both ends, from the middle, or anywhere. If the axis of the twist is to one side of the drawing, you get a spiral staircase shape.

Bendy and **wave** make things wave around. Wave makes a "travelling wave" — like ripples running across the water. Bendy does a "standing wave", like a vibrating guitar string, or a tree swaying in the wind. The size and speed of the waves can be animated any way . . . including by another wave movement. And any number of waves can be combined together to create complex harmonic patterns . . . a precise visual equivalent of a sound synthesiser.

Flip turns things round in perspective, like opening a door, or the lid of a box. Or for getting perspective views of walls, floors, etc from flat designs.

Tumble and **turn** are for making flat drawings curl into tube shapes, like sticking a label on a can.

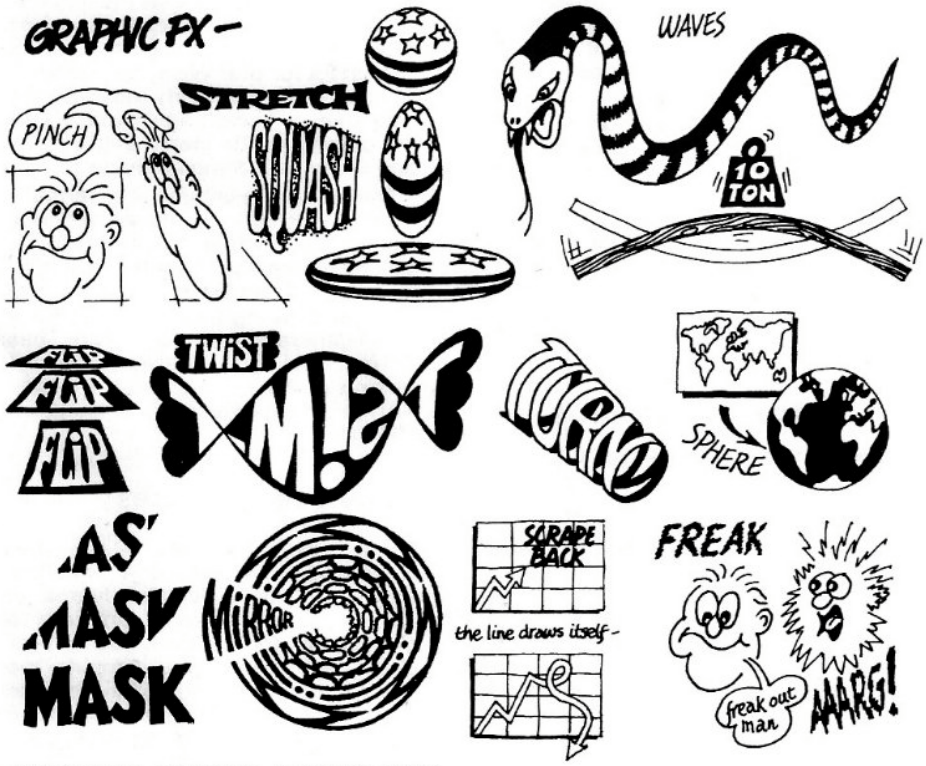
Mirror — with this, you draw a line, which then acts exactly like a mirror, reflecting whatever parts of the drawing are on one side of it. The mirror can move around any way you like, and the effect can be used selectively, as usual . . . for instance, suppose you've got a character dancing in one half of the screen in front of a landscape background — if you put a mirror down the middle of the screen, you'll get a mirror-image second dancer in the other half of the screen . . . but without affecting the background. Several mirrors can be combined for kaleidoscopic effects.

Scrape-back is used to make a drawing draw itself on, as if by an invisible hand — often used for animating graphs. The line can draw itself, or un-draw itself, in any way . . . or simply follow the way you drew it originally. Another example — suppose the line draws itself on, and with a slight delay, simultaneously un-draws itself . . . the result is a short bit of line flowing round the otherwise-invisible track like a worm gliding through a maze.

Freak — this adds distortion to a drawing, making it look fuzzy, or spiky, or wobbly, according to your desire . . . great for effects like sudden fright, or shivering with cold, or just to add a subtle sense of vibration. Or you can push it to extremes and get a shattering explosion.

The animation chart

Antics will store several hundred cels at once, and all of them can be animated independently with any number of FX. Any group of cels can be taken to make up a complete drawing, and each drawing can be animated as a whole, in addition to what the individual cels are up to. And any part of a cel — right down to a single line or point — can also have its very own action. Individual FX are like notes of music, letters of the alphabet — meaningless on their own . . . but when dozens and dozens are composed together, a rich and lively piece can be created. Keeping track of it all is done with the animation chart. The machine automatically records everything you do and presents it on the screen in the form of a chart. This lists, drawing-by-drawing, cel-by-cel, exactly what FX are happening when — You can alter anything anytime — rub out, insert, change the movements, repeat things, copy things, speed up timings, etc, etc . . . everything you do, you can always see a frame-by-frame replay immediately. After that, the finished recording is completely automatic — and that's really all there is to it!!



Stone-age equipment

All this makes up our stone-age software package. It's *flexible* — a truly versatile tool for many kinds of animation . . . not just simple graphics, but proper good-quality character animation too. It's *fast* . . . it works on the same principles as ordinary cel animation, except the machine does all the mechanical bits — immediately . . . complete sequences can be made in a few hours. It's *easy to use* — there's no computer jargon involved — everything works in ordinary language so anyone can have fun animating with it immediately, even young kids. Of course, it doesn't mean the moment you get onto it you'll instantly become an expert animator — but you will be able to start producing stuff right away, and this is the quickest way to learn. And Antics is *available* . . . all you need to start using it is a Tektronix terminal, a drawing tablet, and a good minicomputer . . . basic equipment widely available wherever computer graphics is done — in television, universities, colleges, hospitals, engineering, architecture, scientific research . . . if you've already got the gear, you'll find animation is the ideal way to get your ideas across. And best of all, it's *cheap* only a paltry £4000 for the complete package!

The package is written entirely in Fortran, except for a few "back-end" routines which interact with the machine's operating system — these do all the file-handling, program loading, etc, so the user can do everything without needing any computer know-how. Stone-age Antics is entirely based on the Tektronix 4014 terminal — we did this because it happens to be the most widely available graphics terminal in use today . . . almost everyone in the business seems to have one.

Any graphic tablet can be used, except the small ones, which aren't accurate enough . . . we recommend at least 4k resolution, and size at least 20" x 30" (50cm x 75cm). Any mini computer can be used, provided the core size is at least 128 k-bytes (8-bit . . . equivalent to 128 k-bytes, 16-bit)

. . . at this size, overlaying is necessary, which is inefficient and slows things down . . . to avoid this, 393 k-bytes (8-bit) is needed. Any storage medium can be used (discs or tapes) — basically, the more the merrier.

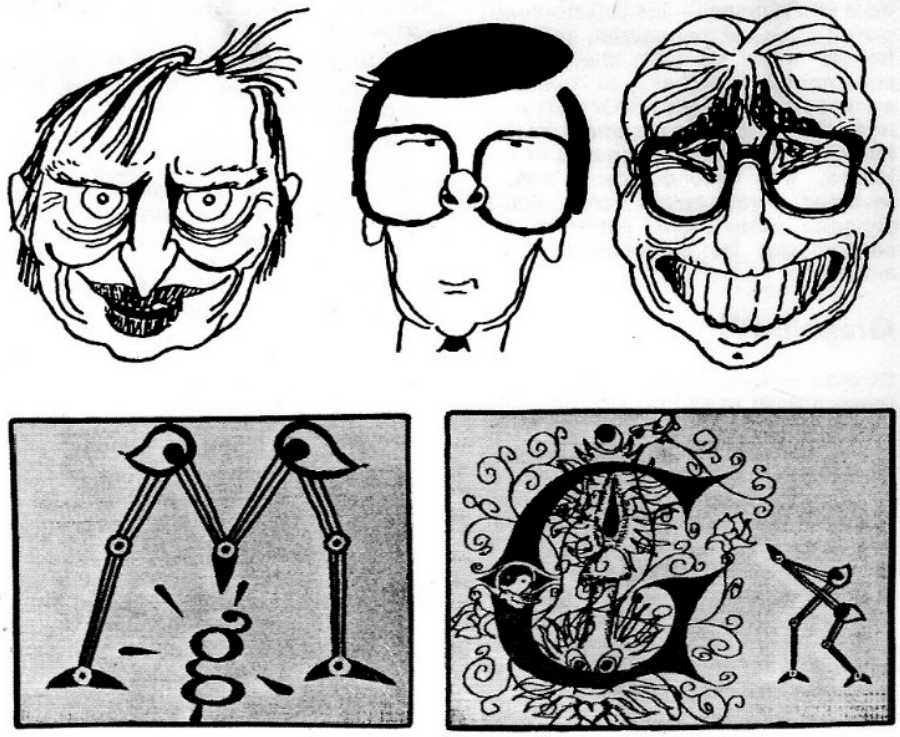
So far, that's all you need to have Antics running in black and white. For colour, virtually any colour display can be used. Cheap ones are OK, but limited, because they won't handle all the Antics features like transparent and luminious colours, fading in-and-out, soft shading, and the smoothing ("anti-aliasing") of jagged edges . . . to get all this you need a colour frame-store display with 64 grey levels on red, green and blue — definition around 768 x 512 pixels — each pixel individually-addressable (very efficiently) for both writing and reading. For recording, any of the 3 methods mentioned earlier can be used — film camera, computer microfilm recorder, or videodisc and VTR. For stills, a range of equipment is available that will deliver high-quality prints or slides (black and white or full-colour) instantly — essential for information and publicity purposes . . . and also for producing things like TV captions, slide presentations, artwork for print, etc . . . even for these purposes, stone-age Antics has much to offer, with all its facilities for composing animated graphics!

Antics in Swedish TV

Our first opportunity to get the prototype stone-age package going came from the Swedish broadcasting company, Sveriges Radio, in Stockholm, between 1976 and 79. About a hundred people have been to play with it . . . animators, artists, designers, producers, typists, musicians, engineers, the regulars from the pub, young kids from school, and even top TV executives actually enjoyed themselves animating away . . . The results were equally diverse — from animated love-letters to football posters . . . graphic designers found they could animate whole title sequences quicker than lettering a static caption. We made a couple of complete entertainment cartoon films, as well as program titles, promo sequences, and station identifications . . . and started the entirely new field of topical animated political cartoons. The first attempt was one day when a strike was on in Swedish TV (nothing to do with us, honest). A student from the film school made a cartoon about it, and we rushed round to the news room to get it shown — only to find (you guessed it) — the guy who could give the OK was on strike!!? The next attempt was the 1979 election broadcast — caricatures of the 5 party leaders were turned into an animated swingometer — as the swing went up and down, so the grins turned into frowns . . . and by a happy quirk of fate (for us, anyway) the election turned out to be the closest, most up-and-down, in Sweden's history!

All in all, it was a clear demonstration of the productive potential of Antics — yet the Swedish prototype remains a demonstration model, for one simple reason — instead of having a minicomputer specially set up for Antics production, we were using the same machine that does all the studio bookings, the accounts, and the music and record libraries . . . so as soon as you start drawing, the whole organisation grinds to a halt and the accountants come rushing in gesticulating wildly. But plans to get a minicomputer are well advanced! Administrative beaurocracy in Sweden being certainly no quicker than anywhere else, the current estimates suggest that all the relevant meetings, discussions and committees will actually produce a decision within a year or so at most!!

Meanwhile, the stone-age package is now developed, tested, and all ready to go . . . it's cheap, and can be quickly installed on many existing machines. So far, we've done no proper advertising, yet we've already got customers in Austria, Japan, and Venezuela . . . and enquiries are coming in daily . . . so the task of building up an ace Antics service is under way . . .*



Black and white pictures photographed direct from the Tektronix screen.
Above - 3 of Sweden's party leaders as they appeared on election TV in the first-ever animated cartoon swingometer! Below, stills from "The Story of G" ? a 6-minute entertainment cartoon. This is probably the first completely computer-animated film to have the pace and quality of movement equal to a hand-made cartoon.

Stone-age to steam-age

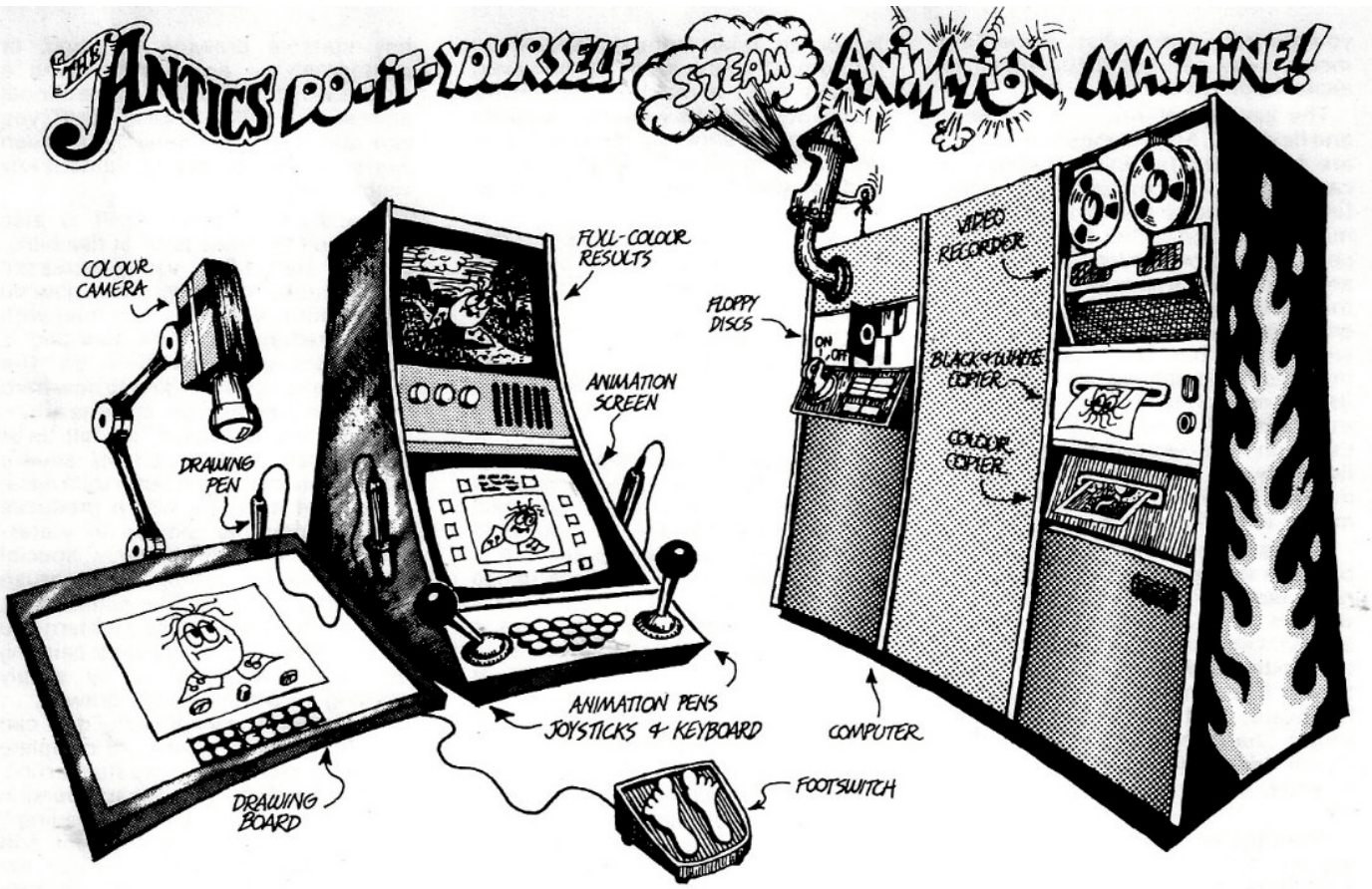
The stone-age package is designed for existing computer graphics machines. So far, these primitive gadgets have been limited to very simple diagram graphics . . . many people are now looking to go beyond that and start doing "proper animation". Stone-age Antics fulfils this demand . . . it takes computer graphics as far into real animation as stone-age hardware will allow. It will open the doors to good animation for many people — particularly in areas like education and research, where animation production is usually out of the question, even though the potential demand is enormous. In these areas, stone-age Antics has a great deal to offer . . . but it isn't yet the ideal all-purpose tool that the film and TV industry are looking for. You couldn't use it to make Fantasia, or special FX for Star Wars, for instance. To do work of this quality, you need the next step — "steam-age" Antics. Like the coming of the steam engine, this one really gets things moving . . .

The stone-age version is essentially a half-way step — the new one brings together everything the industry is looking for in a machine. The essential principle of animation remain the same. But during the last few years, a new generation of hardware has arrived, and we've designed a new version of Antics to go with it — the Antics Do-it-yourself Animation Machine . . .

Steam age features

For a start, the picture quality. The stone-age machine only handles drawings with a limited degree of detail . . . it won't animate a photograph, for instance. You can get close, but only if you simplify the original and turn it into a drawing, like a high-contrast photo. Your average minicomputer simply doesn't have

*Incidentally, if you're an out-of-work animator, and fancy you could do things with stone-age Antics, please get in touch . . . we may need you!



enough storage space to do better. The picture store on the new machine is one hundred times larger — this means it can easily store and animate *anything* — paintings, drawings, photographs, engravings, you name it, there's no limitations . . . they can all go direct into the machine through the TV camera mounted over the drawing board.

The fact is, computers can handle detailed artwork just as easily as simple stuff — to the idiot machine it makes no difference. This is where computer animation really scores — and the real creative harvest begins.

Next, there's the animation screen . . . the stone-age Tektronix is essentially wrong for animation — it won't give instant replay . . . only frame-by-frame. At its quickest, it takes a couple of seconds to draw a frame, so you don't see the action till the recording's done. The new machine gives instant replay on all animation actions, in outline form — there's a footswitch control to run it backwards and forwards (at any speed), and you can easily pin point and correct any mistakes. With Antics, there's no excuse for crummy animation movements!

The stone-age machine is the "interactive" type — handled by conversation through the typewriter keyboard. This does the job OK, and after a little practice, it's actually very fast . . . but there's a question of *feel*. It's like the movie is inside the machine, you're outside, and you're creating it by post — stick something in, get something back. You're always one step separated from your creation. The new machine is the "real-time" sort . . . the gap is eliminated — action and response are simultaneous and continuous. Everything can be animated with direct hands-on contact, like moulding clay.

You can do this directly in time to the sound-track — pre-recorded stereo sound plays on the machine too. In conventional animation, all sound track timings have to be carefully measured and charted. In Antics, just play the track, and simultaneously make marks and doodles with the pen — anything you like to fit the action. Playback these animated doodles, and you get an instant feel for the shape and pace of the action even before you begin animating. And from now on, any animation can be automatically fitted to these doodles just by pointing at them. Usually in animation, sound tracks are always completed first, so the action can be exactly synchronised. The same goes for Antics, of course . . . plus a new possibility arises. Instead of completing the sound track and then being stuck with it, animators and musicians can work together . . . try the music one way, and do an instant test animation on the spot. If that gives you a better idea, try the sound another way. The music and video industries are already beginning to work together in new ways — Antics opens the door to many new possibilities here!

The animation screen is full colour, with the main picture area in the middle, and around it all the info and controls appropriate to what you're doing. The info is stuff like footage counters (if you still need 'em) and which drawings or bits you're playing with (so you never get lost) and what format — 24 or 25 fps, TV ratio, or widescreens 1.85, 2.35, etc — you can instantly switch from one to another. The controls are your hands-on what's doing, and come in many varieties . . .

Apart from the aforementioned footswitch, there are 2 "light-pens" and 2 joysticks. The light-pens can be used to draw direct on the screen — and they're also the direct method of making animation movements. For instance, the twist effect . . . for this a little wheel with a handle appears on the screen, beside the drawing. Plonk the pen on the handle and turn it . . . as you turn, so the drawing twists. If you're twisting both ends at once, use 2 handles — or do one first, then the other — or the second can automatically go opposite to the first — or etc, etc . . .

In this way you could either be animating in real-time, or at any speed, or you could be merely setting a key-frame position. Every movement and effect has its own appropriate method of animating. For many things, the joy sticks are the best tool —particularly camera movements like zoom and pan. An example of light-pen and joystick used together is the "air brush" . . . the light-pen is used like an ordinary airbrush (a miniature spray-gun for paint), with the joystick to control the flow of colour — as you pull back on it, the flow increases . . . at the same time, twisting the stick controls the width of the spray — from a very fine beam to a wide-area cover. As well as original artwork, the airbrush is very handy for re-touching photographs, making collages, and such.

Besides the main picture, the where-are-we info, and the live controls, the other thing on the screen is the "what's next" choices . . . things like "playback", "record", "new drawing", "animate", "alter", etc . . . to choose, just touch with the pen. One ever-present feature is "explain" — whatever you're doing, any time

you're not sure what something means, you can get a fully-detailed explanation on the spot.

The keynote of Antics is richness and flexibility. Most computer systems are far too limited in their range of capabilities. In Antics, the basic facilities, controls and choices number around a thousand, and the permutations presented on the screen are impossible to calculate. It's only at this level you really begin to get the essential flexibility that's needed. The stone-age machine has several hundred basic options, and is already flexible enough to handle most things, especially if used with a little ingenuity. The new machine takes this flexibility to an even higher level, making it an even simpler and quicker matter to go directly to your target.

Antics is also infinitely extendable—because the basic framework is right, new features can be added to it without limit. Also, while the stone-age package is inextricably bound to the Tektronix display, the new one is totally independent of any specific hardware, and can easily adapt to future hardware innovations like digital video, liquid crystal display screens, video discs, digital sound, etc . . .

The display screen, with its main picture in the middle, surrounded by ever-changing combinations of controls, facilities and information, forms the heart of Antics, continuously responding to your touch and movement — the computer itself is the brain that keeps track of it all, and puts everything together as you want it. The animation work is all "real-time", so there's nothing to interrupt the flow of creative juices . . . you can animate with total 100% concentration — the irrelevant and unnecessary garbage that usually makes computer systems so frustrating for an artist, has been eliminated.

Stone-age Antics has already eliminated all computer jargon — it works in plain ordinary language. Handling it, though, is still clumsier than it might be, for two reasons — it involves a lot of measurements, and a lot of verbal descriptions. The measurements are things like frame numbers, cel numbers, position measurements, reduction percentages — for anyone familiar with animation, graphic design, or computer graphics, it will all seem quite straightforward — but non-technical beginners may not take to it easily. The new machine by-passes all measurements . . . everything can be done directly by hand and eye . . . the machine does all its own measuring. Also, with the stone-age machine, you have to make choices between alternatives that are described verbally . . . for instance, if you want a wave effect, you have to choose between descriptions like "travelling wave" and "standing wave" — easy enough when you know what they are — if you don't, you can either try it and see what you get (which is at least entertaining, and possibly educational) or you look it up in the manual (which is also entertaining, straightforward, totally illustrated, and has incidentally been hailed over and over again as an object lesson in how manuals should be written). The new machine, however, doesn't need a manual, and avoids verbal descriptions wherever possible — it simply shows a screen full of waves all moving in different ways, and you pick the sort you want direct by eye.

For things that can't be directly illustrated, there's always the "explain" button. In effect, there's no manual, because the manual is inside the machine. Not only is this easy-to-read, illustrated, etc — it's also *animated* — so when it describes a movement, it actually demonstrates it as well.

There's really only one thing that can't be improved on — *animation jargon*. You simply can't do good animation without it — it's natural to the medium, just as computer jargon is to programming, or joinery jargon to joiners. Antics is purely about animation, and nothing else — this is why you'll not find a single reference to double-mortice tenons in it anywhere. The stone-age machine is generally intelligible, but the new machine goes the whole way. It's designed from the outset as an *animation teaching machine.*

It's also multi-lingual — all the verbal stuff can be instantly switched from English to Japanese, for instance — or any language you like. It's ambi-dextrous too . . . use of display screen, pens, and joysticks can be switched from right-handed to left.

Another feature that's permanently on the screen is "print". The machine comes with 2 printers built-in as standard — one colour, one black and white. The black and white one delivers 8" x 6" half-tone prints of whatever's on the screen instantly — and they're top quality, photographic standard, suitable for reproduction. The colour one can be set up for 8" x 10" prints and transparencies, or 35mm slides — these too are instant, and also of top photographic quality for reproduction.

Automatic sync sound video recording is also built into the machine as standard — so the basic machine is a complete video animation unit. Even if you're working on film, video will give you a full-colour playback to check, before committing the thing to film. For film recording, there's a separate plug-in unit — this is a purpose-built microfilm recorder, and can work on 35mm or 70mm, with appropriate high definition. One point to notice — you can feed a picture into Antics with the TV camera . . . this is normal video resolution (625 lines, say) . . . yet you can animate it and record it on 70mm, and it comes out with full 70mm resolution (3000 lines) . . . the machine fills in the necessary lines.

The machine also has two auxiliary video inputs for cameras, VTR's, or discs, so in effect you've also got the ultimate animated video editing and effects machine, with unlimited potential for combining effects, animation and live-action. One particularly interesting feature is this — feed in some pre-recorded action, and trace key skeletons off it. These skeletons can then be used to animate any suitable drawing, painting, or photograph — apart from being a simple way to do what in conventional animation is called "rotascoping", you can also vary continuously between live-action and animation without any visible jump.

The drawing board itself is also developed to a new level of flexibility. For a start, the vastly-increased picture store means you can now do all the detail you like — go mad with cross-hatching, etc. The new pen is "pressure-sensitive" — so the response varies according to how hard you press. Some of the choices are — constant line thickness, like felt-tip or rapidograph, with round tip, square tip, or italic nib . . . variable thickness, rather like a brush, which produces textured painting similar to water-colours . . . variable colour . . . special textures, like chinagraph or dry brush . . . special patterns, like dotted lines, lines of stars, or any basic pattern you care to design . . . solid colour painting by drawing outlines, or by simply pointing to areas already drawn . . . dots, as before, except each "dot" can now be anything — even a complete animated picture . . . spatter brush, which sprays dots like a coarse version of the airbrush . . . "contour shading", which is a special method for soft shading (for instance, a simple example, draw a black line down one side of the screen and a white one down the other — the painting will automatically fill in soft shading between the two, so you get a solid background shading softly from black to white across the screen) . . . and then the aforementioned air-brush itself. A point to notice with that — you get automatic masking — if you're airbrushing a complex drawing, with lots of masking, the cutting of the masks can well take up most of the time. In Antics, if the lines are already drawn on the screen, you need only point at them to create a masked area.

There's also a comprehensive range of textures and tones (like Letratone) that can be instantly painted into any area in any colour — and you can add new ones of your own. Typography facilities are further developed to include adjustable letter weight and full 3-D lettering — and the keyboard is now replaced by pen selection from the full fount displayed on the screen, so all your fancy characters, accents, etc, can be selected directly. The "shapes" facility is extended to include a whole library of designs, both 2-D and 3-D. . . as well as purely geometrical stuff, there's architectural structures, biological structures, and a whole library of designs and motifs for inspiration, direct use, or as a basis to trace your own designs upon. A comprehensive library system is included for cataloguing library material of your own.

In the stone-age, the handling of 3-D pictures is very rudimentary — in the new machine, it's much more fully-developed. There's special facilities to make it as easy as possible to create 3-D drawings, models and puppets, and full facilities for animating them . . . including designing sets, putting in lighting, skeleton animation of 3-D puppets, complete with

inbetweening, etc, and 3-D camera movements . . . these are done with the two joysticks — one controls focal length and camera direction, the other controls the movement of the camera itself to roam around the model environment — all can be done in real-time, or animated step by step. The camera movement controls can be set to respond in special ways — like an aircraft, for instance, or a helicopter. Models can be built up from a basic drawn framework, then painted in any way, and with any sorts of bits and pieces stuck on. Model animation can be obtained with live-action and artwork in any way — great potential here for special FX in space epics and the like.

The do-it-yourself animation machine

Well, I could go on for hundreds of pages to describe the whole thing in detail — so far, I've just scratched the surface. The machine is enormously rich and flexible — it's a complete general-purpose animation tool. In one easy-to-use unit it combines the facilities of an animation production line, a graphics studio, a photographic workshop, a video effects and editing studio, and a special FX and model studio. It gives you total freedom to use these facilities at will, with virtually none of the delays associated with physical media. In Antics, all physical limitations are transcended — you're playing directly with pure energy. To convey all this in a verbal description is much like trying to catch the wind . . . Hopefully, though, I've said enough to make a couple of things clear. . .

Firstly, that this new machine could indeed be the ideal animation machine that many people in the industry are looking for. The stone-age model does pretty well, within the limits of primitive computer graphics equipment, and will certainly bring "proper animation" into it. But it is the new machine that is needed to satisfy the highest standards of the film and TV industry. . . in competent hands, it's quite capable of turning out animation at least as good as Fantasia, say . . . or special FX as good as 2001. And even in beginner's hands, learning is fun, and a good standard can be achieved quite quickly.

Secondly, the new machine is a simple natural step from the stone-age model. All the principles are there, available and working, but only in a half-developed form. The logical development is to put the same principles to work in the new generation of hardware, and — jus' like that — the Antics Do-it-yourself Animation machine is what you get. This can be done now. All the necessary hardware exists and can be bought straight off the shelf. We have a team of animators, artists, graphic designers, programmers and engineers all ready and waiting to build the first prototype. We have the know-how, the experience, and the people — the only thing we don't yet have is the hardware!!

We can supply you with the complete basic animation machine for around £400,000 — that's not a bad price when you consider it could easily pay for itself in a single production. The hardware you get is as follows — drawing table, TV camera, high-definition interactive colour display (24 bits per pixel) with 2 light pens, 2 joysticks, and footswitch, video frame-store monitor, video-disc and VTR, photocopiers for B&W and colour, computer (dual-processor, 4 Mbytes, with 80 Mbyte disc), and all the bits needed to plug them together. When used as a self-contained unit, floppy discs are the method for permanent archive storage . . . in a large studio with several machines, a central disc-and-tape library can be set up, shared by all machines. Machines can also be plugged into telephone or data networks to send stuff directly round the world. The high-definition film recorder comes in around £250,000.

Market potential

Although the starting price may sound high, it still makes a lot of economic sense when compared with the present escalating cost of conventional animation — and as time goes on, Antics will naturally get progessively cheaper. Before long, no self-respecting TV station or film studio will want to be without one! If you look at film and TV production worldwide, it's possible you'll find as much as 5% of it could be done easier, cheaper, and probably also a lot better with Antics. Even one percent of that market is not to be sniffed at. Then there's the fact anyone in the business knows — the potential demand for animation vastly exceeds the actual production (probably at least 10 to 1) — most ideas simply never get started, because the time and cost is too great. Antics opens up a whole new field of opportunity for animators and animation. And if that's not enough, let's move on to the next step . . .

From steam age to video age

The stone-age package is limited because it has to operate within hardware that is too primitive — the principles are there, but imperfectly developed. The steam-age machine represents the turning point . . . here, for the first time, the hardware is sufficiently advanced to enable the software to take its "ideal" form. The stone-age software has to battle quite hard to get real animation out of the machine. The new machine has everything it needs to do the job properly. The only problem is that this machine is all constructed out of bits and pieces of existing hardware that are designed for many other purposes — this means it's more expensive and less efficient than it could be.

So the next step is to get together with a team of clever video and computer engineers and let them design the ideal hardware to fit the software. The result will be a neat and compact unit, doing the same job, but much cheaper and more efficiently — and thereby opening the market much wider. And then, if hardware development continues the way it always has in the past, a couple more steps will get the complete animation machine down to the size and cost of a domestic video recorder in about 20 years . . . ! Animation could end up becoming a popular hobby, like photography today. But wait, wasn't it Uncle Bob Godfrey himself who said "animation is the last artistic hurdle of the 20th century" before collapsing with laughter? Yes it was, and the joke is he could actually be right!

The utlimate video game?

All video games are actually real-time animation sequences. The obvious thing that's lacking from today's childish efforts is good animation — and the whole trend of development is towards improving the quality. Imagine, for instance, space invaders played with a screen that animates everything with the quality of a Star Wars movie . . . Antics is already designed to do just this. With animation as a basis, you can create literally any video game. It will be a few years before Antics and the video games market actually meet up — but the foundations are already laid, and we've got some pretty good games lined up . . .

Universe is one where the screen is the window of a spacecraft, and the animation joysticks are used to "fly" round the universe — a complete model of the solar system, as realistic as the latest space probes can make it . . . check out all the planets, zap into hyperdrive and explore the galaxy — wind back the star clock to any date — print out astronomical facts and horoscopes — and of course, watch out for the green meanies, always ready to hurl their nasties at you.

Quest — like an animated Tolkein novel, the game begins with Bonzo, the Silly Old Wizard, appearing on the screen to explain your mission — to find the mystic Glass of Light, the only thing able to break the spell of the Demon Kings — Off you troll, to encounter hazards like Snap the Magic Dragon, the Maze of Reflections, and Naughty Nigel the Butch Bandit of Bangalore — each encounter is a video game where you animate the actions of the central character — how you perform determines what happens next, so everyone goes through the game differently. The scenes can be recorded, so the result is a complete animated movie. Sci-fi, cops'n'robbers, all kinds of stories can go to make games like this — a whole new line in publishing! Games can come "ready-made", or "do-it-yourself", where you draw your own characters and scenery.

Choreography — a special version of skeleton animation for choreographers to plan dance and mime sequences and see an instant replay without the time and expense of actually staging it. The score is composed directly in either Benesch or Labanotation, and the machine plays back sync sound animation with realistic figures in leotards — or you can design your own costumes. Other versions of this may be useful for

medical studies of disabled people, or design studies of aircraft cockpits and the like.

Architecture — designing on the machine gives complete freedom and flexibility to shift things around and experiment, and at any time the screen will show a complete 3-D model that you can "walk" around. Perhaps if there'd been something like this in the 60's, we'd have been spared all those horrendous new estates . . . ! This sort of machine is also capable of storing building regulations . . . it can warn you if something won't pass. Bills of quantities can be calculated automatically, schedules produced, etc. Connect up to a central library, and all the latest manufacturers' goodies can be included in your design.

Education — there's endless possibilities here. In biology, 3-D animated models of the human (and other animal) bodies that you can dissect and study — complete with all the names, and little programs to test your knowledge. Similarly in engineering, 3-D models of any complex machine . . . before you rip the gearbox out of your Cortina, check out how it's done step-by-step and see what tools you'll need. And so on — not only great for studying, but an ideal way for researchers, students, teachers and school kids to present their own work.

Animation is the basis of all these games, and many could be made today with our steam-age machine. Entertainment, hobbies, in industry, in schools, universities, libraries, hospitals — limitless animation potential. A vast new market for publishing. Antics isn't threatening to put animators on the dole — quite the reverse, thousands more will be needed in what's threatening to become the boom industry of the 80's and 90's. Even the hand animators who prefer to stay with traditional methods will benefit — hand animation lovingly created frame-by-frame will become the real prestige stuff (every frame an original work of art!) — get ready to double your prices . . . !

And finally, all those potential investors who are hesitating because they think the market for animation is too small to be worth bothering with — remember the endless examples of short sightedness . . . like the Post Office chief engineer who declared of Graham Bell's invention "the possible use of the telephone is very limited" . . . or the German engineer in the 30's who estimated the ultimate world saturation figure for telex machines at 3000, and was dismissed as a fool and a dreamer. There's now almost a million of them and still climbing. The truth is, the only reason animation is such a tiny industry is simply because a machine like Antics hasn't yet been built. What are we waiting for?